

TIMOR-LESTE SEEDS OF LIFE
(PHASE 3)

Technical Advisory Group Report - Second
Visit

Prepared for

AusAID and ACIAR

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Executive summary

Seeds of Life Phase 3 (SOL3) is a program within the Timor-Leste Ministry of Agriculture and Fisheries (MAF), funded jointly by the Governments of Timor-Leste and Australia. Australian funding is through the Australian Agency for International Development (AusAID) and the Australian Centre for International Agricultural Research (ACIAR). SOL3 is managed by a Program Implementation Team formed from senior MAF staff and SOL staff engaged through ACIAR's commissioned organisation, the University of Western Australia. MAF, AusAID and ACIAR engaged a 2-person Technical Advisory Group (TAG) to provide an independent assessment of the progress of SOL3. The purpose of the TAG is to (1) provide an independent assessment of the progress of SOL 3, the contributions of both the MAF and the Australian Government and the extent to which planned benefits are being achieved; (2) assess whether any modifications to the implementation strategy, program design, management or monitoring arrangements are warranted; and (3) provide advice and/or recommendations to address risks, and to improve program quality and sustainability. This second TAG visit was conducted between April 30 and May 8, 2012, and concentrated mainly on the performance management system, the progress and effectiveness of the informal seed component, and the progress towards transition of project execution from SOL3 to MAF. The TAG visited informal seed production groups and on-farm demonstration trials in the *sucos* of Batugade, Cailaco, Carabau, Kotaboot and Lahomea in Bobonaro District; Experiment Stations at Loes, Liquiçá, and Raimaten (rice), Bobonaro; a Seed Production Centre at Corluli, Bobonaro; as well as consulting MAF, SOL3 advisors, AusAID and ACIAR in Dili.

Progress and effectiveness of Component 3 activities: This component delivers two results through the formation of Informal Seed Production Groups (ISPGs) in communities: (1) social capital from the group that can be used for a wider range of rural development activities; and (2) men and women producers working together to manage informal seed production and distribution, initially to group members, but later to the wider community. In 2011/12 SOL3 supported MAF *Suco* Extension Officers to establish 280 ISPGs, with a maximum of four per *suco* in 7 districts. The ISPGs increased a revolving stock of 5kg of certified or foundation seed. As well SOL provided each group with a pest-proof seed storage container, basic tools and a one-day training course. Record keeping and leadership of the groups visited were generally good, enthusiasm was high, and seed amounts and quality were adequate except where inputs arrived late. The better groups were considering expansion and diversification to other crops and enterprises. Simple adaptive research is suggested to improve seed yields. Plans for 2012/13 call for the number of ISPGs per *suco* to increase to six and the number of districts to increase from seven to ten. This, and demands by other Projects, will significantly increase the SEO's workload, so transportation must be assured. The TAG concludes that an excellent start has been made with Component 3.

Progress of the formal transition plan to MAF: The PDD calls for 50% of the operational costs and management of Components 1 (Research) and 2 (Formal Seed) to be transferred to MAF in 2014 and 100% in 2015. This requires a step change in budgets (*e.g.* an increase of US\$160,000 for the National Directorate of Research in 2014), staffing and in management responsibility. In 2013 the budget cycle of SOL should be realigned with that of MAF and MAF's budget re-negotiated to accommodate the greater recurrent costs of staffing, experiment stations and seed production centres. AusAID can play a key advocacy role in this process by emphasising improvements in food security linked to SOL3. A national seed policy is also required identifying pricing and distribution guidelines. Training of key MAF leaders in management skills should occur concomitantly. It is imperative to start preparing for transition so it will proceed smoothly in 2014.

Appropriateness of the monitoring and evaluation system: The performance management system and results framework was assessed and a smaller number of priority questions and indicators were selected to simplify the evaluation framework and reduce workload on staff. It was agreed to simplify the developmental evaluation approach suggested by TAG1, with increased focus on a series of case studies of key components of SOL3 during the life of the project. This will be implemented with MAF and the SOSEK Team or outsourced and supported by the Communications Unit of SOL3. Case studies based on ISPGs are of special interest. End-of-Project outcomes require refinement to describe behaviour changes, *i.e.*, who is doing what differently on the last day of the project. During the growing season a baseline survey of 1,800 households was conducted by staff of the National Dept of Statistics (DNE) – a very significant effort. As well, 43 trials of new varieties of 10 species, and 485 on-farm demonstration trials (OFDTs) were conducted in farmers' fields. Finally, a midterm review of SOL3 is scheduled for mid-2013, and should focus on transition arrangements, the informal seed system, and sustainable food security in the long term.

Improvements in productivity of crops: Crop yields in Timor-Leste are around one third of the average for SE Asia and correlate reasonably with fertiliser use, which is also very low. The food gap in Timor-Leste is met by importing around 70,000 tons of rice annually, and estimates suggest that this cost 2-6 times the cost of fertiliser needed to grow that grain in Timor-Leste. Low soil fertility and poor weed control sharply reduce the return to investments in quality seed of varieties with high yield potential. In response to a TAG1

recommendation, SOL3 staff have assembled an array of soils-related data, and plan to conduct soils analyses, but have not yet evaluated crop responses to nutrients – something that the TAG suggests could be done in the seed fields of willing farmers. The Climate Change Advisor, now in Component 1, will focus mainly on risk assessment and mitigation using a simple crop model. There was a steady increase in breeder, foundation and certified seed production (110 ha) and field inspection of maize, rice, sweet potato, cassava and peanuts. The development of Research Stations and Seed Processing Centres proceeded to plan. Between 50 and 90% of seed produced was supplied to MAF and distributed at no cost.

Progress in accessing and evaluating new sources of germplasm: A white grained maize variety *P07* will be renamed and released in 2012, and a popular rice variety *Matatag* is being purified before testing and probable release. A visit by SOL and MAF staff to IRRI yielded rice germplasm and training materials and should be extended to other CGIAR centres. There is an ongoing search for a suitable multi-use legume component that is badly needed in Timorese cropping systems.

Progress with integrating gender equality into the implementation of SOL: Men continue to be the primary beneficiaries of SOL3 activities, and only 7% of SEOs are females – even though 43% of seed and variety decisions are made by women. The baseline survey dataset is fully gender disaggregated. More women will be engaged in SOL3 if they participate in on-farm variety selection, in ISPGs and access new varieties through smaller seed packs. The percent of women trained by SOL has risen from 19% in 2007 to 34% in 2011.

Progress with other recommendations made in the previous TAG mission: Most recommendations are well addressed. More work is needed on recommendations 1, 2, 4, 5 and 6, but much of this is underway.

Recommendations from the current TAG mission: These are summarised as:

1. **Establish the policy and institutional foundation for transition in 2014/15** – the TAG recommends that the Team Leader and AusAID staff work together with the DG MAF to design a process that enables MAF to secure adequate recurrent budget and numbers of staff with required competencies to take over operational responsibility for research, foundation seed production, and formal seed multiplication by the end of 2014.
2. **Explore yield potential to inform future investments** – the TAG recommends that C1, C2 and C3 teams work with their MAF partners to test the yield potential of recommended varieties through crop nutrition, weed management and plant density treatments on experiment station demonstration plots and with interested farmers as OFDTs or superimposed trials in formal seed and ISPG fields.
3. **Use vulnerability criteria to select new varieties** – the TAG recommends that the Climate Change Adviser analyses vulnerability to food insecurity under historical climate variability scenarios to identify criteria to select varieties and crop systems that will increase household food security resilience under climate variability.
4. **Review efficiency of formal seed production** – As part of a broader national Seed Policy, the TAG recommends that the full cost of producing foundation and certified seed is calculated and used to determine the most efficient options for cost recovery and seed production.
5. **Review the impacts of seed distribution choices** – the TAG recommends that SOL3 together with MAF evaluate the effects of distribution of high quality certified seed at no cost to farmers on the efficiency and effectiveness of distribution, ability to reach the maximum number of farmers and incentives for the development of a private seed sector.
6. **Encourage wider use of social capital developed in ISPGs** – the TAG recommends that the Team Leader work with the Adviser of Informal Seed Production and the MAF Director of Extension to engage with other rural development programs in Timor-Leste that could make use of the social capital being developed by SOL3 in ISPGs.
7. **Support SEOs to ensure they support SOL3 results** – the TAG recommends that SEOs responsible for ISPGs in priority areas be assisted with transportation and training where needed, and that their involvement with other donor-assisted activities and their workload be coordinated with MAF and the donor concerned.
8. **Finalise performance management system and put it into practice** – the TAG recommends that after final consultation with MAF, AusAID and ACIAR, minor refinements are made to finalise the performance management plan, evaluation framework and results framework so that the performance management system can be used as soon as possible.
9. **Prepare for mid-term review** – the TAG recommends that the mid-term review and TAG3 input before June 2013 focus on (1) institutional capacity to transition Components 1 and 2 to MAF; (2) sustainability of informal seed production systems; and (3) the adaptive research and policy framework to enable sustainable food security in Timor-Leste in the longer term.

In summary the TAG continues to have confidence that SOL3 is able to deliver on its objectives in a timely and effective manner, and compliments the program staff for their dedication and enthusiasm. Transition of program research and seed production functions to MAF is challenging, but manageable if it gets underway in 2012. If limitations of crop nutrition can be effectively addressed, SOL3 is poised to have a remarkable impact on food security and human nutrition in Timor-Leste.

Acronyms

ACIAR	Australian Centre for International Agricultural Research
AEZ	Agro-ecological zone
ALGIS	Agricultural Land Geographic Information System
AusAID	Australian Agency of International Development
CGIAR	Consultative Group on International Agriculture
CIAT	Centro Internacional de Agricultura Tropical
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro Internacional de Papa
CSPG	Community Seed Production Group
DNDCA	National Directorate for Agricultural Community Development (MAF)
DNR&SS	National Directorate for Research and Special Services (MAF)
DNE	Direcção Nacional de Estatística
FAOSTAT	Food and Agriculture Organisation Statistics (on line)
FS	Foundation seed
FSMG	Farmer Seed Marketing Group
GoT-L	Government of Timor-Leste
GMO	Genetically modified organism
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IRRI	International Rice Research Institute
ISPG	Informal Seed Production Group
JICA	Japanese International Cooperation Agency
M&E	Monitoring and Evaluation
MAF	Ministry of Agriculture and Fisheries
MEF	Monitoring and Evaluation Framework
NGOs	Non-Governmental Organisations
NPK	Nitrogen, phosphorous and potassium
OFDT	On-Farm Demonstration Trial
PDD	Project Design Document
PDO	Program Development Objectives
QPM	Quality protein maize
RDP IV	Rural Development Program Four
RDTL	Radio Timor-Leste
SEO	<i>Suco</i> Extension Officer
SMS	Short message service
SOL1, 2, 3	Seeds of Life (Phases 1, 2, 3)
SOSEK	Social Sciences and Economics
SPC	Seed Production Centre
SWOT	Strengths Weaknesses Opportunities Threats
TAG	Technical Advisory Group
UWA	University of Western Australia
VRC	Varietal Release Committee

1 Background

Seeds of Life Phase 3 (SOL3) is a program within the Timor-Leste Ministry of Agriculture and Fisheries (MAF). The Governments of Timor-Leste and Australia collaboratively fund the program. Australian funding is through the Australian Agency for International Development (AusAID) and the Australian Centre for International Agricultural Research (ACIAR). The program is managed by a Program Implementation Team formed from senior MAF staff and SOL staff engaged through ACIAR and its commissioned organisation is the University of Western Australia (UWA).

SOL3 evolved from early ACIAR-supported work on variety selection through CGIAR crop centres that started in 2000 (SOL1). A second phase with local variety screening and seed production and distribution with MAF commenced in late 2005 and ended up working in seven of the thirteen districts in Timor-Leste (SOL2). SOL3 builds on the scientific results and technical capacity built in MAF during SOL1 and SOL2. The goal of SOL3 is “Improved food security through increased productivity of major food crops”. The purpose of SOL3 is that “81,000 farmers – 35,000 lowland rice farmers and 46,000 upland farmers – have access to and are routinely using improved food crop varieties”. We note that productivity rather than production is given as the goal, implying an increase in factor productivity, especially returns to land and labour.

MAF, AusAID and ACIAR engaged a 2-person Technical Advisory Group (TAG) to review relevant documentation and consult with stakeholders to report on program activities undertaken since SOL3 commenced in February 2011. The Purpose of the TAG is to:

- provide an independent assessment of the progress of SOL 3, the contributions of both the MAF and the Australian Government and the extent to which planned benefits are being achieved;
- assess whether any modifications to the implementation strategy, program design, management or monitoring arrangements are warranted; and
- provide advice and/or recommendations to address risks, and to improve Program quality and sustainability.

The first visit in October 2011 focused on the transition from SOL2 and the inception period of SOL3. This second visit in May 2012 focused on informal seed production and plans for transition of Component 1 and Component 2 activities from SOL3 to MAF during 2014/15.

During this second input, the TAG consulted with Timor-Leste farmers, SOL3 and MAF staff, and representatives from AusAID, ACIAR and UWA in Timor-Leste between May 1 and 7, 2012. During that time the TAG was able to visit: Component 3 activities and Informal Seed Production Groups (ISPGs) in the *sucos* of Batugade, Cailaco, Carabau, Kotaboot and Lahomea in Bobonaro District; Component 1 Experiment Stations at Raimaten (Bobonaro) and Loes (Liquiçá), as well as consulting with MAF, SOL3, AusAID and ACIAR in Dili.

The TAG congratulates all involved with the progress of SOL3 during the 2011/12 growing season and thanks all participants engaged in the organisation and implementation of the TAG mission.



2 Progress and effectiveness of Component 3 activities

Component 3 is designed to deliver two results on a large-scale that sustain the national seed system: (1) an output of social capital that can be used for a wide range of rural development activities; and (2) an outcome of women and men members of informal seed production groups (ISPGs) competently operating and managing informal production and distribution of targeted quantities of self-declared quality seed. As background it is useful to note that there are 13 districts in Timor-Leste, subdivided into 442 *sucos*, each of which is subdivided into hamlets or *aldeias*. MAF extension efforts are structured around the *Suco* Extension Officer (SEO) who interfaces with up to 300 farm households in each *suco*.

The TAG visited 5 informal groups producing seed. These groups were distributed over 5 *sucos*, and our visits confirmed that the delivery strategy for Component 3 is appropriate and starting to yield promising results. As expected, group effectiveness was a function of leadership and support from the SEO. Where groups had active leaders driving change and an active SEO supporting the change process, the behaviour change and informal seed production results were clear. Lessons learned from group-led change processes such as that used for SOL3 highlight the need for frequent communication, support to leaders, the need for training and adequate transportation for SEOs and frequent engagement to provide incentives for group members to remain engaged and active. There is an opportunity for SOL3 to include activities that respond to small group development lessons in the 2012 Annual Plan. For example, these might include the introduction of a complementary species such as the production of cassava cuttings in maize-based ISPGs.

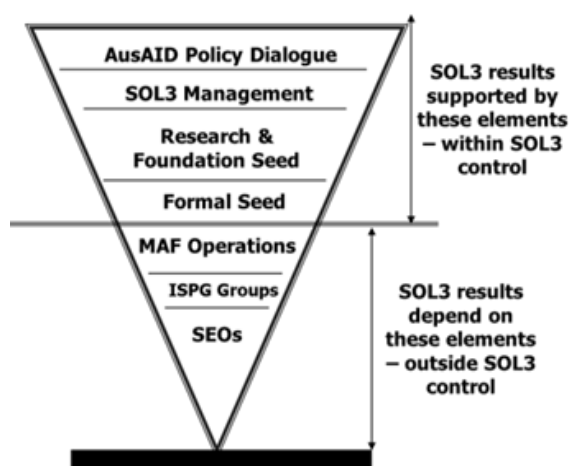


Chart 1 : SOL3 results depend on success of ISPGs

depend on effective SEOs and ISPGs as well as on-going MAF research operations that identify superior varieties and deliver foundation seed to fledgling ISPGs.

Groups visited by the TAG ranged from very dynamic and active groups to those that appeared to be struggling to function, often because of local leadership, delayed input supply, crop failures or inadequate support from the SEO. This diversity is normal. It will help management of this component if a group typology is developed to track the effectiveness of *suco* extension officers, and to devise different engagement strategies and technical packages offered in each district. In several *sucos* there were early signs of

stress in the extension system as the number of groups increased and as transportation available to the SEO began to limit his availability. As Chart 1 shows, SOL3 results

Informal Seed Production Groups (ISPGs) are more likely to be sustained if they can consolidate and expand their existing seed activities, and/or diversify into an expanding range of enterprises. This has been the pattern of development of farmer cooperatives in China, for example, where some have become efficient private producers of seed while others have focused around the efficient marketing of specialist crop products. Examples of this would be to adopt different SOL3 commodity varieties and, where strong enough and interested, work with MAF to implement new crop management practices. These may require use of additional inputs that will increase crop output, increase net crop returns, reduce economic risk and increase family food security. The ISPGs may also evolve in different directions through contact with other programs. Examples of these would be engagement with the IFAD Cereal Storage Program, Government of Timor-Leste National Program for Suco Development (supported by AusAID), JICA Irrigated Agriculture Program, or the ACIAR Livestock Systems Research.

The social capital being built in ISPGs evolves through a series of well-known stages that can be monitored to test group health as well as progress towards behaviour changes that result in adoption of new varieties and technologies for improved food security. One common approach to measuring these changes uses Bennett's hierarchy (see Annex 2) – there is an opportunity for the SOL3 performance monitoring and evaluation framework to use this approach to support Component 3 management decisions.

Chart 1 highlights the dependence of SOL3's success on the social capital being built in the ISPG groups. This social capital and group relationships with SEOs and District MAF staff are the core institutional arrangements that link the national seed system being developed under Components 1 and 2 of SOL3 and food security at the rural community in Timor-Leste. The Component 3 operational budget is a small proportion of the total SOL3 investment – less than 10% of all operational costs and around 13% of total Australian investment. There is an opportunity to focus investments from other components on activities that support Component 3 outcomes. For example, some of the adaptive research undertaken under Component 1 as OFDTs could be supported as simple superimposed agronomy trials to boost production; the scale of Component 2 could possibly be reduced to sharpen its focus on supporting ISPGs; and case studies of successful ISPGs could replace more formal assessments of impact under Component 4. These and other possibilities are described below.

- **Increasing yields of seed by improved practices** – the yield of seed could be increased while conducting adaptive research in the seed field using a simple plus one design, where several 5m x 5 m plots are laid out in the centre of the 0.2 ha seed field and treatments imposed. Treatments could focus on increasing the efficiency of seed production by increasing seed yields. These trials could include seed treatment, and a modest amount of fertiliser (*e.g.* 30-50kg N/ha) and phosphorous (*e.g.* 15-30kg P₂O₅/ha). A possible design could be 4 treatments: no treatment; seed treatment; 50kg N/ha; 30kg P₂O₅/ha. This could be replicated twice to give 8 plots superimposed on the seed field. All factors tested should give similar or improved yields vs. the check, so farmers would not be out of pocket. Other practices suitable for this type of adaptive research include a comparison of weeding practices (two hand weedings vs. herbicide), planting densities (*e.g.* 3 plants/m² vs. 6 plants/m²) and micronutrients (ZnSO₄ at 15kg/ha) to test the yield potential of farming systems used by the groups. This approach would require agreement from the host farmer and possibly a follow up observation of the experimental area to ensure that production was not depressed in the subsequent year.
- **Development of seed production expertise** – in later years more successful groups could be trained in seed grading, packing and storage to support their transition to professional seed producers at a scale that would contribute directly to food security in Timor-Leste. Groups could also be combined as Farmer Seed Marketing Groups who

- could negotiate services from Seed Processing Centres developed under Component 2.
- **Monitoring Group progress** – staff from Component 4 could monitor seed production and quality of more active groups and use members of the most successful groups as mentors and communication resources for new or struggling groups as part of a peer learning network. In addition, case studies could be used for longitudinal studies of groups to understand the different elements of success and challenges for rural development groups in Timor-Leste and to develop group typologies. The communications resources invested in Component 4 should primarily focus on ISPG and SEO audiences – helping them connect to markets and information sources as well as enabling them to take advantage of emerging mobile telephony, which is likely to drive transformational change in rural Timor-Leste during the life of SOL3 as the telephone market is liberalised¹.
 - **SOL3 Management (Component 5) complemented by AusAID can foster donor harmonisation** - SOL3 managers could engage other donors working in rural areas to encourage them to use ISPGs for targeting benefit flows from other programs (*e.g.* IFAD Cereal Storage Program, Government of Timor-Leste National Program for Suco Development (supported by AusAID), JICA Irrigated Agriculture Program, ACIAR Livestock Systems Research).

As a result, the TAG **recommends** that the Team Leader work with the Adviser of Informal Seed Production and the MAF Director of Extension to engage with other rural development programs in Timor-Leste that could make use of the social capital being developed by SOL3 in ISPGs. This could include groups benefiting from activities under programs such as RDP4, National Program for Suco Development, IFAD Cereal Drum Program, ILO infrastructure programs and health outreach programs. In time, as the private sector develops a more comprehensive network of input suppliers, groups and FSMGs could negotiate for cheaper rates on key inputs such as fertiliser, herbicide and seed treatment.

The TAG recognises that ISPGs and other initiatives from projects such as RDP4 and IFAD will place a greater workload on SEOs. Increased numbers of ISPGs per *suco* (from four to six) planned for 2012/13 will also increase the SEO workload. However, SEOs, living close to the grass roots of the farming community, remain a critically important agent for change. The TAG therefore **recommends** that SEOs responsible for ISPGs in priority areas be assisted with transportation and training where needed, and that their involvement with other donor-assisted activities and their workload be coordinated with MAF and the donor concerned as part of the AusAID contribution to harmonisation in the rural development sector.

Efficient, effective and sustainable functioning of ISPGs will also be aided by:

- **The monitoring of Quality Declared Seed** – the strength of the ISPGs depends ultimately on their capacity to grow and distribute high quality seed, and for the most part will be self-declared and monitored by group members who have been trained by Component 3 staff. It will be important that a small seed sample is purchased from each group every second year and checked for purity and germination by Component 2 staff. The TAG suggests that 10-15 of these samples chosen at random be grown out alongside pure sources of the variety each year to monitor the range of genetic drift that will likely occur in the ISPGs. This will be most important for out-crossing crops such as maize, especially if the recessive trait underlying Quality Protein Maize is introduced. Grow outs of this type would normally be carried out by C1 staff on experiment stations as part of their responsibility for ensuring that the purity of released varieties is maintained.

¹ For example see impact of telephone market liberalisation on rural livelihoods in PNG and Vanuatu at: <http://www.pacificpolicy.org/2012/05/net-effects/> and <http://www.odi.org.uk/resources/docs/6056.pdf>

- **Continued emphasis on good record keeping** – the TAG endorses and encourages the keeping of an ISPG book that provides a definitive record of all group transactions. Such a record provides a history for the group and tends to discourage corruption and behaviours that run counter to overall group welfare.
- **Branding** – a small proportion of ISPGs will develop into independent seed producers, and they should be encouraged to market under their own brand, while still identifying the common name of the variety concerned (*e.g.* ‘Lahomea Sele’). The value of the brand at this stage is simply to help develop a sense of responsibility for generating high quality seed, shown by a high proportion of customers who return the next season to purchase from that seed source.
- **Seed Fairs and package size** – the TAG notes that one seed fair in each of the initial Districts (7) will be held during 2012, and encourages this initiative to distribute seed to disadvantaged farm families who otherwise might not be able to afford improved seed. The TAG suggests that SOL3 staff from Components 2 and 3 experiment with seed package size, on the assumption that many well-identified smaller packages of seed give a large number of farmers an opportunity to try out new varieties in a manner that does not expose them to the risk associated with a complete change of their customary variety. This strategy has worked well with grain legumes in East Africa, where women can buy small (100-250g) packages in the market and experiment with them at little cost or risk.
- **Contact with other informal seed systems** – the TAG enthusiastically endorses the linkages established between MAF and the informal seed sector in Nepal and suggest that these be continued. Informal seed systems in Mozambique might also offer additional ideas that could be used to improve the current system of ISPGs in Timor-Leste, especially if some are evolving towards small-scale private seed companies. In addition the two countries share similar environments and are at a similar stage of development. Links to the informal seed sector of Indonesia would also be of direct benefit, and may open up some cross-border seed trade opportunities.
- **Foundation seed needs** – the TAG believes it will be desirable to supply the most active ISPGs with high quality foundation seed (FS) if they are beginning to develop a capacity to produce and market seed on a larger scale. If we assume the primary role of Component 2 (formal seed production) is to provide FS at 5 kg/ha per year to each ISPG, then the capacity of Component 2 needs to be ultimately around 5 t of FS annually, plus the amount of FS needed by producers of certified seed in the formal sector.
- **Role of new varieties** – the financial viability of ISPGs is questionable as adoption of their chosen varieties increases to more than 50% in a *suco* and seed sales external to the group begin to diminish. It is expected that Component 1 (Research) will identify, test and release a new variety of maize about once every 5 years. This may simply be an improved version of Sele for maize or Ai Luka 4 for cassava. If the new variety can be easily distinguished from the older improved variety then it can be supplied to existing ISPGs who are interesting in testing it, and income from seed sales should again increase. Thus the viability of ISPGs and their potential for growth depends on the flow of new varieties with superior characteristics from Component 1 – each component depends on the effective functioning of the other.



3 Progress of the formal transition plan

3.1 The costs of transition

In its first visit, the TAG recommended that the emphasis in SOL3 components should shift from “what is done” to “how it is done” by MAF during this transition phase, especially in established Components 1 (varietal screening and OFDTs) and 2 (formal seed production). It was recommended that this change should start after the 2011/12 cropping season if MAF is to effectively assume full responsibility by 2015. These conclusions have not changed. The TAG continues to note that there will be competing demands on the time of MAF staff and leadership to support implementation and meet participatory demands from other donor projects such as the EC-funded RDP4, the JICA-funded Agricultural Master Plan and the IFAD-funded cereal drum storage program.

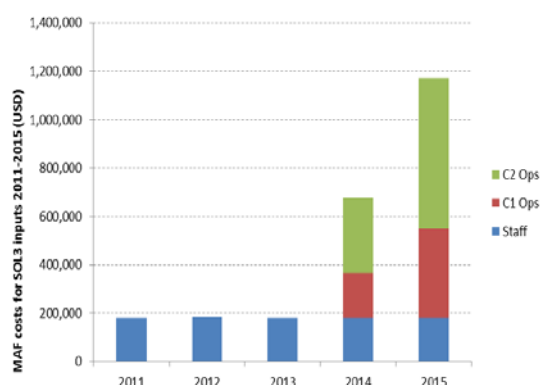


Chart 2: MAF costs for transition.

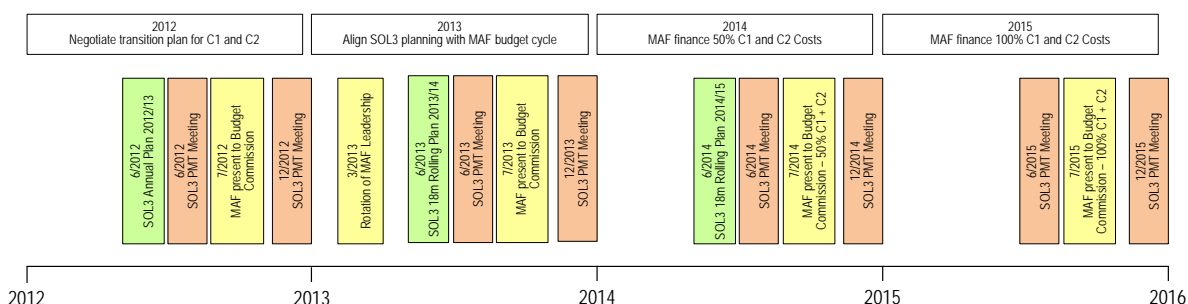
Source: PDD Appendix 5, Table 1 (p110)

The PDD includes a transition of SOL3 funding, management and control that starts formally in year 4 (50% of operational costs contributed by MAF for components 1 and 2) and is fully transitioned in year 5 (100% of operational costs contributed by MAF). The financial cost of this, summarised in Chart 2, requires a step-function change in the resourcing and operation of several MAF directorates. For example the National Research Directorate 2012 operational (non-salary) budget was ~\$130,000. Meeting 50% of the Component 1 operational costs in 2014 would require a recurrent annual increase in the order of \$160,000.

3.2 Preparing for transition

As shown in Chart 3, the Team Leader and AusAID need to work with MAF during the second half of 2012 to focus on preparing a case for national investment in the skilled staff and recurrent budget needed for the national seed system that can be reflected in 2013 and 2014 budget allocations. In early 2013, as new MAF leaders are put in place, SOL3 will need to re-negotiate relationships and one way to initiate this is to align SOL3 planning with the MAF budget cycle. AusAID support in policy dialogue and bilateral engagement is an essential contribution to preparations for the transition. This has resource implications for AusAID in the 2012/13 and 2013/14 financial years.

Chart 1 : Indicative time line to prepare for transition in 2014



The immediate challenge is to support MAF to work with the Ministry of Finance (MoF) to secure adequate recurrent budget for 2014 and 2015. Given the political and budget cycles, this should be a focus of the second half of 2012 with a view to influencing the 2013 budget outcome and securing the required resources for 2014 and beyond. One way that a case could be presented is to look at the costs of achieving food security in Timor-Leste before, during and after SOL3 – an analysis of vulnerability and risk (productive potential, climate variability, food position in the early 2000s [before SOL3], food position during SOL3 [to 2015 say] and food position under several scenarios to 2020 [e.g. with SOL3 targets maintained by adequately resourced MAF research and extension capacity compared with importing cereals to close the food gap]). This work could be prepared by the MAF planning and research directorates with support from the Climate Change Adviser using GIS, crop models with long term weather data, and other analyses.

Without a strong case to justify this investment with the Budget Commission and Ministry of Finance, MAF will struggle to allocate the financial resources needed for the planned transition. The likelihood of an effective transition and the consequences of a delayed transition should be addressed during the mid-term review in the second half of 2013. Human resources are likely to be adequate as they include staff who will return from project-supported post-graduate training in Indonesia and Australia during the next 2 years. However, the success of the transition will depend on leadership from key MAF staff as they step up and into new roles. The TAG emphasises the need for MAF and SOL3 advisors to work together as soon as possible to identify and “groom” key Timorese staff who will lead Components 1 and 2 during and after the transition period.

3.3 Policy dialogue to support transition

At the same time, there is an important role for AusAID to engage with GoT-L in policy dialogue around food security – including issues such as: building a strong case for investment in a national seed system by GoT-L; development of a National Seed Policy; development of MAF Strategic Plan and Medium-term expenditure framework (perhaps harmonised with the JICA Agricultural Master Plan work); distortion of market signals for Timorese seed producers & farmers with distribution of free seed and subsidised cereal imports; and the cost effectiveness of importing fertiliser and other agrochemicals vs. imported cereals in sustaining and expanding local food production (Section 5.1). This effort will support the immediate challenge of securing recurrent budget to sustain SOL3 investments, and will identify opportunities for possible future investments in rural development and social and environmental protection.

One of the lessons learned from the Nepal study visit conducted through SOL3 was the importance of having an agreed and tested national seed policy before developing a national seed law. MAF seems to have embraced this idea and there is an opportunity for SOL3 and AusAID to support the Ministry to develop such a policy for Timor-Leste. A National Seed Policy is urgently needed in Timor-Leste to outline the relationship between the formal and informal seed sectors, how and to whom certified seed will be supplied, cost recovery and relationships with the private seed sector. This provides an opportunity for AusAID policy dialogue support to the national seed system, in particular in relation to seed and cereal import and pricing/distribution policies.

Accordingly, the TAG **recommends** that the Team Leader and AusAID staff work together with the DG MAF to design a process that enables MAF to secure adequate recurrent budget and numbers of staff with required competencies to take over operational responsibility for research, foundation seed production and formal seed multiplication by the end of 2014.

4 Monitoring and evaluation system

4.1 Performance management system and results framework

The revised Performance Management Plan is ready to be finalised and used in practice. The recommendations and resources provided by the TAG (October, 2011) to simplify the performance management framework and results framework have been adopted in the revised Performance Management Plan. With minor refinements and after final consultation with MAF, AusAID and ACIAR, this plan is ready to be endorsed by the PMT and put into practice.

The results framework needs minor refinement to ensure consistency and finalise the tools for systematic use. The associated MS Excel charts provide a simple means for quarterly progress reporting. Progress monitoring should be implemented now and used for systematic reporting to the Team Leader and MAF leaders on at least a quarterly basis. The details of these refinements have been discussed with the SOL3 M&E Advisor.

The performance management framework can be simplified further. Fewer indicators, better alignment of indicators with output and outcome statements, simplification of indicator descriptions and development of simple reporting templates will enable efficient compilation of data from advisor reports into a semi-annual output-to-purpose report. Details of these refinements have been discussed with the M&E Advisor and should be implemented in May for completion of the performance management system in June 2012.

Accordingly, the TAG recommends that after final consultation with MAF, AusAID and ACIAR, minor refinements are made to finalise the performance management plan, evaluation framework and results framework so that the performance management system can be operationalised and early monitoring results included in reports for the PMT.

Provide evidence to support recurrent budget allocations for MAF research and extension

The TAG confirms its view formed in October 2011 that there is an opportunity for SOL3 monitoring results and evaluation findings to provide evidence to inform the case for increased recurrent budget allocations for agricultural research and extension. Developing country benchmarks for agricultural research and development in Asia Pacific are around 0.45% of total agricultural output². Timor-Leste agricultural output is around US\$150 million per year – suggesting that MAF should have a research and development budget of around US\$1 million per year³. In the 2012 Financial Year the National Directorate of Research and Special Services in MAF has a recurrent budget allocation for non-salary operations of ~\$130,000. SOL3 is unlikely to achieve sustainability and end-of-program outcomes in Component 1 and Component 2 unless MAF successfully attracts increased recurrent budget allocations for research.

4.2 Evaluation framework

Focus on a small number of primary evaluation questions

The performance management plan now incorporates an evaluation framework that includes evaluation questions and some evaluation methods. The questions presented in Table 10, pp 33-35 of the draft Performance Management Plan provide an appropriate long list from which to select questions for specific evaluations. It would be more useful if the evaluation framework presented a smaller number of priority questions that evaluators and the communications team could use as primary questions, from which they could derive

² Bientema, N.M. and Stads G-J. (2008) *Measuring Agricultural Research Investments*. Agricultural Science and Technology Indicators, CGIAR Washington DC USA [see http://www.asti.cgiar.org/pdf/Global_revision.pdf]

³ Government of Timor-Leste 2012 Budget Papers

secondary questions appropriate to the purpose and context of each evaluation or communication interview. This would also simplify the evaluation framework and enable it to better link with the communications strategy.

Simplify approach to developmental evaluation

The first TAG report suggested that SOL3 explore the use of a developmental evaluation approach linked to the TAG process. This recognised the complexity of SOL3 as an institutional change project and the dynamic context of project implementation. The implications of developmental evaluation were discussed with SOL3, AusAID and a TAG adviser in November 2011. After reviewing the draft Performance Management Plan and evaluation framework, the SOL3 resources are most likely to yield useful evaluation information through simpler approaches based on a regular schedule of carefully chosen case studies complemented by a formal mid-term review and independent completion review.

The evaluation framework should be reviewed with ACIAR in particular, to ensure that the SOL3 performance system meets their needs as well as those of MAF and AusAID. The proposed ACIAR impact evaluation (we assume the purpose is to evaluate impact of SOL1 and 2 since it is too early for impact from SOL3 and the impact baseline has just been completed for the current phase of the project) should be scheduled to complement the SOL3 performance system. It would ideally be conducted as a case study at a time to complement other field activities.

A focus on case studies programmed annually to respond to evolving questions and needs is consistent with a developmental evaluation approach, but does not require additional resources of a developmental evaluator. The result will be more appropriate for SOL3 and the needs of the scale-up of informal seed production and transition to MAF management of the research and formal seed systems.

Case studies to consider for 2012/13, to be implemented by the SOSEK Team or outsourced to contracted local evaluators, include:

- Performance of ISPGs formed in 2011 and NGO groups receiving SOL3 seed in 2011/12 growing season to identify drivers for behaviour change, keys to group cohesion and opportunities for group growth that would form the basis for a group typology to be used in rural development in Timor-Leste.
- Commence longitudinal studies of new ISPGs and NGO groups receiving SOL3 seed to track group growth and identify drivers for behaviour change and keys to group effectiveness in delivering food security for participating households.
- Impact of SOL2 rice activities on participating farming households in *sucos* near Maliana, Bobonaro District.
- Study of attitudes of farming women and men to agronomic practices that maximise the yield potential of improved varieties including plant spacing and planting depth, seed treatment and weeding, but focusing particularly on attitudes to soil fertility and the use of organic and inorganic fertilisers.
- Study of the work conducted by District Extension Officers and SEOs to identify time spent in logistics and transactions, the time spent engaged with community clients and the time spent in organisational affairs so that any opportunities for increased effectiveness or efficiency might be realised.
- Study of the uses made of mobile telephony by cereal farmers in 7 target districts of Timor-Leste to identify opportunities for improved communication and agri-business development as the mobile telephone market is liberalised during the life of SOL3.
- Review the efficiency of formal seed production by calculating the full cost of producing breeder, foundation and certified seed and using this to determine the most efficient options for cost recovery and for producing the amount of formal seed required to meet the needs of planned ISPG activities in SOL3 and with NGOs.

- An economic comparison of the impact of imported rice on the rice production sector in Timor-Leste and its cost effectiveness compared with investments in crop inputs and their distribution (this will inform policy on food security).
- An assessment of the effects on the agricultural sector of imported seed of untested varieties distributed free by the GoT-L compared with a research-based process of varietal identification and national seed production (this will inform policy on seed).
- An assessment of the effects on the formal and informal seed sectors of targeting vs. non-targeting the distribution of free seed by MAF (this will inform seed policy)

Revise and finalise the evaluation framework by June 2012

With these revisions the evaluation framework should be completed in this simplified form. The methods presented in the evaluation framework should include document review, semi-structured interviews, focus groups, goal attainment scaling and case studies as well as any other group capacity methods such as Joint Organisational Assessment (a tool developed for small-group monitoring in AusAID community development programs in PNG) if considered necessary. Unless there is a strong reason to make the required investment, there is no need to include Most Significant Change in the evaluation methods.

The evaluation framework should be completed by June 2012 and designed to include a schedule of case study evaluations during 2012 and early 2013. That schedule should be included in the final 2012/13 Annual Plan. The Annual Plan should include resources (from M&E/SOSEK team, contracted evaluators and MAF staff) to enable 8-10 case studies to be implemented during 2012/13.

4.3 End-of-program outcomes

End-of-program outcomes need refinement to reflect expected behaviour changes. The SOL3 design included detailed end-of-program outcomes. In the M&E standards used for Timor-Leste under the AusAID Evaluation Capacity Building Program (ECB), end-of-program outcomes should describe who will be doing what differently on the last day of the program. As such they should describe behaviour change that can be realistically expected at the end of the program.

The current end-of-program outcomes (see Table 3, page 20 SOL3 Performance Management Plan) do not consistently meet the ECB standard for end-of-program outcomes. Most describe outputs (program deliverables) rather than behaviour change.

Simpler, and more suitable end-of-program outcomes could be presented as:

- **Purpose** – 81,000 farmers – 35,000 rice farmers and 46,000 of upland farmers – grow one or more MAF/SOL varieties.
- **Component 1** – MAF research staff competently manage all phases of the research cycle including budget preparation and negotiation, objective setting, planning and field execution of trials, analysis, hypothesis testing and reporting.
- **Component 2** – MAF seed production staff competently manage the efficient production and processing of targeted quantities of formal seed and MAF extension staff competently manage the efficient distribution of this seed to farmers.
- **Component 3a** – MAF extension services staff and district officers competently establish and support ISPGs to produce quality seed of improved varieties in required quantities.
- **Component 3b** – Women and men members of ISPGs competently operate and manage informal production, quality control and distribution of targeted quantities of self-declared quality seed.
- **Component 4** – M&E/Sosek staff competently implement field evaluation activities and systematic monitoring of the national seed system to inform management by MAF leaders.

The focus on behaviour change at end-of-program outcome level highlights the importance of institutional strengthening in all SOL3 components and the need for a shift from research to delivery by focusing more on “how” activities are implemented rather than “what” activities are implemented.

4.4 Evaluations during the 2011/12 growing season

The development of the network of six research stations (Betano, Manufahi; Loes, Liquiçá; Darasula, Baucau; Qintal Portugal, Ailieu; Maliana Rice Station, Raimaten, Bobonaro; and Maubesse Upland (Urulefa), Ainaro), is continuing, with the formal opening of the revamped Loes Station taking place May, 2012. Betano is now considered complete; Loes is in its final stages of development; and upgrading continues at Darasula. Urulefa and Raimaten Station are relatively undeveloped, needing fencing and more buildings, but are being used as trial sites already. All stations have at least one professional research staff member on site while Loes and Betano have four each.

Genetic evaluations were conducted under Component 1. A total of 43 trials of cassava, maize, peanut, potato, rice (upland and irrigated), sweet potato, winged-bean, climbing bean, barley and wheat have been established this season. Three long-term fertility trials using maize/velvet bean associations have continued in 2011/12. Increases of breeder and foundation seed and cuttings of cassava and sweet potato have occurred on experiment stations, and 485 on-farm demonstration trials (OFDTs) were grown during the main rainy season (November-April). Maize constituted 42% of the OFDTs followed by sweet potato (23%), cassava (22%), rice (8%) and legumes (4%). The OFDTs are the vehicle by which new varieties are tested on farm. As the TAG recommended in its last mission, an extra plot in OFDTs (OFDT+) that demonstrates improved growing practices as well as improved varieties will help Timorese farmers become familiar with the next steps in increasing household food security. The new white grained maize variety, *P07*, when officially named is ready for release and large scale multiplication. It will be widely used in western Timor-Leste. A steady transfer of functions to MAF staff has taken place during the 2011/12 season in preparation for the handover of function from SOL3 to MAF starting in 2014. For example, MAF staff are now competent to design relatively simple single season trials and to conduct the trials to a high standard. They can also undertake competently the analysis of single experiments and produce summary tables. Meta-analyses across sites and years will be taught and supported in the coming season. Stand establishment is still a major issue with maize in particular, and the TAG suggest that Component 1 scientists evaluate the impact of standard seed treatments, and trial the use of a “jab” hand planter (see <http://www.youtube.com/watch?v=y5ZOWi-xRLY>) as an alternative to a dibble stick whose depth cannot be easily controlled.

Contract growers have had a successful season in increasing certified seed on 110 ha, though harvest is still underway. During 2010/11 season production on a similar area resulted in 48 tons of rice, 23 tons of maize, 3 tons of peanut, 443,000 sweet potato cuttings and 220,000 cassava cuttings. The 2011/12 season has been considerably better for crop production so output should be improved. Yields of seed are still very modest – averaging around 1t/ha of cleaned seed for maize and rice, produced with virtually no inputs. Installed seed processing and storage capacity has steadily increased at the 5 SPCs in the districts of Ailieu, Baucau, Bobonaro, Liquiçá, and Manufahi while the seed warehouse in a sixth district is being built in Viqueque. Seed officers inspect formal seed fields at several stages, and seed is officially sampled to provide data for the seed label attached to foundation and certified seed. Extension assistance is provided to growers in four districts.

SOL3 should seriously consider treating seed with standard chemicals to help distinguish it from grain and to improve its emergence rate. It will be critical that the seed treatment chemicals used are not toxic to humans. It is important to increase yields of seed to improve

the security of supply, and to increase the return on project investment in seed production facilities. As noted previously, using seed fields as sites for simple experiments on factors affecting seed yield, with farmers' permission, would significantly increase yields and could reduce the area needed to produce the seed needed. A large proportion of the rice and maize seed produced in 2010/11 (93% and 48% respectively) was given away free by MAF, and this greatly distorts the seed market and creates the false impression that seed is the same as grain and worth little. Seed is an expensive commodity and should be priced accordingly to avoid distortions in the seed market and to encourage private producers. Considerable training of MAF staff to take over 50% of Component 2 activities in 2014 and 100% in 2015 is taking place, and TAG compliments Component 2 staff for their forward planning in this regard. However, the TAG notes the need for a greater involvement of MAF's Seed Department in both production and certification activities.

As a result, the TAG recommends that SOL3 together with MAF evaluate the effects of distribution of high quality certified seed at no cost to farmers on the efficiency and effectiveness of distribution, ability to reach the maximum number of farmers and incentives for the development of a private seed sector.

There is no evidence of case studies or performance evaluation being conducted during the 2011/12 growing season. This is because the M&E/SOSEK team was focused on implementing the baseline survey. This focus has understandably occupied the team, but it has been at the expense of commissioning the monitoring system and conducting case study evaluations during the 2011/12 growing season.

The baseline survey results are expected to be finalised in June 2012. Rapid appraisal of early baseline results suggests a very thorough survey that was implemented in difficult logistical circumstances. Working with the Timor-Leste Statistics Office (DNE) to administer the survey was sensible and is a good example of how SOL3 activities should be planned and implemented to build local capacity and sustainability. Similarly, alignment of the baseline survey with the GoT-L household food security survey represents good practice.

Early results from the baseline survey could provide an evidence base for the 2012/13 Annual Plan that could be used to support its refinement. For example, the survey confirms that maize is the core food security crop; that SOL3 varieties were used by 13% of surveyed maize farmers, 10% of surveyed rice farmers and 16% of surveyed peanut farmers; shows that less than 30% of farmers have heard of SOL; and found that almost half the surveyed farmers used a mobile phone (compared 22% using radio and 10% using television). These findings inform the communication strategy being finalised by the project.

4.5 Preparing for a mid-term review

An investment the size of SOL3 requires an independent progress review at mid-term. The TAG notes that AusAID and ACIAR are aware of this and will make plans during late 2012 and early 2013 to conduct the mid-term evaluation.

As a result, the TAG **recommends** that the mid-term review and TAG3 input before June 2013 focus on (1) institutional capacity to transition Components 1 and 2 to MAF; (2) sustainability of informal seed production systems; and (3) the adaptive research, extension and policy environments that will enable sustainable food security in Timor-Leste in the longer term.

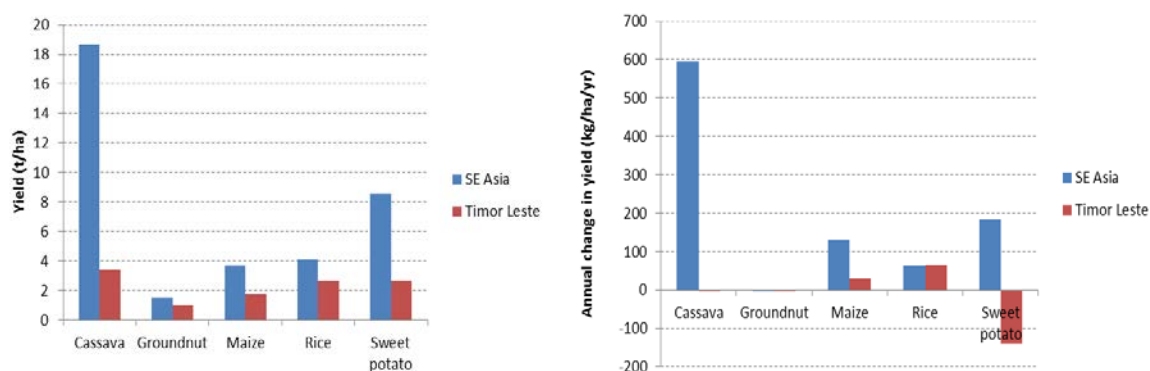


5 Changes in crop productivity

5.1 Yield potential is not yet being realised in Timor-Leste

Soil fertility remains a major constraint to crop productivity. As shown in Chart 4, yields of the target crops in Timor Leste are generally much lower than the average for SE Asia (means for 2008-10; FAOSTAT, 2012).

Chart 2 : Timor-Leste is missing out on the yield potential of key crops

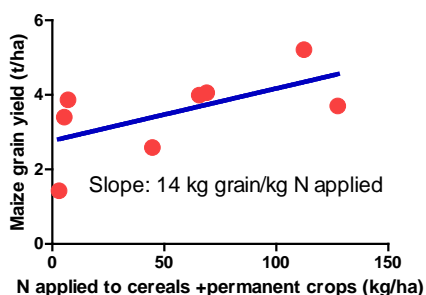


Source: FAOSTAT, 2012; Yield gains are calculated from 2000-2010; average yields are means of 2008-10 data

In addition, the increases in yields over the last decade, with the exception of groundnuts and rice, have been much less than those in SE Asia. Population will double in 21 (3.4% p.a.) to 32 (2.2% p.a.) years. As noted in the TAG1 report, little fertiliser is used in Timor-Leste, organic fertiliser sources are few, and legumes are a relatively minor component of the cropping system. Furthermore, weeds are controlled manually in fields where plant densities are often low, so weeds are aggressive and limit the area most households can manage to less than 1 hectare. At a national level the situation has not changed much over time other than a 30-40% increase in yield due to the use of SOL's improved varieties but limited to where they are grown. Low input systems are low output also, so increased crop production is likely to come from expanded cropped area if the use of inputs is not increased substantially. Chart 5 shows the general relationship between national average maize yields and the average level of N fertiliser applied to land planted to arable and permanent crops for leading agricultural countries in SE Asia. Although the trend is not statistically significant ($P=0.10$), it averages 14 kg grain maize (and rice) per kg of N applied, and suggests that 50 kg/ha of applied N would result in an additional 700 kg maize grain/ha.

This is reasonably consistent with data published in FAO's Fertibase⁴ on fertiliser responses in Indonesia. The average yield increase over the last decade in Timor-Leste has been 30 and

Chart 5: Maize yield vs. N rate SE Asia
(Source: FAOSTAT, 2012)



64 kg/ha/yr for maize and rice respectively, so the increased yield from applying 50 kg N/ha would require 23 and 11 years to attain if it was obtained simply from non-fertiliser sources such as improved varieties of these two staples. This is about a half the rate of increase in food production needed to feed the expanding population, so in the absence of fertiliser this will require an increase (around 50%) in area sown to basic food crops over the next 20 years. Expanding the cropped area is likely to come with an increased environmental cost. The fertility situation is probably worsening. With

⁴ <http://www.fao.org/ag/agl/agll/nrdb/index.jsp?lang=en>

none or little fertiliser applied, it is highly likely that Timor-Leste is a net exporter of soil nutrients. This is the case in East Africa where a similar situation regarding fertiliser use prevails⁵.

Should Timor-Leste import rice or import the inputs necessary to grow rice and maize? The country currently imports around 70,000 tons of medium quality rice annually, at a CIF cost of around \$450/ton (<http://www.oryza.com/>) for a total cost of \$31.5 million. To grow this quantity of rice on the existing rice area would require around 5,000 tons of N, equal to 11,000 tons of urea (46:0:0; worth around \$6m landed) or 28,000 tons of DAP (18:46:0; worth around \$16 m landed). As well, importing and distributing fertiliser helps ensure that economic benefits from growing the crop return to the agricultural sector rather than to the rice marketers, and there are carryover effects of fertiliser applied to subsequent crops as well. A similar argument applies to maize, the most important crop in Timor-Leste. As well, because food production is relatively inefficient in its use of land and labour in Timor-Leste, the price at which imported grain is sold is often less than the domestic cost of production of the same crop. Thus distribution of imported grains provides a major disincentive to local production. Determining the hard numbers and complex relationship between locally produced and imported grains would make a suitable case study for the SOSEK group.

The challenge of low soil fertility was raised during TAG1 (see TAG1 Recommendation 5). The TAG notes that SOL3 staff are taking reasonable initiatives to address this major limitation to food security. SOL3 research trials using maize intercropped with velvet bean (*Mucuna*) show significant yield increases over sole maize, mainly because of residual nitrogen. For example, in the wet season at Betano the maize component of the velvet bean/maize association yielded 0.9-1.2 t/ha more than sole cropped maize, while in the dry season this advantage increased to 2.6-3.5 t/ha, and appears to be increasing with time as weed suppression by *Mucuna* reduces the weed seed bank. At Loes the advantage with *Mucuna* intercrop in the wet season was 0.5-0.7 t/ha and 1.5 t/ha in the dry season⁶. These yield advantages are due in part to weed suppression with a marked reduction in weed biomass that was more than matched by the *Mucuna* biomass formed. *Mucuna* clearly competes with maize as an intercrop, so the net benefits of *Mucuna* appear to be largely due to improved soil fertility from N that the *Mucuna* fixes. This is gradually released from roots and nodules over 1-2 years so the benefits are cumulative and may represent the equivalent of 25-175 kg N/ha supplied by *Mucuna* – consistent with observations elsewhere⁷. The experience of researchers in soil fertility in sub-Saharan Africa suggests that organic and inorganic sources of crop nutrients are both needed, rather than simply one or the other.

SOL3 staff have assembled some soil fertility data from older SOL reports, commissioned a report on Geology and Soils in Timor-Leste, and translated soil maps and key soil profiles from *Solos de Timor*, a Portuguese-era document. Grain samples from harvested OFDTs from a single variety (*Sele*) will be sent to the University of Western Australia for elemental analysis, with the goal of identifying limiting soil nutrients. Other possibilities for identifying soil nutrient limitations could be followed up with ear leaf analysis for macro- and micronutrients and the application of the Diagnosis and Recommendation Integrated System (DRIS) analysis⁸ for identifying nutrient imbalances. In the 2012/13 cropping season a refurbished soils laboratory established in Timor-Leste will have the capability to analyse soil P levels for all experimental sites, and this is a very promising development. Collectively this evidence highlights the complexities of soil types in Timor-Leste, identifies

⁵ See Henao, J. and Baanante C. 2006. Agricultural production and soil nutrient mining in Africa: implications for resource conservation and policy development. p. 169 In: Africa Fertiliser Summit Proceedings, International Fertiliser Development Center, Muscle Shoals, AL, USA.

⁶ Maize-velvet bean replicated trials. In: Seeds of Life Annual Research Report 2011 (in preparation)

⁷ Gilbert, N., 2012. *Dirt poor*. The key to tackling hunger in Africa is enriching its soil. Nature 483, 525-527.

⁸ See for example: A. M. O. Elwali, G.J. Gascho, and M.E. Sumner. 1984. DRIS norms for 11 nutrients in corn leaves. Agronomy Journal 77: 506-508.; and K. Schaller (2007); http://www.oiv2007.hu/documents/viticulture/270_oivschaller2007.pdf

likely locations of nutrient deficiencies, but does not provide quantitative responses to applied soil nutrients. There remains a need to complement the improved varieties developed by SOL3 with carefully evaluated but improved growing practices so the investments made by the project in improved seed achieve their maximum return.

Consistent the goal of SOL3, the TAG urges the project to continue a modest research program aimed at identifying the extent to which improved crop management practices through the efficient use of inputs and improved management practices impact productivity of food crops in Timor-Leste. This could start with plots demonstrating yield potential of SOL3 varieties on 1-2 key experiment stations in plots positioned so that they serve as demonstrations during field days. A small-scale adaptive on-farm research program could be established in seed fields to begin to unravel the package of practices that result in stable high yields at economically optimal yield levels. There are at least four compelling reasons for this: 1) Food security: the current 20% shortfall in food production will continue to widen unless crop nutrition and efficient weed management are addressed; 2) Maximise the return on AusAID and MAF investments in improved seed; 3) Provide guidelines for a future project that can intensify production and the efficiency of food production; and 4) at some point the GoT-L will be persuaded to address the national food shortfall and in the absence of research results may import large quantities of fertiliser that could provide nutrients in inappropriate ratios for crop needs in Timor-Leste. Wastefulness of this type can only give the use of fertiliser a bad name. It takes time and investment to generate appropriate crop recommendations for major soil types, and while this is not the mandate of SOL3, any research that can be conducted towards this end may save the country resources in the future and significantly improve its food security.

The TAG also suggests that station assessments of new varieties with local checks be undertaken under contrasting level of soil fertility whenever possible, e.g., under zero fertiliser and 90:50:50 units of N:P₂O₅:K₂O/ha to assess and exploit G x Management level interactions. To avoid issues of carryover fertiliser effects on station, the fertilised evaluation could take place in farmers' fields.

As an outcome of the above discussion, the TAG **recommends** that C1, C2 and C3 teams work with their MAF partners to test the yield potential of recommended varieties through crop nutrition, seed treatment, weed management and plant density treatments on experiment station demonstration plots and with interested farmers as OFDTs in formal seed plantings and in ISPG fields.

5.2 Progress in accessing and evaluating new germplasm

The accession and evaluation of new sources of germplasm is proceeding steadily under Component 1. A white maize variety, *P07*, suited to farmers in western Timor Leste, will be renamed and released in May, 2012. An improved rice variety with farmer appeal (*'Matatag'*) is being purified and tested more widely in Bobonaro district. Trials of rice, maize, cassava, sweet potato, peanut, wheat, barley and winged-beans are currently being harvested and analysed, and reflect links with the CGIAR centres IRRI, CIMMYT, CIAT, CIP, and ICRISAT. There is need (confirmed by discussion between the TAG and farmers during this visit) to identify a multipurpose legume and improved varieties of target crops with a range of maturities to shorten the hunger gap and give farmers more options for risk management. For example, improved versions of very early maturing maize (*batar lais*), grown by 60% of farmers, would allow a larger early maize harvest. Crop models will help visualise promising options and provide an indication of whether they would reduce the length of the hunger period as well as reducing risk of losses to weather. Crop models could also be used to evaluate the importance of intercrops that bridge the dry season, such as cassava and pigeon pea. The TAG observed a reasonable quantity of pigeon pea (*Cajanus*

cajan) in farmers' fields in Bobonaro district where it was flowering and forming pods after the maize had been harvested. This multipurpose crop merits further research attention by SOL3. Identification of a quality protein maize (QPM) variety would improve nutritional status of children weaned onto maize diets, and contact will shortly be made with CIMMYT to obtain seed of early and QPM varieties carrying some level of downy mildew resistance. Good leads on a suitable QPM variety were also recently provided during a visit by Paul Fox of ACIAR to El Salvador⁹ and merit follow-up.

The recently concluded memorandum of understanding between MAF and IRRI, an output arising from the SOL3-supported visit to IRRI, is an example of the institutional capacity being built by SOL3 that enables MAF to engage with sources of germplasm in its own right. This model could also be followed with CIMMYT, which will open an office in Sulawesi, Indonesia, in 2012. Access to germplasm through the CGIAR centres, new technology, training and regional conferences are important elements of the sustainability strategy for SOL3 that should be vigorously pursued. The TAG also urges SOL3 and MAF to follow up on the initiative between EMBRAPA and MAF developed in 2011 that could provide adapted germplasm and training course offered in Portuguese for MAF staff.

The acquisition of new germplasm is now monitored with the National Seed Inventory System. This system for tracking and managing formal and informal seed supply, inventory and demand is in place, and MAF is currently able to manage this activity. How its implementation evolves will depend on the development of a National Seed Policy.

5.3 Use vulnerability criteria to select new varieties

One way that the case for sustained investment in a national seed system could be presented is to look at the costs of achieving food security in Timor-Leste before, during and after SOL3 – an analysis of vulnerability and risk (productive potential, climate variability, food position in the early 2000s [before SOL3], food position during SOL3 [to 2015 say] and food position under several scenarios to 2020 [*e.g.* with SOL3 targets maintained by adequately resourced MAF research and extension capacity compared with importing cereals to close the food gap]). This work could be prepared by the MAF planning and research directorates with support from the Climate Change Adviser using GIS, crop models with long term weather data to estimate climatic risk, and other analyses.

The use of crop models with historical weather data can also identify criteria that could be used in selection of new varieties that have the greatest potential to contribute to the goal of food security for Timor-Leste by matching their phenology to the length of the season at different altitudes. This approach could also be used in an *ex-ante* evaluation of alternative crop management procedures – for example, dates of planting of varieties of different maturities, and prospects of relay crops that utilise stored soil water during the dry season. Although current plans call for the use of the FAO model AquaCrop that simulates effects of water and crop maturity for a range of crops, more sophisticated models such as APSIM will also allow soil fertility treatments and specific crop species to be accurately modelled – provided the minimum dataset of soil and weather parameters can be accurately obtained. See <http://www.apsim.info/Wiki/Default.aspx?Page=APSIM-Model&NS=&AspxAutoDetectCookieSupport=1> for further details. State-of-the-art crop models like APSIM can also be used to “bench-test” risk mitigation strategies. However, users will definitely benefit from a training course in the use of APSIM and its species-specific modules.

As a result, the TAG **recommends** that the Climate Change Adviser analyses vulnerability to food insecurity under historical climate variability scenarios to identify criteria that could be used to select new crop varieties and amended management practices that will increase

⁹ Fox, P.N. 2012. Trip report 11-21 March 2012 El Salvador. ACIAR 5pp,

household food security resilience under climate variability, particularly in the poorest regions of Timor-Leste. This could include early season maize, multipurpose legumes, maize-based intercrops, rainfed and irrigated rice, and crops in farming systems designed for drought resilience.

5.4 Taking selected varieties to scale

The recommendations from TAG1 included raising farmers' awareness of new varieties so that SOL3 could achieve the scale planned by completion in 2015. Useful communications outputs since TAG1 have been produced. These include variety promotional materials and Guidelines for Informal Seed Production of Maize in Timor-Leste. These should be available as downloads from the SOL3 website. SOL3 activities have had good community exposure in five districts through programming on the Maliana Community Radio.

The TAG compliments staff of Component 2 for their detailed planning on transition of this activity to MAF starting in 2014, though continued emphases will be needed on adequacy of recurrent budgets and quality assurance throughout this process. The performance of Component 2 during 2011/12 highlights a number of issues that could be explored with activities in the 2012 annual plan: (1) more seed is produced than is required by ISPGs and NGO Groups, and the surplus is distributed free of charge by MAF, resulting in distortion of the emerging market for quality seed; (2) the exercise of fully costing the production of breeder, foundation and certified seed has not been undertaken to determine how each of these should be priced in a market economy. This will be important preparation for the emergence of a private seed sector and for full cost recovery for MAF, steps that are essential to sustaining a supply of high quality certified seed; and (3) as previously noted opportunities may exist to conduct OFDTs and superimposed crop management trials with contracted seed producers as well as the better ISPGs to identify more efficient multiplication methods to reach the SOL3 seed targets in the most sustainable and efficient way. The most efficient way forward appears to be production of minimum quantities of high quality breeder and foundation seed needed for the ISPGs (this would only be 10-15 tons/year per crop species). Any surplus should be distributed by civil society groups (including the private sector – emergent as it is right now) with MAF recovering costs of production only. Experience in other countries is that the public good is in breeding, quality assurance and initiating the seed system while the private good of seed distribution and scale-up is best fostered by civil society groups including the private sector as it emerges.

The Project should also consider producing a carefully outlined plan of seed increase compared against time, sometimes termed a seed “roadmap”. This would include planted areas and quantities of breeder, foundation, certified and QDS informal sector seed, laid out by cropping season, for each released variety.

Accordingly, the TAG **recommends** that the scale and full costs of producing breeder, foundation and certified seed are calculated and used to determine the most efficient options for cost recovery and for sustainably producing the amount of formal seed required to meet the needs of planned ISPG activities in SOL3 and with NGOs.

5.5 Other opportunities

5.5.1 Problem-solving interdisciplinary teams

The TAG has noted that while many people accompany them on field visits, it is rare for all major disciplines among project staff to be present in a farmer's field at the same time. The structure of the SOL3 Project lends itself to administrative “silos” and there is limited incentive for team work across disciplines and activities. A number of projects have found it helpful to have interdisciplinary teams that focus on the resolution of problems at the farm level. In SOL3 these teams could be composed of a subset of a Component 1 researcher, a

formal seed manager, an informal seed manager, a regional agronomist, an extension officer and a socio-economist. The team focuses on a particular problem, such as understanding why yields of SOL3 crops are low or unstable in a specific area, why some SOL3 target species are not grown in a particular region or why specific combinations of crops are appealing. Fact finding is conducted through informal survey methods with 10-15 farmers interviewed individually or in groups of 2-3 in their fields, with their spouses if possible. The survey begins with some key questions, and at the end of the day the answers to the questions are reviewed by the team, and revised and rephrased according to findings. The following day the revised questions are asked of a new group of farmers, and this pattern continues until the team feels it understands the problem and can design an on-farm trial or intervention to address it. This approach is – interdisciplinary, iterative, interactive, innovative, informative. The TAG suggest that this approach be trialled in the 2012/13 crop season in one key district, noting that each team would require only three days of field work to generate an investigative approach that is very closely aligned with farmer circumstances.

5.5.2 Capacity building

Capacity building has increased sharply to 4,085 person days in 2011 as ISPG group members have been exposed to a one-day training course in informal seed production. The number of women trained has also increased from 19% in 2007 to 34% in 2011, following a substantial effort in teaching basic skills in language, research and extension that has resulted in a documented improvement in staff capability. This is an important accomplishment, given the challenges of Timor-Leste's recent history. However, as SOL3 approaches the period of transition of function to MAF, it will be increasingly important that current and emerging leadership in MAF be trained in management skills as well. The possible leadership changes in MAF following the June 2012 general election and the prospect of a change in most senior MAF Directors in mid-2013 further emphasises the need to identify and equip managers. We suggest that in 2012/13 MAF leadership and prospective leaders, especially at the district level, be offered a relatively high level management course as part of the transition strategy.

5.5.3 External communications

TAG1 noted that improvements in the project website (<http://seedsoflifetimor.org/>) were needed. Some improvements in appearance and in short case studies and life stories have been made in the last 6 months but there is considerable room for increasing its impact. Smart phones with internet access and a much more competitive telecommunications environment are coming to Timor-Leste, meaning that the internet will become increasingly available to farming communities. Some suggestions are:

- **Publications for downloading** – the Annual Research Reports are repositories of present and past information, but only 2006 and later are on the website. Load all previous SOL Annual Research Reports on the site for reference purposes. Recent publications, such as “Guidelines for Informal Seed Production of Maize in Timor Leste” should be posted.
- **Baseline survey data** – when summary reports of the baseline survey are prepared they should be posted to the SOL3 site.
- **Simple crop production recommendations** in English and Tetun.
- **Information sheets** on each crop variety released by SOL3 in appropriate languages.
- **Videos describing key operations in informal seed production** in appropriate languages.
- **Research Highlights** – TAG1 noted the need for targeted publications of research results, and recommended the production of Research Highlights located on the website.
- **Digital files of audio interviews** between farmers and SOL3 staff (e.g. Maliana Community Radio) that could be used for dial-in telecommunications in the future.

6 Progress with integrating gender equality

A review of the draft 2012 Annual Plan and component presentations to the TAG suggests that gender is more consistently identified and included in discussions by advisors. There is however not yet systematic inclusion of activities and strategies to achieve equity in benefit flows amongst women, men and youth. Men continue to be the predominant primary beneficiaries of SOL3 activities. Much of this is driven by cultural norms, especially in rural communities, but field evidence and baseline survey data (see below) confirm the important role of women in making decisions about what is grown and in household food security.

The small number of groups visited during the TAG visit highlighted active participation by women in the selection of species and varieties to grow, the importance of flavour and texture of the cooked product in variety selection, and the interest in marketing quality seed at a premium price in local markets.

Similarly, baseline data include several useful directions for gender equality. For example, 43% of seed and variety decisions are made by women (Table 91, p88) and 33% of information about seeds and varieties comes from MAF extension staff (Table 99, p93). Despite this, few *suco* extension officers are women (~7% in 2012) and there are as yet no seed campaigns designed to target women farmers. One way to do this is to support group-group interactions and seed fairs with those ISPGs that have more than 20% women and successful results, such as the one in Cailaco *suco*, Bobonaro District. A second area of emphasis would be purposeful involvement of women in participatory variety evaluation on station and in OFDTs, so that criteria women use in selecting a variety are taken into consideration during evaluation and variety release procedures. A third step, already noted above, would be to package seed in smaller packages that could be purchased by women while doing market shopping, and tested in a corner of the field with little risk. Finally, although there has been a substantial improvement in the percent of women trainees, there is continued room for improvement given the large proportion of decisions on planting materials made by women in Timor-Leste.

The TAG has not made specific recommendations relating to gender since the SOL3 team is alert to the importance of gender equality and is responding to information and opportunities as they arise. It would be appropriate for gender equality to be one of the criteria used for the mid-term evaluation in 2013 to ensure that any changes in direction are identified and resourced at that time.



7 Progress with TAG 1 recommendations

The October 2011 TAG report made 8 recommendations and identified a number of opportunities to refine the implementation strategy during 2012. Progress against these is summarised in Chart 6. The TAG appreciates the extent to which its recommendations have been implemented in the past 6 months, which coincided with the busy 2011/12 growing season and the baseline survey field work. Most recommendations are being adequately addressed. Some work is still needed on TAG1 recommendation 1 (to complete and start using the performance management system); recommendation 2 (to prepare transition plan for C1 and C2); recommendation 4 (review the best way to communicate scientific results to ensure efficiency); and recommendations 5 and 6 (include agronomic OFDTs in 2012 Annual Plan to test yield potential). There is also on-going work planned to address recommendations 1, 3, 5, 7 and 8.

Chart 6 : Progress with TAG1 recommendations

Recommendation in October 2011		Response at May 2012
1	Simplify and focus performance management	
	(a) Performance monitoring using a results framework	<ul style="list-style-type: none"> Results framework included in revised PMP Performance framework linked to M&E Standards
	(b) Developmental evaluation, including SOSEK case studies	<ul style="list-style-type: none"> Discussion with AusAID November 29, 2011 No further action
	(c) Management monitoring using simple variance from plan measures for activities and outputs	<ul style="list-style-type: none"> TAG1 Plan versus Actual (variance from plan) charts used in revised PMP
2	Transition from "what" to "how" C1, C2 and C4 activities are planned and implemented to prepare for handover to MAF in 2016	<ul style="list-style-type: none"> C1 Advisor gradually transferring research functions to MAF staff C2 transition plan under preparation
3	Lead harmonisation of major donor initiatives with MAF	<ul style="list-style-type: none"> Discussions around MAF Strategic Plan started
4	Improve flexibility of project scientific reporting	<ul style="list-style-type: none"> No changes noted; ; 2011 Annual Report in preparation
5	Understand soil fertility	<ul style="list-style-type: none"> Geology and soils report produced Q4 2011 No soil fertility field trials yet
6	Use OFDTs as a vehicle for improving farmers' agronomic practices	<ul style="list-style-type: none"> No OFDT "best bet" grower practices demonstrated yet
7	Improve priority setting in crop research	<ul style="list-style-type: none"> Revised TORs for Climate Change advisor includes improved agro-ecological zone definition
8	Raise farmers' awareness of new varieties	<ul style="list-style-type: none"> Communications strategy developed, team engaged Baseline survey conducted Q4 2011



8 Recommendations

Based on document review, interviews with SOL3 stakeholders in Dili, Bobonaro District and field interviews in 5 *sucos*, the TAG recommends that SOL3 work with MAF to:

1. **Establish the policy and institutional foundation for transition in 2014/15** – the TAG recommends that the Team Leader and AusAID staff work together with the DG MAF to design a process that enables MAF to secure adequate recurrent budget and the number of staff with required competencies to take over operational responsibility for research, foundation seed production, and formal seed multiplication by the end of 2014.
2. **Explore yield potential to inform future investments** – the TAG recommends that C1, C2 and C3 teams work with their MAF partners to test the yield potential of recommended varieties through crop nutrition, weed management and plant density treatments on experiment station demonstration plots and with interested farmers as OFDTs or superimposed trials in formal seed and ISPG fields.
3. **Use vulnerability criteria to select new varieties** – the TAG recommends that the Climate Change Adviser analyses vulnerability to food insecurity under historical climate variability scenarios to identify criteria. These could be used to select new crop varieties and crop systems that will increase household food security resilience under climate variability, particularly in the poorest regions of Timor-Leste. This could include early season maize, multipurpose legumes, and crop combinations in farming systems designed for drought resilience.
4. **Review efficiency of formal seed production** – As part of a broader national Seed Policy, the TAG recommends that the full cost of producing foundation and certified seed is calculated and used to determine the most efficient options for cost recovery and for producing the amount of formal seed required to meet the needs of planned ISPG activities in SOL3 and with NGOs.
5. **Review the impacts of seed distribution choices** – the TAG recommends that SOL3 together with MAF evaluate the effects of distribution of high quality certified seed at no cost to farmers on the efficiency and effectiveness of distribution, ability to reach the maximum number of farmers and incentives for the development of a private seed sector.
6. **Encourage wider use of social capital developed in ISPGs** – the TAG recommends that the Team Leader work with the Adviser of Informal Seed Production and the MAF Director of Extension to engage with other rural development programs in Timor-Leste that could make use of the social capital being developed by SOL3 in ISPGs. This could include groups benefiting from activities under programs such as RDP4, ACD, IFAD Cereal Drum Program, ILO infrastructure programs and health outreach programs.
7. **Support SEOs to ensure they support SOL3 results** – the TAG recommends that SEOs responsible for IPSGs in priority areas be assisted with transportation and training where needed, and that their involvement with other donor-assisted activities and their workload be coordinated with MAF and the donor concerned as part of the AusAID contribution to harmonisation in the rural development sector.
8. **Finalise performance management system and put it into practice** – the TAG recommends that after final consultation with MAF, AusAID and ACIAR, minor refinements are made to finalise the performance management plan, evaluation framework and results framework so that the performance management system can be operationalised and early monitoring results included in reports for the PMT as soon as possible.
9. **Prepare for mid-term review** – the TAG recommends that the mid-term review and TAG3 input before June 2013 focus on (1) institutional capacity to transition Components 1 and 2 to MAF; (2) sustainability of informal seed production systems; and (3) the adaptive research and policy framework to enable sustainable food security in Timor-Leste in the longer term.

Annex 1

TAG Rapid Appraisal SWOT Analysis

Annex 1: TAG Rapid Appraisal SWOT Analysis

Strengths	Weaknesses
<ul style="list-style-type: none"> • Components 1 and 2 are mature and ready for gradual transition to MAF over next 2 years • Soil information a useful start to understanding yield potential and options for food security • P07 maize ready for release and <i>Matatag</i> rice gaining wide acceptance • MAF-IRRI engagement a good start to building MAF relationships for new germplasm and training • Re-focused climate change effort aligned with SOL3 goal and purpose • Component 1 gradually transferring research functions to MAF; Component 2 planning for transition • Component 3 monitoring and performance on track • SOL3 building social capital in ISPGs that can support other rural development efforts (RDP4, ACD <i>etc.</i>) • Pivotal visit of SOL3 leaders to Nepal's seed system • Performance management plan and results framework ready to be finalised and put to use for next PMT • Communications strategy and staffing to support change processes and adoption • Baseline survey conducted with DNE enumerators • Baseline survey aligned with MAF household food security surveys • Credibility of SOL name continues • MAF continues to have strong ownership of SOL • Demand for quality seed still exceeds current supply • Field occupational health and safety behaviours improved from TAG1 visit 	<ul style="list-style-type: none"> • Institutional constraints continue to pose risks to sustainability and delivery of 2015 results • No (or very limited) crop nutrient response curves available on SOL3 varieties; yield gaps persist • No systematic monitoring and reporting of progress and performance yet – system ready to go, use it! • Management monitoring not yet systematically used • Early signs of strains to system as ISPG scales up • Lack of formal seed policy to drive operating environment for national seed system • Annual Plan lacks clear actions to prepare for transition in 2014 and 2015 • Annual research plans developed before field results are to hand • Baseline consumed too much of M&E/SOSEK resource • Website needs strengthening to make it more useful • No full costing on unit costs of foundation and certified seed for cost recovery • MAF currently has insufficient recurrent budget to sustain component 1 and 2 activities by year 4 • Components 1 and 2 continue to be focused more on what is planned and done than how those processes are designed to transition to MAF implementation • Consistent approach to branding needed in formal and informal seed production • AusAID QAI lacks management response to several identified risks and constraints

Opportunities	Threats
<ul style="list-style-type: none"> • AusAID policy dialogue with GoT-L to support seed policy and budget case for successful transition to MAF • 2011/12 Velvet Bean-Maize results show promise; move to OFDTs • Increase return to seed by establishing yield potential, determining yield gaps on experiment Stations • Soil analysis and pot trials to better understand responses of key crops to nutrients • Evaluation of climatic risk through crop model and historical weather data; design risk mitigation strategies • Include preparation of C1 and C2 transition plan in 2012/13 Annual Plan • Exchange visits with CIMMYT, ICRISAT, CIAT and CIP should yield relationships, flow of new varieties & training opportunities to support transition of C1 to MAF • Assess simple with/without crop input responses in C2 seed fields • Seed treatment to identify C2 seed, improve standards • Plan program of simple OFDTs to understand crop yield potential in 2012/13 growing season – link with C3 • Evaluation of varieties with different maturities • Better targeting of science reporting • Management training for MAF transition under C4 • Prepare to align SOL3 plans with MAF budget cycle • Finish performance management plan and put it into practice ready for June PMT meeting • Baseline data points to opportunities for gender • Include schedule of case studies in 2012/13 annual plan • Test hypotheses using baseline survey data • Prepare communications products to meet emerging digital connectivity capacity as telecoms competition starts in Timor-Leste • Increase focus on strategic, developmental issues including MAF recurrent budget, harmonisation with RDP IV, poverty targeting and food security strategy for urban communities and rural poor • Australia leads harmonisation activities with donors supporting MAF to manage absorptive capacity • Explicitly plan and use a wider range of capacity development methods including mentoring, on-the-job learning and learning-by-doing • Develop transition plan for C1 and C2 before end 2012 	<ul style="list-style-type: none"> • Foundation and certified seed being given away undermines emerging market for quality seed • Subsidised rice imports continue to undermine emerging market for quality seed and improved rice production • MAF leadership rotation anticipated for March 2013 • Competing demands on SEOs may jeopardise services provided to ISGPs • Inadequate MAF budget to ensure successful transition • Lack of appropriate policies favouring domestic food production • Growth in population (demand) exceeds rates of increase in food supply

Annex 2

Measuring progress towards behaviour change

Annex 2 – Measuring progress towards behaviour change

