

Seed multiplication and distribution in developing countries: What is the best option for Timor-Leste?

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Abstract

Planting good quality seed is a key component for improving productivity in all agricultural environments and is especially important in developing countries. The current large yield gap between improved seed and farmer-saved seed is due to varietal yield differences, low seed replacement, poor seed quality and low adoption of good agronomic practices. In Timor-Leste, quality seed of improved varieties has been shown to contribute 15 -131% higher yields than traditional varieties. Despite these benefits, availing improved seed in sufficient quantities at planting time is a challenge for many farmers. The key problem faced by government agencies in developing countries is the high costs of multiplication and distribution of quality seed

This paper examines two approaches to seed multiplication and distribution implemented by the Government of Timor-Leste Ministry of Agriculture & Fisheries in the past five years (2010-2015). The approaches distinguish: (a) centralised certified seed production and distribution (2010-2011) and (b) decentralised community based and commercial seed production and distribution (2012 to 2015).

Certified seed produced by specialised contract growers using MAF facilities for seed processing and storage was found to be 2.3 times more expensive than growing seed commercially with MAF quality control supervision. In just 4 years of adopting the decentralised community based commercial seed production approach, the seed replacement rate of two major crops (rice and maize) increased fivefold from a mere 4% in 2011 to 20% in 2015. MAF has chosen the latter approach as the most viable option for the future.

Introduction

Seed, fertiliser and irrigation are the three most critical agricultural inputs for enhancing crop productivity in developing countries (SoL 2013). Among the three, seed is the cheapest input but if good quality seed is not used, there is large yield gap between it and seed from traditional sources. This yield gap is greatly enhanced when quality seed of improved varieties is cultivated. Studies in Timor-Leste have shown that pure seed of improved varieties can increase yields by between 24% and 54% in cereals and legumes and 15% to 131% in cassava and sweet potato compared with traditional varieties (SoL 2014). Despite the benefits of using improved varieties, availability of quality seed in sufficient quantities is a challenge in developing countries because of the high cost of seed multiplication and distribution.

A strong correlation exists between seed quality and improved crop productivity with some studies showing up to 100% yield improvement (FAO 2015). Seed should be replaced regularly to maintain seed quality. Deterioration is particularly rapid in cross-pollinated crops because different varieties

cross in the field generating a high percentage of off-types. Self-pollinating crops may also lose viability as they become mixed over time. For hybrids, seed must be replaced annually but for self-pollinating crops the seed replacement rate (SRR) is approximately every 4 years (i.e. 25%) and 35% for cross-pollinated crops.

The SRR is very low in developing countries. In most Asian countries it is less than 20% (Gerpacio and Pingali 2007) and in Africa <10% (Maredia et al 1999). Seed from the formal sector in Tanzania is estimated to be below 10% of all seed used (Ngwediagi et al 2009), 7.5% in Uganda (Kabeere and Wulff 2008), 3.5% in Ethiopia (Atilaw and Korbu 2011) and 20% in Kenya (Wulff et al 2006). In Southeast Asia the SRR is 10-25% (Gill et al 2013).

Most countries have released higher yielding varieties and increased availability of quality seed to meet the needs of farming households in a cost-effective way (Fischer et al 2014). However, seed diffusion is often slow. The major reasons for this are the low levels of seed replacement, poor seed quality and low adoption of recommended agronomic practices (Gerpacio and Pingali 2007).

This paper discusses seed multiplication and distribution experiences across Asia and Africa and examines appropriate options for Timor-Leste.

Data sources for study

A number of sources of data were collected and analysed for this study including publications from Africa and Asia. National data in Timor-Leste on cultivated areas for the major food crops, seed production, the number of Community Seed Production Groups (CSPGs), number of Commercial Seed Producers (CSPs), statistics on the National Association of Commercial Seed Producers (ANAPROFIKO) and data from the National Directorate of Agriculture, Horticulture and Extension (NDAHE) within the Timor-Leste Ministry of Agriculture & Fisheries (MAF). Other data on the costs of MAF producing certified seed was sourced from a report compiled by an intern from Columbia University (Planicka 2012). Information was also collected from MAF municipal directors, their community seed coordinators, extension staff and chiefs of CSPGs and CSPs.

Seed multiplication and distribution in developing countries

The development of a modern national seed multiplication and distribution system normally involves progression through four stages as mentioned by Douglas (1980), Pray and Ramaswami (1991), Jaffe and Srivastava (1992) and Ruskie and Eicher (1997). These stages are as follows:

Stage 1. Farmer selection and supply: In this simple traditional seed system, most farmers save their seed for planting the following season. If a new variety is released by the national research program, seed multiplication is very low and adoption poor. The productivity of farmer-saved seed remains low.

Stage 2. Introduction of improved varieties: The public sector tests improved germplasm (local and foreign) and releases new varieties. The public sector also produces breeder and foundation seed. Farmers start replacing traditional varieties with improved released varieties and achieve improved yields. Use of other agriculture inputs are low but gradually increase over time. The private sector and non-governmental organizations (NGOs) start taking interest in seed multiplication and distribution of public varieties albeit on a limited scale. Seed productivity is moderate.

Stage 3. Widespread use of improved public varieties and early spread of private varieties: Private sector dominates the public sector as they play an active role in varietal research and development. The public seed sector supplies breeder seed of self-pollinated and open-pollinated varieties (OPV) of food and minor crops. The private sector focuses their efforts on seed required for niche crops (cash crops), low-volume and high-value crops and hybrids that give good profit margins. Seed

multiplication and distribution becomes more diverse and decentralised. There is increased involvement of agro-input dealers in selling seed. Seed producers put certification labels and private brand names on their seed. The private sector becomes involved in certified seed production. Seed productivity is high.

Stage 4: Advanced seed system: A complex but well-developed national seed system exists wherein different agencies related to the seed sector are actively involved (seed companies, seed traders, agro-input dealers, seed producers, seed processors, seed regulatory bodies, etc.). The private sector releases/registers most varieties of cash crops and hybrids including the production of breeder seed. Foundation, certified and commercial seeds are produced by private firms and farmer groups. The public sector limits its research to OPV and minor crops. Seed policy, seed law and regulations are fully functional. The seed business is fully commercialised. There is widespread use of improved seed among farmers. Seed productivity is continually increasing.

Seed systems of the majority of the countries in Africa and Asia are currently in stage 1 and stage 2 of development. In African countries, seed is overwhelmingly supplied by the informal seed system i.e. by farmer-saved seed in Benin, Bukina Faso, Cote d'Ivoire, Ghana, Guinea, Mali, Niger, Nigeria, Sierra Leone. There are a few exceptions to this rule. In South Africa and Kenya, seed from the private sector outstrips that of the public and informal seed sectors. In Senegal, on-farm seed multiplication and seed from the public sector is almost equal (Niangado 2010). There is no meaningful presence of the private seed sector in Bukina Faso, Guinea, Mali, Niger, Sierra Leone and Senegal but it is gradually emerging in Ghana, Cote d'Ivoire, Nigeria, Uganda and Tanzania.

In countries where private agro-input dealers are fairly well developed, donor supported programs and NGOs promote seed fairs and seed voucher schemes to distribute seed to target groups. Seed fairs are a practical way to distribute seed in post-emergency situations (e.g. drought, floods, earthquakes, etc.) but as the cost of organising these events is high, they tend to continue only in the presence of donor funding. Government agencies rarely organise these activities on their own. Another short coming of the seed fair approach is the high travel cost for poor farmers living in remote locations to attend the events. Travel costs are often higher than the value of seed they receive.

The seed voucher approach for seed distribution has been effective in African countries where agro-dealers are prevalent. Through the voucher, the agro-dealers can market their seed and beneficiaries may be well targeted. The seed voucher approach is also expensive and generally implemented by NGOs, rarely by government agencies.

NGOs working in remote and under-served areas promote community seed production wherein individuals or groups of farmers are encouraged to produce their own seed, store it for their own use next planting season and distribute surplus seed to needy farmers within the community (Wiggins and Crombwell 1995). The main objective of this approach is to self-supply quality seed. It is effective in reaching vulnerable farmers living in remote locations but to remain effective, community based seed production requires regular seed replacement every 3-4 years.

The South and Southeast Asia, the seed sector is more advanced than most African countries as there is widespread use of hybrid maize, rice and vegetables, particularly in Korea, Malaysia, Thailand, Indonesia and Vietnam. Seed multiplication is also being done by both parastatal companies, the private sector and by community seed groups. In India for example, a parastatal company is engaged in seed multiplication and a number of private companies are involved in seed production and marketing. In Indonesia, seed is produced through farmers' cooperatives and

selected multinational companies. Forward contract agreements for seed multiplication between seed companies and farmers are common.

In summary, there is no single approach that is popular in both Africa and Asia. Whether the public or private sector or NGOs dominate depends upon the stage of development of the national seed system. As the national seed system matures from a simple traditional seed system towards an advanced seed system, the number of organisations involved in seed multiplication and distribution increases. At the beginning of 2011, the MAF in Timor-Leste adopted a balanced approach with involvement of public, private and NGOs in seed multiplication and distribution, thereby emerging from a national seed system previously in Stage 2 (Introduction of improved varieties) of development.

Seed multiplication and distribution approaches in Timor-Leste

At the end of 2015, the release of new varieties and multiplication of seed for distribution to farmers in Timor-Leste continued to have many similarities to other parts of the world where the national seed systems are in stage 2 of development. Improved germplasm of different crops are imported and evaluated against traditionally grown varieties. Seed of those lines chosen for release to farmers is maintained as breeder seed by researchers. Plant breeders increase this seed in purified quantities (foundation seed) for further highly controlled multiplication as certified seed. Certified seed may be either distributed directly to farmers or multiplied into greater quantities as commercial seed and finally community seed.

Prior to 2012, the MAF adopted a centralised approach wherein it was wholly responsible for certified seed production and distribution. In developing the national seed system between 2012 and 2015 it focused on the multiplication and distribution of commercial seed and community seed. The pros and cons of each of these approaches are discussed below.

a) Certified seed multiplication and distribution

The production of certified seed involves the use of foundation seed and the production, storage and distribution of seed under stringent quality control procedures. This approach also involves developing a contract agreement between the MAF and specialized contract seed growers who are subject to multiple supervision and quality control inspection visits by government seed technicians during the growing season and at harvest. Trained MAF staff inspect the crop at least four times during the growing season and select potential seed at harvest using a previously agreed buy-back guaranteed price provided the seed meets agreed production standards. When all seed production and quality control criteria are fulfilled by the seed grower their seed is procured by MAF and taken to one of MAF's purpose-built seed processing centres for further drying, cleaning, grading, testing and packaging, labelling and storage for subsequent distribution as high quality certified seed of officially released varieties.

In 2010-2011, Timor-Leste required an estimated total of 2,277 tonne of maize and rice seed to meet the national seed requirement for the following year (Table 1). Since commercial seed was not yet being produced, the distribution of certified seed was the only option for MAF to support the seed requirement of farmers. A total of 82 tons of maize and rice seed was distributed that year, equivalent to only 4% to total seed requirement (i.e. SRR = 4%).

Table 1. Seed replacement rate (SRR) from distributing certified seed, 2011

Crop	Area cultivated (ha)	Seed rate (kg/ha)	Seed requirement (tonne)	Seed supply of improved variety (tonne)	Seed replacement rate (SRR)
Maize	75,804	20	1,516	32	2%
Rice	38,069	20	761	50	7%
TOTAL	113,873		2,277	82	4%

Source: MAF 2011, SoL 2013

The estimated cost of producing maize and rice seed to meet Timor-Leste's total certified seed requirement of 721 tonne during 2011 is presented in Table 2. The seed price of \$3.50 per kg included the cost of production plus processing, storage and transportation of certified seed to each MAF municipal headquarters (Planicka 2012, Young 2013).

Table 2. Estimated cost to produce T-L's total seed requirement in 2011 using certified seed

Crop	Amount of seed required at 35% SRR for maize and 25% SRR for rice and peanut (t)	Total area required to produce seed (ha)*	No. growers required at 0.6 ha land/grower	Seed cost to grower US\$/kg**	National seed cost US\$/kg***	Total cost of supplying national seed requirement (US\$)
Maize	531	531	885	\$1.25	\$ 3.50	1,858,500
Rice	190	127	211	\$1.25	\$ 3.50	570,000
TOTAL	721	658	1096			2,428,500

Note: * Area required to produce seed assumes 1 t seed produced/ha for maize and 1.5 t seed produced/ha for rice; ** seed cost to grower, ***total actual cost of producing one kilo of certified seed including cost of processing, storage and transport to MAF municipal office.

A cost of nearly US\$2.5 million annually to service its national maize and rice seed requirement is a large expense for a small nation of 130,000 farming families (almost \$20.00/farm family). A major portion of this expense is the cost of processing and storage and then transporting the seed to municipal headquarters for distribution to farmers. Should certified seed be the sole source of seed servicing Timor-Leste's annual maize seed requirement, then other issues must be considered, including the following:

Development of specialized seed growers: From Table 2 it is evident that Timor-Leste would require >1,000 individual seed growers with at least 4-5 years of experience in quality seed production to fulfil the nation's seed requirements. Developing such professional seed growers poses a challenge in terms of cost, capacity building and in providing the buy-back guarantee for the quantity of seed they produce.

The cost of seed processing facilities: The real cost of producing certified seed is very high. In addition to the approximate US\$2.5 million annual seed production costs, there is also infrastructure and equipment procurement, operation and maintenance costs required to support MAF's seed processing, testing and storage as well as training and supervision of staff and contracted farmers.

Transportation, storage and seed handling: Transportation of seed from the production sites to processing centres and subsequent distribution to farming families living in distant villages is also an issue, especially in light of the existing poor rural transport network.

Low purchasing power: A majority of the rural population in Timor-Leste are subsistence farmers and have low purchasing power. As long as the price of seed is high, making seed available to farmers will be problematic and diffusion of improved varieties will remain low.

Implication of seed distributed free: Government distribution of free seed was initially implemented as a short term measure using imported seed. Should it continue, the annual cost would be a minimum of US\$2.5 million or higher if other food crops such as peanuts, cassava and sweet potato were also included. Distributing free seed to farming families also tends to nurture a culture of dependency which is contrary to accepted development policy and the objectives of the MAF. Moreover, while the direct cost of distributing either locally produced formal seed or imported seed is high (about \$3.50/kg) the opportunity costs associated with imported seed distribution can be more than three times greater due to poor quality (i.e. in terms of seed purity, germination rate and less suitable variety) and greater likelihood of late distribution and delayed planting (Young 2013)

b) Commercial seed production and development of community based seed multiplication.

The prohibitively high cost of MAF multiplying and distributing certified seed to farmers encouraged the introduction, in 2012, of a regulated commercial seed component to the emerging national seed system. This additional component of the formal seed sector was a step towards the development of a cheaper, more efficient and more sustainable community-based seed system.

Commercial seed production is a decentralized production, storage, processing and marketing activity implemented by organized groups of farmers operating in their home villages and known as commercial seed producers (CSPs). To be eligible to produce commercial seed for sale, all CSPs have to follow basic seed production procedures set by the seed department of the MAF National Directorate of Agriculture, Horticulture and Extension (NDAHE). These conditions were initially promulgated in National Seed System for Released Varieties (NSSRV) guidelines approved by the National Seed Council.

CSPs must initially request a 5-year registration from MAF and then an annual authorisation to multiply a specific quantity and variety of certified seed into commercial seed. CSP seed production plots and the resulting seed are checked by municipal seed officers or other personnel from NDAHE.

CSPs harvest, process and arrange for their seed to be sampled by MAF personnel and tested for physical purity, germination and moisture content in the NDAHE seed laboratory. The seed is then securely packaged in 5kg lots in double plastic bags. CSPs market their seed using their own brand name and registration number and pink label showing seed test results and date. They also market under the 'Fini ba Moris' brand of the NSSRV that assures their seed quality (Kunwar et al. 2013).

To ensure the CSPs were qualified to multiply high quality seed, they received training from MAF extension staff on seed production, storage, processing and marketing over a three year period (2012-2015). The initial training was followed up with periodic monitoring support from MAF Municipal extension staff and assigned NDAHE Municipal seed officers.



Figure 2. CSP members holding packets of their commercial seed ready for sale

Nineteen CSPs were established in 2013 following the spirit of the National Seed Policy. By the end of 2015, 69 CSPs were in operation averaging 5 per Municipality with at least one operating in each Municipality including the Oecussi special region (Table 3). Each CSP has an average of 25 members.

Table 3. Registered commercial seed producers by municipality, 2015-2016

Municipality/region	Number of CSP	Seed crop produced
Aileu	5	Maize, rice, peanut
Ainaro	3	Maize and rice
Baucau	12	Maize, rice, peanut
Bobonaro	7	Maize, rice, peanut
Covalima	4	Maize, rice, peanut
Dili	1	Peanut
Ermera	3	Maize and rice
Lautem	6	Maize, rice, peanut
Liquica	4	Maize, rice, peanut
Manatuto	5	Maize, rice, peanut
Manufahi	6	Maize, rice, peanut
Viqueque	8	Maize and rice
Oecussi special region	5	Maize and peanut
TOTAL CSPs	69	

The multiplication of seed by commercial seed producers dramatically reduces the cost of seed production. In 2014-2015, 295 t of commercial seed of improved varieties of maize and rice was produced and distributed by MAF and its development partners to more than 40,000 farmers. This methodology increased the SRR to 20% from the 4% when distributing certified seed. (Table 4) and costs were reduced to approximately \$2.30/kg or US\$0.68 million annually (Table 5). From the Table 2 and Table 5, it can be noted that the market price of certified seed of maize and rice is 2.3 times more than commercial seed.

Table 4. Seed replacement rate distributing commercial seed, 2014-2015

Crop	Cultivated area (ha)	Seed rate (kg/ha)	National seed requirement (t)	Seed supply of improved variety commercial seed (t)	Seed replacement rate (%)
Maize	44,812	20	896	185	21
Rice	28,128	20	563	110	20
TOTAL	72,936		1,459	295	20

Source: MAF 2011, Seeds of Life 2015

Table 5. Estimated cost to produce Timor-Leste seed requirement as commercial seed, 2014-2015

Crop	Amount seed required at 35% SRR for maize and 25% SRR for rice (t)	Total area required to produce seed (ha)*	Number of CSPs required at 5 ha/CSP for maize and rice	Cost to grower (US\$/kg)	Farm gate seed price (US\$/kg)	Total cost of supplying national seed requirement (US\$)
Maize	314	314	63	\$0.22	\$ 1.50	471,000
Rice	140	93	19	\$0.32	\$ 1.50	210,000
TOTAL	454	407	82			681,000**

*Area required to produce seed at 1 t seed/ha for maize and 1.5 t seed/ha for rice, 2014-2015

** Based on a similar cultivated area to 2010-2011, the total cost was approximately \$1,063,000

Taking into consideration the reduction in cropping area of rice and maize from 114,000 ha in 2010-2011 to 73,000 ha in 2014-2015, the savings were large at approximately 50%. These savings were mainly due to the fact that CSPs provided their own labour, used their own seed facilities (equipment, seed warehouses) and there was less distance and costs involved in delivering the seed to the local MAF Municipal office. This approach also enabled MAF to cease distribution of certified seed directly to farmers from 2014, thereby dramatically reducing the need for MAF to produce large quantities of expensive certified seed and significantly improving the sustainability of the national seed system post-SoL.

Seed from the CSPs (commercial seed) and some certified seed is provided to Community Seed Production Groups (CSPGs) to produce “community seed”. Community seed is then stored for use by group members the following season and any surplus seed is shared, bartered or sold to family members or neighbours in the community. Over the past 4 years, MAF has established 1,207 CSPGs that are producing community seed. These CSPGs were originally MAF farmer groups who were trained in community seed production by MAF extension staff. A community seed group is normally composed of 10-12 members. By December 2015 some 15,000 farming households were members of CSPGs and had directly benefitted from community seed production and distribution (Table 6). Neighbouring farmers were also recipients of quality seed of improved varieties produced by these CSPGs.

Table 6. Number of CSPGs established as of December 2015

Municipality	No. of CSPGs	Type of Group			Number of members		
		Men	Women	Mixed	Men	Women	Total
Aileu	81	10	4	67	719	367	1,086
Ainaro	71	12	4	55	653	279	932
Baucau	127	24	1	102	1,044	426	1,470
Bobonaro	113	12	0	101	836	435	1,271
Covalima	148	39	2	107	1,519	451	1,970
Dili	26	0	2	24	190	252	442
Ermera	72	9	6	57	597	365	962
Lautem	137	21	1	115	903	498	1,401
Liquica	62	19	2	41	422	220	642
Manatuto	72	20	1	51	666	147	813
Manufahi	67	22	7	38	623	260	883
Oecussi	99	8	10	81	706	554	1,260
Viqueque	132	30	1	101	1,285	404	1,689
Timor-Leste	1207	226	41	940	10,163	4,658	14,821

CSPGs generally multiply seed in a single plot approximately 0.2-0.25 ha in area. Open pollinated crops are isolated from other crop varieties and the plots are collectively managed by groups. Their seed requirement for the following year is collectively stored in airtight containers to maintain seed quality. Neither the crop nor seed is quality inspected or certified by the MAF, but if the group follows seed production protocols including proper drying, grading and airtight drum storage the resulting product is good quality. As seed is primarily produced to meet group members' needs, it is in the group's interest to maintain high production standards. MAF extension staff assist CSPGs to replace their seed with Government certified or commercial seed every 3-4 years for maize and 4-5 years for rice and peanut. Since community seed is not and cannot be quality assured, under NSSRV guidelines, CSPGs must not sell their seed in the market place.

MAF extension staff provided seed production training to the initial batch of 280 CSPGs established prior and during to the 2011-12 wet season. These groups were trained to produce seed of maize, rice and peanuts and planting material (cuttings) of cassava and sweet potato. One hundred and eighty five of these groups successfully harvested maize, rice and peanuts (Table 7). By the 2014-2015 crop season, the number of trained groups had increased to 1,207 of which 1,135 were producing seed of improved varieties of maize, rice and peanuts. In 2015, there were 3-4 CSPGs in each of 363 (82%) of the total 442 sucos in Timor-Leste. These produced a total of 191 t of community seed.

Table 7. Seed production by community seed groups in 2011-2012 and 2014-2015

Year	Crop	No. of harvested CSPGs plots	Total community seed (t)	Average seed production (kg/CSPG)
2011-2012	Maize	90	13	148
2011-2012	Rice	55	16	300
2011-2012	Peanuts	40	3	68
TOTAL		185	32	
2014-2015	Maize	670	104	155
2014-2015	Rice	185	75	403
2014-2015	Peanuts	280	13	47
TOTAL		1,135	191	

Source: MAF NDAHE 2015

Discussion

Of the two different approaches to seed multiplication implemented and compared in Timor-Leste, the community-based approach was the most successful. This approach was able to produce and distribute high quality commercial seed to the farming community at approximately half the cost of the centralised certified seed option while leaving a significant profit margin as a production incentive for the commercial seed producers. As production of commercial maize and rice seed expands to around 400 t/year it is anticipated the price of commercial seed will decline to around \$1.00/kg (i.e. approx. 100% above the grain price) and agricultural input suppliers will become increasingly involved in commercial seed sale and distribution (e.g. at \$2.00/kg).

Major costs incurred in the 'certified seed approach' are seed processing, storage and transport from producers' seed plots to Government seed processing and storage facilities. Additional costs include overheads and re-distribution of certified seed from the centralized facilities to MAF municipal offices. Community and commercial seed are more widely and readily available across the farming communities at planting time and farmers face less delay with being issued the seed.

Commercial seed production not only ensures that a secure supply of quality seeds is locally available to farming families at planting time, it also improves farm family autonomy and independence and encourages transition to commercial agriculture by commercial seed producers and their farm family members.

Community seed production groups generate their own seed at low cost but to maintain quality they should systematically replace their parent seed stock with high quality commercial seed every 3-4 years for maize, every 4-5 years for rice and peanuts. Groups that follow good agricultural practices tend to maintain their seed purity better than those that follow the guidelines less stringently. With experience, the groups require less extension support but continued technical support and connections to a supply of commercial seed (or certified seed) are critical to the ongoing success of the program.

It was observed that confidence among MAF team members working within the national seed system at the national and municipal level has dramatically improved over the past four years. For some years to come MAF has committed to locally purchase its annual seed requirements from commercial seed producers for redistribution to ordinary farming households rather than import more expensive, less suitable varieties with less assurance of seed quality. This is great news for commercial seed producers as the market for seed of major food crops in the private sector remains undeveloped, no doubt partly due to MAF distribution of free seed.

Since the seed system in Timor-Leste is currently in its infancy, considerable effort is required to extend the benefits of MAF released varieties to as many farmers as possible for at least 3-4 more years. This action should further raise awareness of both the benefits of planting quality-assured Fini ba Moris brand seeds and the superior productivity of MAF-released varieties, thereby improving overall market demand for commercial seed.

Commercial seed producers multiply seed for sale. As of 2015, the largest seed sales were to the Government, NGOs and development partners. In recent years, the amount purchased has increased to fulfil requirements. However, commercial seed producers currently multiply seed at considerable cost under speculation of being able to sell their seed the following year. In order to avoid this kind of uncertainty and expecting CSP take all the business risk, a forward contract system could be introduced and institutionalized. This system would provide a guarantee regarding price, quantity, quality and time for delivery to the would-be seed buyer and at the same time reduce risk for seed producers.

During the years that the Timor-Leste government purchases seed locally, MAF will need to set a national target for seed replacement rate for all major crops of which MAF released varieties are available. MAF personnel at the national, regional and municipal level should also meet early in the second quarter of each year to forecast seed requirements for the following year and formulate a supply plan for discussion, finalisation and endorsement by the seed planning and production coordination committee of the National Seed Council.

In Timor-Leste, most improved food crop varieties are public goods released by MAF over the past decade. The private sector, NGOs and agencies all rely on accessing these varieties. Being a public good, potential seed buyers from the private sector have limited incentive in promoting and marketing varieties over which they have no commercial control. Keeping the public informed about the benefits of their varieties and stimulating future demand for commercial seed will remain the responsibility of the Government and CSPs for a number of years. One method of achieving this is to support CSPs with seed-related services such as advertising material and market information.

Additional support could also be provided in the form of fertilisers, herbicides and pesticides if Government funding allows.

There has been wealth of information on nutrition and agriculture in Timor-Leste however seed security actions are not pragmatically tied to enhancing better nutritional outcomes (Franzo 2013). Introduction of a targeted seed security interventions on nutrition security would be the smart way forward in future (USAID OFDA 2013).

Each CSP has an individual label which identifies its particular product. It is therefore important for them to maintain high standards to build their brand image and reputation. As demand for good quality seed grew during the years leading up to 2015, CSPs commenced interacting with each other to establish a system for marketing bulk quantities of seed and ensuring the quality of seed from different sources remained consistent. At the beginning of 2015, representatives of each of the 69 CSPs met to discuss quality issues, storage and marketing of their seed. During a meeting in March 2015, these CSP representatives formed a national association of commercial seed producers locally known as ANAPROFIKO (*Assosiasaun Nasional Produtor Fini Komersial*). In preparation for the 2015-16 crop harvest ANAPROFIKO became a vehicle for input supply (e.g. providing plastic bags and labels to each CSP for packaging their seed to uniform NSSRV standards) and for defending the rights of CSPs on seed related issues. However, ANAPROFIKO is in its infancy and follow-on support will be required in the near term for it to negotiate on behalf of all CSPs for large seed sales to Government, NGOs and other organizations and provide effective services to members.

The long term future of the national seed system in Timor-Leste relies on increased involvement of the private sector. Currently, agro-input retailers sell mainly high-value low-volume hybrid vegetable seeds. A few sell seed of OPVs released by MAF but most do not because they see the government distributing large quantities of maize and rice free to farmers. Hence, there is no incentive or demand for seed of these crops to be marketed through private sector outlets. However, as subsidised seed multiplication and distribution is gradually phased out, the private sector should become increasingly involved. As in other countries, Government agencies will continue to support varietal development and release and the distribution of seed to vulnerable households. These Government agencies will also need to create an enabling policy and regulatory framework to encourage the private seed sector to flourish.

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