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Community Seed Production

Editors: CO Ojiewo, S Kugbei, Z Bishaw and JC Rubyogo

Food and Agriculture Organization of the United Nations

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International Crops Research Institute for the Semi-Arid Tropics

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C.O. Ojiewo, S. Kugbei, Z. Bishaw and J.C. Rubyogo

Language Editor

S. Sridharan

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Preface

During the 1970s and 1980s, seed system support in developing countries was focused on strengthening public sector institutions including agricultural research centers, extension services and state-owned seed corporations. This approach achieved limited success in Africa such that structural adjustment programs in the 1980s and 1990s resulted in general withdrawal of state seed system support. It created space especially for the private sector but also for civil society seed organizations while maintaining linkages with public sector agricultural research systems. The 1990s also saw the emergence of large-scale direct seed purchase and distribution, particularly in Africa, in response to natural disasters and crisis. Since 2000, agricultural development has been at very low levels with widespread underinvestment in the sector worldwide. However, there are now indications that donors are regaining interest in agriculture and especially in the seed sector.

Over the past decade, there has been an emerging trend to lower yield gaps through promoting more efficient and accessible input markets and 'market-led technology adoption in agriculture'. This strategy encourages increasing the use of new adapted varieties with appropriate inputs and development of effective output markets to absorb surplus production. Consequently, higher incomes and profits for re-investment are generated. The objective of the Agricultural Green Revolution for Africa Program for Africa Seed Systems (AGRA-PASS) is to introduce 400 new varieties of 10 staple crops, assist more than 50 African seed enterprises to serve the needs of smallholder farmers, and train up to 10,000 well-functioning agro-dealers within five years. This effort, of particular importance, aims to go to scale with the new USAID/AGRA three-year Scaling Seeds and Technologies Partnership of US$ 47 million to accelerate smallholder farmer access to transformative agricultural technologies.

On-farm seed saving is a well established tradition amongst farmers in Africa, most of who are women. They self-source virtually all their seed and rarely purchase commercial seed of staple crops. Therefore, it remains a formidable challenge to convince them to willingly pay a premium for quality seed coming from the new private enterprises. It is necessary to emphasize the importance of developing a suite of best practices for sustainable production intensification, which utilizes existing land to obtain higher yields and production while minimizing harmful effects on the environment. It should focus on ensuring access to appropriate crop varieties (high yielding, drought/pest/disease tolerant and with good food quality attributes) in combination with better crop cultivation practices (more efficient use of inputs including water and nutrients, and/or effective control of pests, diseases and weeds) and strengthening a pluralistic seed system that meets the demands of the poor.

Many food security crops of Africa, and of other continents, have not attracted private sector interest. They have relied on local seeds of low-margin and high-volume crops, which are also expensive to transport and distribute. Crops will only attract the formal commercial seed sector when subsidies are applied. The same holds true for seed supply of minor or neglected crops (often called orphan crops which include various staple crops). On the other hand, the public sector tries to respond to the seed needs not adequately met by private enterprises or where public sector efforts do not crowd out the potential for private sector profit. In essence, both the public and private sectors cannot fulfil the entire seed needs of farmers, especially of smallholders located in remote areas who have limited purchasing power.

The civil society – independent of the private sector and government – plays a unique role in promoting and advocating Community Seed Production (CSP) for smallholder farmers. Oftentimes, farmer groups, farmer associations and other community-based institutions provide support to seed related activities complementary to the public and commercial sectors. The CSP approach is widely used to deliver seeds to smallholder farmers, although no clear definition or criteria exists for assessing success.

FAO-assisted seed programs in Africa have demonstrated that CSP fulfils an important role and need that is neither purely commercial nor farmer managed, thus creating a link between traditional farmer seed management and commercial seed production. It includes activities

relating to smallholder seed enterprises, informal seed supply systems, and other local seed system development programs. In this respect, a well-functioning CSP should be complementary to formal sector seed activities in the public or private sectors. Further exploration of the CSP concept is necessary by corroborating African experiences with similar approaches used in other parts of the world. There is a need for greater understanding of underlying issues in CSP and to explore ways to mainstream it within the overall agricultural development strategies.

Due to this underlying need, FAO, in collaboration with ICRISAT, ICARDA, and CIAT, organized an expert consultation workshop in Addis Ababa, Ethiopia, in December 2013 on Community Seed Production. The workshop's objective was to create a roadmap and develop strategies for enhancing effective uptake and implementation of CSP in developing countries to contribute to improved and sustainable crop production, food security and rural livelihoods. It also explored the scope, opportunities and challenges in CSP, as well as the critical points necessary for an effective implementation.

About 30 international experts with a wide range of knowledge on CSP came from different parts of the world. They attended the workshop and made technical presentations, engaged in small working groups and deliberated pertinent technical issues. In their presentations, they provided the context, unique features of CSP initiatives, elements of sustainability, lessons learned, and opportunities and strategy for moving forward based on their experiences. The small working groups provided an opportunity for the participants to discuss specific challenges and lessons learned, proposed strategies to consolidate and build on successful initiatives, and encouraged uptake by other countries and regions. The program also included a field visit that provided a practical and real life example of CSP in Ethiopia. The workshop concluded with a panel discussion consisting of selected representatives to discuss and outline how to strengthen and promote market-oriented CSP schemes that optimize benefits to farmers in each region and the global farming community.

The diversity, wide range of presentations and discussions at the workshop established a baseline of the current status of CSP in different regions and developed the following key discussion points:

- CSP approaches vary and are location-specific. There is no recommended general framework.
- CSP sustainability is not based on commercial considerations only. Governance factors (leadership, business planning, sharing of risk and linkage with public sector institutions) are particularly important.
- Greater crop diversification, better quality seeds and the introduction of new varieties increases genetic diversity and contribute to the viability of CSP and a reliable seed production. Other value added dimensions should be taken into consideration, such as processing of final products.
- Although usually ignored in CSP programs, quality assurance is crucial at all levels and underscores the linkage with the formal seed sector.
- There is a general lack of published information on the establishment and performance of CSP programs. This has resulted in the use of different approaches with no consistent technical guidance.
- Key challenges in CSP include the shifting from subsistence farming to business oriented enterprises and the implementing policies that create an enabling environment.

These proceedings provide details of the main issues presented and discussed at the workshop as part of the effort to further the debate surrounding CSP practices. They include an acceptable general definition of CSP and how to enhance the uptake and implementation of CSP, and deliver pertinent messages on issues related to CSP which could be used for guidance in implementing relevant projects.

Review of Community Seed Production Practices in Africa Part 1: Implementation Strategies and Models

Stephen Walsh[1], Tom Remington[2], Samuel Kugbei[3] and Chris O. Ojiewo[4]
[1]Catholic Relief Services (CRS), Nairobi, Kenya
[2]Catholic Relief Services (CRS), Lilongwe, Malawi
[3]Food and Agriculture Organization of the United Nations, Rome, Italy
[4]ICRISAT-Ethiopia (c/o ILRI Ethiopia) Box 5689, Addis Ababa, Ethiopia

Correspondence: Samuel.Kugbei@fao.org

Summary

This review is limited in scale and scope and covers five case studies in Africa. Two of the studies are classic emergency interventions: one post-conflict and one post drought. Three of the case studies are developmental in nature; one focused on different approaches to increase farmer access to recently released drought-tolerant cereal varieties, another looking at smallholder participation in legume seed supply, and one looking at three women's groups as seed enterprises. This review is based on an analysis of published and unpublished policy reviews, briefing and discussion papers, journal articles, meta-reviews, training material, strategy documents, evaluations, and case studies on seed production and seed delivery with a focus on the diverse but not well understood area between farmer seed management and commercial seed. This review has also been informed by discussion with seed system practitioners, particularly those involved in the case studies examined. This space between farmer seed management and commercial seed has been referred to as community seed production, smallholder seed enterprises, informal seed supply, and local seed system development programs. The objective of this review is to examine the status and trends in community seed production in order to identify key criteria for success and possible areas of improvement, including the role of community seed production in linking formal (public and private) seed sectors with the farmer seed system. The first section of the review (Part 1) details the five case studies in terms of major activities and implementation strategies.

1. Introduction

1.1. Context and framing

Farmers everywhere depend on seed as a fundamental input to crop production. The quality of seed and variety determines the success in productivity and stability (resilience to pests, disease, and drought). Agriculture accounts for ¼ of GDP and nearly 2/3 of the labor force and livelihoods in Africa and more than 60% of the rural population lives on less than $1.25 per day (Livingstone *et al*., 2011). An estimated 33 million small farmers in sub-Saharan Africa farm on less than 2 ha and rely on family labor with no mechanization (Wiggins 2009). Cereal yields have been stagnant in Africa since 1960 at roughly 1 MT per ha compared to 2.5 tons per ha in South Asia and 4.5 tons per ha in East Asia (Hunt 2011) whereas sub-Saharan Africa's population is slated to more than double by 2050 to 1.8 billion.

During the 1970s and 1980s, seed system support in developing countries focused on supporting the public sector via national research programs, extension services, crop protection departments, farm input supply, laboratories and equipment, seed production farms, and training (Venkatesan 1994). Challenges with state seed enterprises have been well documented and include: monopolistic behavior, low accountability, low amount of seed provision, and low responsiveness to farmer needs. Following structural adjustments in the 1980s and 1990s, state seed system support was increasingly dismantled through lower subsidies, concerted efforts to create private sector space, and an increase in project-based seed support to civil society organizations with public sector research linkages. The hypothesis underlining structural adjustment of agricultural reform in Africa was that public sector

focused agriculture was not cost-effective. The 1990s also saw the advent of large-scale emergency seed interventions in Africa that were responding to natural and man-made disasters (early 90s drought in southern Africa/Rwandan genocide). From 2000, there has been widespread agreement that the agricultural sector in Africa was under invested and in crisis, performing worse than the 1970s as measured in per capita production.

The last decade has seen an emerging consensus around 'market-led technology adoption in agriculture' as the path out of the abyss. This Green Revolution in Africa approach would occur through lowering yield gaps via planting new varieties of staple food crops, increasing yield potential with fertilizer and soil management, and making input markets more efficient and accessible and output markets easier to exploit so that surplus production can be converted to income and profits can be re-invested to further increase productivity (Scoones and Thompson 2012). Within seed systems, this Green Revolution orthodoxy − improving input (seed and fertilizer) and output markets to create effective demand − was clearly embodied in the Bill and Melinda Gates Foundation and Rockefeller Foundation-funded Agricultural Green Revolution for Africa Program for Africa Seed Systems (AGRA-PASS), which set a ten-year goal to introduce 400 new varieties of 10 staple crops contributing to poverty and hunger alleviation of 30-40 million people. Seed is the 'tip of the arrow' by which new knowledge is delivered to farmers and the point of entry for complimentary agricultural investment (PASS Strategy Memo).

Major risks and assumptions to the AGRA-PASS strategy included the expectation that smallholder farmers would be willing to pay a premium for certified seed with a 20-30% yield improvement, that the private sector would receive more support for production and distribution of seed than public sector institutions, that public sector breeding could engage effectively with private sector seed companies, that farmer adoption would be driven by a niche-focused breeding process creating varieties meeting smallholder demands, that output markets would develop to absorb generated surplus, and that policies would be implemented to enable input and output market development (PASS Strategy Memo). By 2012 some key AGRA-PASS investments rooted in these hypotheses were being actively re-evaluated, for example, maize hybrids as the overwhelming focus for AGRA-PASS seed investment and the agro-dealer networks as the preferred input delivery mechanism for farmers. While many activities in seed production and dissemination may (and should) be commercialized, most seed reproduces easily and is stable over multiple generations. This capacity of seed to effectively self-replicate while in the hands of the user significantly limits the opportunities for repeated and sustained sales of a single variety, that is, unless there is loss in genetic purity or physiological deterioration due to pest or disease which drive a repeat purchase. Thus, even in highly developed and efficient farming systems such as the United States more than 2/3 of wheat seed used each year is recycled from farmers' own fields (Minot 2007).

Outside of acute emergencies – such as war, resulting in displacement and abandoning of seed stocks, or other natural calamities, such as drought, flood, pest or disease, causing massive crop loss – the extent of farmer recycling drives seed demand for any variety. In non-emergency contexts, farmers' in Africa self-source upwards of 80% or more of annual seed needs and when they do source off farm it typically comes from a neighbor or from local grain markets. Reasons for self-sourcing as opposed to seeking seed from the formal (commercial or public) sector are many and may include: satisfaction (real or misguided) with own seed; lack of familiarity and/or appreciation for the 'value added' of new varieties or certified seed; no availability; not aware and/or not able to apply complementary technologies to maximize the benefit from the seed; cost (Muliokela 1998). Where shocks to the seed system reduce supply and increase demand due to drought, flood, or conflict; self-sourcing or sourcing from a neighbor may not be sufficient to meet sowing requirements. Where there is incipient demand for new varieties, due to traits such as drought tolerance and disease resistance or new output market opportunities demanding new traits (color, storability, size, processing quality), the commercial sector may not be nimble enough, alone, to meet farmer demand.

The seed business, for food crops, is generally low margin and high volume driven whereas transport and distribution costs are expensive in Africa. For the case of seed for major food crops, when there is limited varietal out-crossing or quality degeneration, the window for commercial opportunity is often short-lived because of the capacity of seed to quickly and effectively self-replicate in the hands of farmers. The formal commercial seed sector – unless there is a market making a subsidy from a government, foundation, UN/Agency, or NGO – is unlikely to address seed supply issues of food crops or crops in remote areas as it is not financially justifiable (Minot and Smale 2007). There is no pure business case to be made for commercializing seed for food crops where there are high operating costs and challenges to achieve scale in operation. Genetically modified crops may someday alter the market dynamics of commercializing seed by enabling a business model to be based on high margins and low volume. Specialty and niche seed markets exist and are exploitable in Africa. These tend to be dominated by very small entrepreneurial seed specialists and where there is scope for scale they require significant capital investment.

As this discussion illustrates, seed is complex and practical solutions aimed at enabling farmers to access and effectively utilize new and existing varieties in a sustainable and cost-effective manner are context specific. This calls for a pluralistic approach, involving multiple actors spanning the public and private sector, recognizing their unique roles and capacities (rights and responsibilities), functioning effectively at an organizational level closest to the problem (subsidiarity), and acknowledging self-limitations and actively seeking out synergies with other actors (solidarity for the common good). The necessity for cooperation and 'creative complementarity' is based on the premise that seed products, services, and policies beneficial to farmers cannot be developed though a disproportionate focus on the public sector (research organizations, plant health and seed inspectorates, government extension, government managed subsidy programs), the private sector (seed companies, agro-dealers, seed trade associations, for profit organizations), or farmer and civil society organizations (farmer cooperatives and associations, NGOs). A key challenge to 'pluralism' is in identifying each actor's unique gifts and establishing incentive structures that promote and reward collaboration across the public, private, and civil society spheres.

1.2. Definition of Community Seed Production

The public seed sector – composed broadly of national breeding programs, agricultural extension, national plant protection, and seed inspection agencies – focuses on the development of varieties for diverse agro-ecologies, the '*extension*' or delivery of those products to highly heterogeneous populations, and the creation of an enabling policy environment for this to occur. Ideally, the public sector fills a space in the seed system and responds to seed demand where private sector engagement is limited and where public sector efforts do not crowd out the potential for private sector profit.

The private seed sector is the most active and dynamic force in seed systems globally – investment in seed-related R&D dwarfs that of any government – and in Africa the commercial seed sector for botanical seed is growing with strong donor support. However, outside of hybrid maize and vegetable seeds, it is difficult to make a business case for pure private sector investment.

The civil society – independent of the private sector and government – has a unique role in promoting and advocating for the interests of small farmers in seed systems. Farmer groups, farmer associations, community-based organizations, and NGOs can support seed related activities that ultimately creates complementarities between the public and commercial sector. These activities may include farmer aggregation to lower input costs and raise extension impact, identification and early bulking of promising varieties in farming communities, training and quality control on

seed production and disease recognition, linking producers to markets that value specific varieties (product traits), and advocating for beneficial regulations and access to subsidies.[1]

This paper defines community seed production by what it is not – it is neither commercial seed production nor farmer managed seed production – and recognizes (and argues) that there is an important role and need for seed production that is not purely commercial nor farmer managed. In all of the case studies in this review, the community seed production has two objectives: to increase farmer access to varieties (often but not always new) and to increase quality of local and improved varieties through variety maintenance, selection, handling, and storage (Almekinder and Louwaars 1990).

While community seed production nearly always involves a subsidy and is predicated on the adage that seed is a public good with private benefits, this does not negate the role of incentives schemes and the profit motive to raise efficiency for different actors in the system. Community seed production occupies a middle ground between the farmer system and the public and commercial sector and its key challenge is in identifying where and how it can most effectively engage with the public and private sector to create an enabling environment that creates the most good for the most farmers and for society as a whole. Where there is less commercial opportunity, community seed production should be more developmental with higher subsidies and stronger links to the public sector. Where there is more commercial opportunity, community seed production should involve lower subsidies and explicit links to the private sector.

2. Materials and Methods

2.1. Criteria for Identifying Community Seed Production Case Studies

The case studies referenced in this review are based on a literature review dating back a decade and reflect the authors' definition of community seed production. Several dozen studies were identified and reviewed. Those referenced here were well documented, presented data, highlighted common challenges and opportunities in community seed production, and covered the main cropping systems in Africa that have been subject to project-based support for seed production, storage and marketing. Effort was made to include different regions, farming systems, and include conflict and post-conflict contexts.

1. **Farmer Seed Enterprises in Uganda – *Sonia David***
   Agriculture and Human Value 21: 387-397 (2004)

Three farmer group seed enterprises in Eastern Uganda produce and market two newly released bean cultivars over six seasons and three years. The groups were visited once a year by researchers and an extension officer conducted an impact evaluation after three years. Insights are drawn from project documentation and through follow up visits to these groups one year after project closure and to randomly selected households in the project area five years after project closure.

2. **Comparative Study of Three Community Seed Supply Strategies in Tanzania – *Rohrbach* et al.**
   ICRISAT (2002)

Three projects promote the production of certified or quality declared seed of sorghum and pearl millet in the same geographical area. All encourage small-scale farmers to produce and sell with mixed results. Training and seed quality control was a focus of all projects. Marketing and the relative value of certified versus foundation versus quality declared seed were main challenges.

1 The distinctions between public, private, and civil society spheres are not clear cut. Farmer cooperatives, commercial seed companies, public sector entities, and NGOs may at times be closely tied to and dependent on other 'spheres' for their survival. These categories are based on a working definition of 'public' being government run and mandated with an aim to protect and promote the public good and reinforce government legitimacy, 'private' being owned by individual(s), with a primary aim of making a profit, and 'civil society' being non-governmental with a primary aim to promote the public good but without precluding a profit motive.

3. **Community Based Seed Supply in Sudan – *A. Khidir Osman***
   Leisa Magazine 23 (2007)

Between 2002 and 2005, CARE International in Sudan implemented a project to enhance the food security status of approximately 65,000 rural families in North Kordofan. Some of the main components of the project were to improve seed availability through distribution of high quality seeds of improved varieties released by research, capacity building and training of local communities, and the promotion of seed multiplication at community level.

4. **Cooperative Community Based Seed Enterprise in Haraghe, Ethiopia – *Osman Ibrahim***
   Case Study from Farmer, Seeds, Varieties: Supporting Informal Seed Supply in Ethiopia
   Thijssen, Bishaw, Beshir, de Boef. Wageningen (2008)

This FAO project was funded by the Royal Norwegian Government with two aims: (1) crop production improvement through on-farm seed multiplication, production, storage and marketing of seeds of improved and local farmers' cultivars of selected food crops; (2) promotion of crop diversification through demonstration plots and the production of seeds of cash crops to increase the farmers' income.

This was a large-scale model termed 'Cooperative Community-based Seed Enterprises' (CCBSE) and discusses their establishment and results over a five year period in a drought-prone area of Ethiopia.

5. **Smallholder Farmers' Participation in Legume Seed Supply in Kenya – *Mburu et al.***
   ICRISAT: Project analysis of the USDA funded Lucrative Legumes Project (2007)

This three-year project aimed to identify and address constraints from production to market for pigeonpea, groundnut, and chickpea. The project was implemented by Techno Serve, Catholic Relief Services, and ICRISAT and carried out over three years and across two different agro-ecological zones and more than 17,000 farmers were supplied improved legume. More than 600 farmer groups were involved in the project as a conduit for seed production and training.

3. Case Study Key Summaries

3.1. Farmer Seed Enterprises in Uganda – *Sonia David*

1. **Agriculture and Human Value 21: 387-397 (2004)**

In the study area of Eastern Uganda beans are grown from March–May and September–November, with the first season being dominant due to more certain rains. Study sites were selected based on high demand for bean seed whereas groups' selection was based on having at least ten members, limited other activities and previous business experience. One group, IBFA, had previously produced bean seed and received training whereas the other two were trained over five days on pest and disease identification and management, agronomy for seed production, post-harvest handling of seed, simple methods for testing germination and moisture content, marketing and promotion, book keeping, costing, and group dynamics (Table 1)[2].

Groups were encouraged to multiply local landraces; however, no group expressed any interest because of anticipated low demand. Groups were provided with three pieces of equipment: a threshing rack to reduce loss/mechanical damage to seed, a sorter to enable work to be done while seated, black polythene sheets for drying. No financial assistance was provided to any group, equipment and seed was provided on a 'cost share' basis. Producers decided which varieties to multiply (Table 2).

2 The author of this case study eventually published three training handbooks on bean production, business skills for small-scale seed producers and an accompanying trainer guide: http://www.icrisat.org/tropicallegumesII/

Table 1. Characteristics of Three Farmer Group Bean Seed Enterprises in Eastern Uganda

	IBFA	MWG	BKTWG
Original members	10 household	10 women	12 women
Years established before working with project	1	5	1
Activities prior to seed production	None	Sales of food crops	Sales of food crops, piggery
Previous contacts with external agricultural agencies	High	High	Low
Production means	Communal then individual	Communal	Communal
Fertilizer or soil improvement	No	No	No
Spray against insects and hire oxen for land preparation	No	Yes	Yes

Table 2. Two bean cultivars released in 1994 were multiplied: K132 and K131

	K132	K131
Characteristics	Large red mottled – close resemblance to widely grown K20	Small beige – small in size – previously unknown in Uganda
Yield	500–1500 kg/ha on station / reported + 25% than K20	1200–2500 kg/ha on station / reported + 40% than K20
Disease tolerance	Susceptible to pythium root rot and common bacterial blight	Resistant to bean common mosaic virus, susceptible to angular leaf spot

Production for all three groups was considered low at less than four metric tons over 23 seasons (Table 3). Group members were expected to rogue for off-types and take note of disease. Individual growers were expected to return all seed produced for storage and marketing and received 25% of earning. David (2002) cites fluctuation in production as being related to sickness and labor availability than anticipated market demand with the exception of IBFA in 1995B. David (2002) cites a multitude of factors accounting for low yields (low fertility, late planting, and high disease incidence) but does not rank or otherwise measure these constraints and their likely effect relative to the Uganda seed enterprises production.

Table 3. Seed produced (kg) by three farmer group bean seed enterprises in Eastern Uganda

		1994A	1994B	1995A	1995B	1996A	1996B	Total
K132	IBFA	90	50	117	123	105	195	680
	MWG	n/a	n/a	300	0	55	40	395
	BKTWG	n/a	n/a	240	83	40	95	458
K131	IBFA	550	120	536	470	170	35	1881
	MWG	n/a	n/a	10	60	13	0	83
	BKTWG	n/a	n/a	67	0	10	0	77

All groups reported selling most of their seed within 2–6 months after harvest at prices of 600–1200 Ush, where the high price for grain was 700 Ush and the reported retail price of certified bean seed was selling for 600–800 Ush (Table 4). This suggests that farmers who did not value seed would not pay for certification. David (2002) notes that the average unit of sale was 3 kg in Mbale District and significantly less in Ikanga District due to generally lower demand for bean in the latter. All groups reported K132 selling faster due to strong consumer trait preferences compared to K131 although they were priced similarly. Groups were presented with the idea of selling through stockists and rejected it due to expected low prices and a desire to control sales. BFA and BTWG reported slower sales than MWG and cited lack of promotional effort, competition with Ugandan Bean Program, which distributed the same varieties for free in some areas.

Table 4. Gross Revenues (USD) for Two Farmer Group Bean Seed Enterprises in Eastern Uganda – 1995*

	Season A		Season B	
	MWG	BTWG	MWG	BTWG
Gross revenue ($)	207	213	40	63
Total production (kg)	310	307	60	83
Revenue per kg	0.67	0.69	0.67	0.76

*Exchange rate of 1050 Uganda Shilling (Ush) per United States Dollar is used for both seasons

Revenue may appear small but four years after the project ended, IBFA and MWG were still producing seed whereas BKTWG stopped, although production levels were not available. A random sample of households in the two project districts was conducted four years after project closure and 67% of households (n=30) knew the MWG name whereas only 11% (n=45) knew the IBFA name. Also, 23% of the households surveyed had purchased from MWG compared to 4% of the households surveyed purchased from IBFA.

3.2 Comparative Study of Three Community Seed Supply Strategies for the promotion of improved sorghum and pearl millet varieties in Tanzania – *Rohrbach* et al. *ICRISAT:* 2002

In the case study area of central Tanzania (Dodoma and Singida), the same varieties of sorghum and pearl millet were produced and marketed using three different models: lead farmer model, farmer groups, and primary school gardens (Table 5). The three programs had different geographical coverage but most of the analysis and findings presented here are where program coverage overlapped in Dodoma and Singida regions of Central Tanzania.

The Ministry of Agriculture and Food Security (MAFS) lead farmers program began in 1998 as part of a five-year DANIDA project aimed to rehabilitate key seed capacities in Tanzania: the national seed unit, seed farms, Tanzania Official Seed Certification Institute (TOSCI), Sokoine University of Agriculture (SUA), and district agricultural staff. One component of this program was the On-Farm Seed Production Program to support community seed production. The ICRISAT supported primary school gardens initiative was started in 1999 to promote the adoption of new sorghum and millet varieties developed by the regional Sorghum and Millet Improvement Program (SMIP). The Christian Council of Tanzania supported farmer group program was formally known as Sustainable Seed Multiplication Program and was initiated in the 1990s in response to drought and is church supported. The aim of this program is to increase seed availability and food security for rural poor in semi-arid areas.

Sorghum and millet are important traditional hardy cereal crops, notably in areas not suitable for maize. These areas are typically high in surface temperatures and low/erratic rainfall. Sorghum and millet account for about 25% of all cereals in Tanzania and central Tanzania, Dodoma and Singida,

account for roughly 1/4 of the total area allocated to sorghum in Tanzania. Average farmer yields are under 1 t/ha for sorghum and about 0.8 t/ha for pearl millet compared to nearly 1.4 t/ha for maize (Monyo *et al.* 2004).

Village selection for the lead farmer approach was identified by agricultural officials in each region to start after a baseline survey. Each village selected two farmers with the idea that at least one would be a lead farmer. For the farmer group approach, this was part of a large program started in the early 1990s focused on drought areas in five regions. Targeted districts were identified on the basis of drought. All interested farmers had to join or be a member of a farmer group linked with the Diocese of Central Tanzania. For the school program, five districts were identified and the two pilot districts chosen to start based on being most dependent on sorghum and millet. Schools were identified based on climate, having good land, access to population, and the willingness of an agricultural teacher to be the link at the school.

Table 5: Characteristics of Three Community Seed Supply Strategies in Central Tanzania

	Lead Farmer	Farmer Groups	Primary School Garden
Target direct participants	125	660	54
Target coverage	50 villages (3 regions)	40 villages (5 regions)	50 schools (2 regions)
Role of state extension	High	Low	More support in Singida
Lead funding source	DANIDA	Church	ICRISAT and USAID
Lead management	TZ Government	Church	Education Authorities

Training was big focus in all programs – accent of training was on seed production and on certification procedures. As discussed below, a big emphasis and challenge in all projects was working within and around what would seem to be arbitrary and unenforceable project guidelines regarding categories of seed and its purchase price.

From independence through the 1970s, only three varieties of sorghum/millet were released: Lulu and Serena in 1970s and for pearl millet, Serere 17 in the late 1960s. From the 1980s, with the advent of the Sorghum and Millet Improvement Program (SMIP), which was established by southern African governments in the early 1980s and backstopped by ICRISAT. Several varieties were released and promoted (Table 6) via SMIP: for sorghum: Tegemeo (1986), Pato (1995), Macia (1999) and for millet: Okoa (1994) and Shibe (1994).

Table 6: Sorghum and Pearl Millet Varieties Promoted

	Pato (SDS 2293-6)	Macia (SDS3220)	Okoa
Characteristics	Earliness, yield, cream/ mottled grain	Earliness, yield, white grain, much shorter – easy to scare off birds	Earliness, head length, yield
Yield over local variety	126%	139%	48%
Day to flowering	68 (85 for local variety)	64 (85 for local variety)	62 (68 for local variety)
Plant height (cm)	173	131	n/a
Year of release	1995	1999	1994

On-station trials were conducted over two years and nine sites for sorghum and four years and 14 sites for pearl millet

Source: Adoption of Improved Sorghum and Pearl Millet Technologies in Tanzania Monyo *et al.* ICRISAT, 2004.

Table 7: Estimated Seed Production of Three Community Seed Supply Strategies in Central Tanzania

	Lead Farmer	Primary School Garden	Farmer Groups
Dodoma Sorghum (99/00)	17 acres/5,947 kg*	Pato:31 acres/8,050 kg	Pato: 110 tons
Dodoma Pearl Millet (99/00)	8 acres/1,156 kg*	Okoa:29.5 acres/3,600 kg	
Singida Pato (99/00)	No production	69.75 acres/14,800 kg	
Singida Okoa (99/00)	No production	64.75 acres/14,200 kg	

*Production passing TOSCI inspection.

Sources: Seed Unit, Ministry of Agriculture and Food Security / ICRISAT /Christian Council of Tanzania

Seed production data from the three programs was limited to the year 1999/2000 (Table 7).

All programs were expected to source Foundation seed from the government run and DANIDA supported seed farm at a government set price of 5,000 TZ shillings per kg, which was ten times the highest price in rural market and fifty times the price of grain. The government set price for certified seed was 1,000 TZ shilling. The church farmer group and school programs complained about acquiring Foundation seed at 5,000 TZ shilling per kg while many of the lead farmers in the TZ government managed program were not sure what they paid for acquired seed.

A field survey of participants across the three programs was conducted in March 2001, after planting. Lead farmers (15) were identified only where they had harvested a crop and from 8 different villages, participating schools (23) were identified randomly from a sub-set of 50 in both Dodoma and Singida, and farmer group participants (33), with more than one year of program experience, were identified by farmer group leaders from three villages from a random sub-set of all participating villages. Dodoma was where all three programs had operated for at least two full years and was the focus. Singida was added because the school program was considered successful here. The focus of the survey was marketing, quality control, and implementation partnerships.

Prices were to be set after consultation with community leaders and farmers, reported unit seed prices ranged by 600%. School sales were reportedly strong (Table 8) because ¾ of seed produced was in Singida, which was a 'new market' and parents were cajoled to buy seed. Less than ¼ of farmer group members surveyed reported selling at local markets yet still sold 40% of seed produced. This was due to a church seed procurement contract with the FAO. Lead farmers were not allowed to sell outside of their village as the design of the program was for lead farmers to produce seed for their community.

Table 8: Reported Production and Sales: Program Participant Survey

	Lead Farmers (N=15)	School (N=23)	Farmer Group (N=33)
% visited by extension or to discuss production problems field (00/01)	69.2	46.7	9.1
HH mean harvest (00)	872 kg	742 kg	489 kg
% of harvest sold per HH	12%	70%	39%
% selling on local market	67%	76%	24%
% selling no seed	33%	24%	15%
Ratio of Dodoma grain price to mean HH selling price of seed	26%	43%	20%
% of 2001 harvest expected to be sold to external organizations	41%	n/a	84%

National seed regulations barred the sale of unpacked seed outside of the community. All programs had a focus on increasing access and availability of new varieties but there was limited emphasis of demand raising or of farm level support on seed selection, handling, treatment and storage (Table 9). Reported unit sale prices by all programs were more than two times the price of grain for unpackaged and untreated seed.

Table 9. Reported Seed Treatment of Sorghum Prior to Sale to Local Farmers: Program Participant Survey

	Lead Farmers (N=15)	School (N=23)	Farmer Group (N=33)
Insecticide	13%	61%	23%
Fungicide	0%	22%	0%
Packaging	14%	48%	18%

Across all three programs there were many reported changes in crop management practices for seed production (Table 10). It would be interesting to see, a decade on, if any of these practices have remained with farmers. Also, it is unlikely that the production investments cited below make sense for rural farmers. Despite regular extension support and TOSCI inspections, approximately 50% of the lead farmers surveyed (n=15) did not know the required field isolation distances and another 40% suggested it was 100 m or less. Among the school garden teachers and farmer group members surveyed, there was confusion on isolation distances.

Table 10: Reported Changes Cited in Seed Production Practices: Program Participant Survey

	Lead Farmers (N=15)	School (N=23)	Farmer Group (N=33)
Isolation of Field / Better Soil	87%	85%	85%
Space / Line Planting	100%	62%	75%
Use of any fertilizer	87%	71%	36%
Harvesting when completely dry	67%	29%	61%
Drying on elevated structure	85%	40%	69%

Farmers were advised to isolate 300 m for pearl millet and 200 m for sorghum. In 2001, TOSCA (national seed regulatory agency) announced a new quality declared seed standard for pearl millet and sorghum with an isolation distance of 100 m.

The farmer group initiative supported by the Diocese of Central Tanzania was seen as being independent, and received limited extension support from state actors. The lead farmer program was a focal point of extension support. Among the school programs, there was reported uncertainty on the role of state extension.

Despite the challenges, overall these programs appear to have been very successful in mobilizing the movement of SMIP varieties into areas of Tanzania that would benefit. An ICRISAT adoption study in 2001 estimated that in the mid 1990s approximately 5% of total sorghum and millet was allocated to improved varieties (Table 11). While the 2001 study was limited to 267 HH, of which 32 were in Singida and 40 in Dodoma, the results are encouraging.

The adoption study indicated that more than 2/3 of farmers surveyed in Dodoma and more than 1/3 in Singida were planting improved sorghum variety Pato while improved sorghum variety Macia was being planted by 1/8 of surveyed farmers in Dodoma but none in Singida. The study also indicated that pearl millet variety Okoa was being grown by more than 1/4 of surveyed farmers in both Dodoma and Singida (Table 12).

Table 11: Farmer Awareness and Use of New Sorghum Varieties (2001)

	Dodoma (N=40)	Singida (N=32)
Farmers aware of new sorghum varieties (%)	80%	60%
Farmers have grown improved sorghum varieties (%)	60%	38%

Source: Adoption of Improved Sorghum and Pearl Millet Technologies in Tanzania, ICRISAT (Monyo 2004)

Table 12. Knowledge Source of New Pearl Millet Variety Okoa (2001)

	Dodoma (N=40)	Singida (N=32)
Extension	58%	48%
Other farmer	39%	43%
Research or other	3%	9%

Source: Adoption of Improved Sorghum and Pearl Millet Technologies in Tanzania, ICRISAT (Monyo 2004)

The adoption study also estimated as of 2001, 42% of millet planting area in Dodoma was under new pearl millet varieties as compared to 13% in Singida.

3.3. Community Based Seed Supply in Sudan. *A. Khidir Osman, Agricultural Research Corporation / El Obeid Research Station. Leisa Magazine 23: (2007)*

The project was implemented by CARE International Sudan through community-based organizations called Village Agriculture Committees and with strong collaboration with the Ministry of Agriculture's seed management administration and the El Obeid agricultural research station. Activities were carried out in North Kordofan state, which is located in the central-western part of Sudan, at the northern edge of the savannah belt. The state has a total population of approximately 2.9 million and the two localities targeted by the program, Sheikan (540.918) and EL-Nehoud (256,482), account for more than ¼ of the state's population (UNDP 2010).

The area is traditionally agro-pastoral and is characterized by complex linkages between environment, poverty and conflict over natural resources that are becoming increasingly scarce (Table 13). In addition to raising animals and growing crops, a third source of livelihood is derived from the natural forests in the form of fuel wood production, building material, gum arabic and fruit harvesting from various trees. The state is famous for gum arabic (*Acacia senegal*) production and Sudan accounts for 70% of world production. The states export crops including groundnut, sesame, hibiscus, and watermelon seed. Sorghum and millet are the main food crops.

Seed insecurity is reportedly driven by recurrent drought and it is widely reported that the rainy season is becoming shorter which has impacted yields of millet, sorghum and cowpea. Farmers in the program were reported to have become dependent on relief programs for both food and seed. The

Table 13. Livelihood Profile for North Kordofan State- Sheikan and El-Nehoud

	Geo-location	Production system	Threats / hazards
Gum Arabic Agro-pastoral	Mid to South-Western North Kordofan State	Cash crops (groundnut and watermelon), livestock, gum Arabic production	Land conflict / access to water
Gurdood Agro-pastoral	Southern North Kordofan State	Clay and sandy soils / sorghum production and livestock	Land conflict / drought

Source: UNDP 2010: North Kordofan State Livelihood Profiles

author notes that surveys conducted in the area identified seed as the most important constraint, and seed as the input most needed to raise productivity. It is not known what quality of seed security assessment was conducted prior to this intervention.

The El Obeid agricultural research station provided CARE Sudan with all seed varieties in this project, developed an extension program and training manual, backstopped the training of village agricultural communities involved in seed production, and conducted on-station and on-farm trials. Varieties used in the project were reportedly selected and identified based on early maturity/drought tolerance. It was noted that these varieties were not used prior to this project because of '*non-availability, poor accessibility and lack of extension advice*.'

The project reported to serve 65,000 rural families in El-Nehoud and Sheikan over the course of three years with 136 tons of sorghum, 138 tons of millet, 447 tons of groundnut, 27 tons of sesame, and 9 tons of cowpea. Table 14 suggests that the recommended package per family was not achieved.

Table 14. Project Seed Provision for Two Localities in Northern Kordofan

	Sorghum	Millet	Groundnut	Sesame	Cowpea
Total seed distributed (kg)	136,000	138,000	447,000	27,000	9,000
Recommended amount per HH (kg)	2.5	1.5	15	1	2
Potential HH served	54,400	92,000	29,800	27,000	4,500

Seed was distributed through the Ministry of Agriculture, agricultural research stations, and community organizations. The project reported remarkable yield increases that do not seem feasible unless the baseline comparison was a drought year (Table 15).

Table 15. Project Estimated Yield Increases from Using Quality Seed of Improved Varieties

	Yield (kg / ha)		Yield Increase	
	El-Nehoud	Sheikan	El-Nehoud	Sheikan
Groundnut	588	779	30%	24%
Millet	393	264	66%	67%
Sorghum	321	452	27%	10%
Sesame	276	260	19%	57%
Cowpea	460	229	67%	52%

*One feddan =.42 hectare

The project also conducted trainings, with participation of researchers and specialists from local seed inspection services, to raise farmer knowledge on seeds and seed production. Topics covered included seed quality (varietal purity, germination, testing), agronomy, seed storage, and certification. The project reports that farmers have become more aware of the importance of high quality seeds, new varieties, and seed multiplication techniques.

Some of the trained farmers became seed producers. Their farms were inspected by the Seed Management Administration of the Ministry of Agriculture to guarantee production of quality seeds, and inspection fees were paid by the farmers. Other field inspection duties were shared between project staff and research staff. Some farmers who produced quality seeds of the improved varieties were able to sell their inspected seeds to the project, to individual farmers, and to formal seed sector companies.

To ensure the continued dissemination and supply of the improved varieties the project adopted a seed repayment system to promote seed exchange. The idea was that this would reduce dependence on external sources and promote self-reliance. However, total seed repayment rates were low, ranging from 29% for millet to 78% for groundnut. Reasons cited for low repayment were limited storage facilities, monitoring and follow up, and a general lack of awareness of how the repayment system functioned. In addition, several relief programs in the project areas distributed seed for free so the concept of repayment was not easy to understand.

Project Success Story

Khirat Salim Khirat, a 27-year-old farmer from Um Diresa Village, 35 km west of El Obeid town, is the head of the Village Agricultural Committee and has been involved in seed production for the last three years. He is one of 15 farmers in the '*seed multiplication business*'. Khirat believes this has opened a path to agricultural development in the area.

A participant in four of the project trainings on different aspects of seed production, he continues to follow the seed multiplication regulations and standards he learned such as recommended isolation distances and agronomic practices. His fields were inspected and he even received a certificate. He has sold seed to farmers in his community, projects, and even a local seed company (Table 16). Prices offered were reportedly 15% more than the regular grain prices. A manager of a seed company in El Obeid reported to purchase US$ 85,000 (17 million Sudanese dinar) worth of seed from producers during 2006.

Table 16. Khirat Salim Khirat's 2005/2006 Production

Crop	Local variety	Yield (kg)	Area (ha)
Sorghum	Yarwasha	4.14	497
Sorghum	Arf Gadmak	22.07	559
Groundnut	Sodiri	4.14	745
Groundnut	Guebish	2.76	931
Cowpea	Ainalgazi	1.38	414

The project established Village Agricultural Committees. These community-based organizations were responsible for record keeping, storage and redistribution of repaid seeds. The project reports that this system was very effective in improving the dissemination, accessibility and availability of quality seeds of the adopted improved varieties. A key challenge to this project was the low seed repayment rates.

This community-based seed supply project has brought many benefits. Farmers in El-Nehoud and Sheikan now have access to new varieties and can acquire them locally instead of buying externally where they may have little recourse if there are issues related to germination or not being true to type. In addition, the project strengthened links between a number of critical actors in the seed supply chain in North Kordofan: El Obeid Research Station, Village Agricultural Committees, seed inspection services and extension staff under the Ministry of Agriculture, local seed companies, and most critically local seed producers and farmers.

For small-scale farmers, the development and maintenance of a sustainable community-based seed supply system is essential to improve their food security, especially in conditions where their seed stocks have been severely affected. Hopes are high with the new IFAD project (Box 1).

Box 1. IFAD Seed Development Project in Sudan

In February 2012, the International Fund for Agricultural Development announced that they will provide a $10.07 million grant to the country's Seed Development Project. The project aims to help improve farmers' food security, income and resilience to environmental shocks, such as droughts. It will help farmers increase crop productivity through the use of certified seeds, and improve soil and water conservation techniques.

The project, co-financed by the Sudanese government, will be implemented in Rahad and Sheikan in North Kordofan, and Abbassiya and Abu Gubeiha in South Kordofan. More than 108,000 smallholder farmers — including young people and women — and 1,280 seed growers are expected to benefit from the initiative.

3.4. Cooperative Community Based Seed Enterprise in Haraghe, Ethiopia – *Osman Ibrahim* Case Study from Farmer, Seeds, Varieties: Supporting Informal Seed Supply in Ethiopia – *Thijssen, Bishaw, Beshir, de Boef. Wageningen (2008)*

In the drought-prone areas of Ethiopia, seed insecurity contributes a great deal to the inefficiency of the agricultural sector. This case study discusses an FAO and Government of Ethiopia implemented project entitled '*Strengthening seed supply systems at the local level in Hararghe zones in Eastern Ethiopia*', which established Cooperative Community-based Seed Enterprises (CCBSE) to support informal seed supply. With funding from the Norwegian government, this five-year project had two aims: (1) crop production improvement through on-farm seed multiplication, production, storage and marketing of seeds of improved and local farmers' cultivars of selected food crops: (2) promotion of crop diversification through demonstration plots and the production of seeds of cash crops to increase the farmers' income.

3.4.1 Seed security in Hararghe Zone in Eastern Ethiopia

The seed insecurity in the drought-prone areas of Ethiopia in general and Hararghe zone in particular, is created and aggravated by economic as well as environmental factors. The major constraints are lack of improved and adapted varieties, low levels of service provision and support from research, input suppliers, and extension. Many traditional semi-arid production areas are remote, causing serious marketing barriers for service providers and low access to markets for farm produce. Recurrent droughts and the need for repeated replanting in the same season have made traditional seed-saving practices an unreliable source for planting in subsequent seasons. Successive years of severe drought/erratic rainfall have necessitated repeated re-planting and farmer seed-saving practices have become unreliable.

Neither emergency seed supply interventions nor past seed multiplication projects have had a sustainable impact on seed insecurity and the informal seed sector has not been able to maintain a secure supply of appropriate seeds. A more sustainable seed security system will strengthen the production and income generation capacity of farmers. While the introduction of drought-tolerant and/or short-maturing local and improved varieties combined with crop diversification and informal on-farm seed multiplication schemes have been popular and appreciated in Haraghe, there is a need for varietal improvement (pure-line and mass selection) and on-farm seed multiplication of local varieties.

3.4.2. A twelve step strategy for the establishment of community-based seed enterprises

A systematic approach is critical in the assessment, planning and development of CCBSEs.

1. Establish CCBSE criteria with local authorities. In general, criteria include accessibility, resources, availability of land, and capacity for irrigation, functional community organization, a seed market, and the capacity of local authorities to assume leadership.

2. Train extension staff to conduct a survey to identify locations for CCBSEs.
3. Informal discussions with selected communities on establishing CCBSEs.
4. Conduct baseline survey, with local development agents, to select appropriate sites with a pre-existing and functional community organization.
5. Train and orient local authorities and community groups on group formation, the project strategies for on-farm seed multiplication, and marketing.
6. Establish CCBSE as a legal entity with a signed agreement with local government.
7. Identification and supply critical seed and equipment on credit basis with easy repayment terms.
8. Establish community seed stores.
9. Begin seed production and establish a revolving fund.
10. Capacity building: training, extension, field demos, professional workshops, study tours, etc.
11. Link CCBSE unit with key stakeholders: research and formal and informal seed suppliers.
12. Linking the CCBSEs with markets.

3.4.3. The model of community-based seed enterprises

The model for the CCBSE is simply the establishment of a cooperative at community level. Access to appropriate technologies and facilities will enable the cooperative to plan and handle seed production operations from planting to cleaning, marketing and distribution.

The CCBSE model has three major components.

1. Community organization and the operational and administrative establishment of the enterprise.
2. Development and dissemination of appropriate varieties and technologies.
3. Crop biodiversity maintenance and on-farm conservation.

3.4.4. Support in the establishment of the enterprise

The organization and establishment of a CCBSE unit includes setting-up a cooperative organization, establishing seed cleaning facilities, strengthening seed storage capacity. In addition, contractual arrangements between the CCBSE and individual farmers in the community need to be fostered. The CCBSE unit is community-based, owned and managed; it plays a major role in leading and running all the CCBSE activities. Planning and execution is in the hands of the community organization, with initial managerial and technical, support, guidance and supervision provided by the local government (woreda) extension agents and technical experts.

Simple, practical and affordable local technologies, inputs and procedures are used within the CCBSE operations for seed production, quality control, and postharvest cleaning, packaging and storage. The farmers concerned play the major role of establishing the enterprise's seed facilities and assets: they contribute all required agricultural land, labor, and construction materials.

Each CCBSE starts with the establishment of a more than five-hectares cooperative-owned seed farm. The project provides technical support, supervision, and guidance. In addition, the project furnishes the CCBSE with initial seeds, other agriculture inputs, necessary equipment for seed cleaning, and the construction and management of simple seed stores.

The project sees contractual seed production as the most important activity. CCBSEs advertise a contract for seed multiplication by interested seed growers in the community. The agreement or contract places particular emphasis on the major cereal food crops (maize, sorghum and wheat) and selected cash crops (potato, onion and haricot beans). Standard practices for seed crop establishment and quality control are performed under the direct supervision and technical

guidance provided by project field staff and the local government (woreda) development agents and technical experts.

In the course of project implementation (2002–2007), four CCBSE units were established, and four were under establishment as of 2007. Profile information on the project CCBSE units established in East Hararghe, and those under establishment in West Hararghe and East Shoa are summarized below: location, human resources, crops, facilities, and major constraints.

3.4.5. Seed production

The CCBSEs' seed production (Tables 17–19) data include the amounts of seed delivered, areas planted and estimates of total seed production over the period 2003 to 2007. Initially the activities of the CCBSEs were limited to the multiplication and demonstration plots of selected crop varieties at the CCBSE seed farms. This was for the following reasons:

a. severe scarcity and shortage of initial seeds (pre-basic and basic seeds);

b. emphasis on seed quality and demonstration of the standard practices for quality seed production;

c. need to familiarize members with the concept, arrangements and agreements of the CCBSE contractual seed multiplication scheme.

Actual yields were difficult to obtain due to several factors:

a. tendency of the seed growers not to abide by the terms of the contractual agreement, e.g., demanding higher prices than initially agreed upon, and giving priority to the distribution of the produced seed to relatives, friends and neighbors in the community;

b. need to reject a number of contractual seed fields because of poor seed quality;

c. insistence of the CCBSEs on involving all their members as contractual growers, often resulting in poor follow-up on the seed production, quality control and final collection;

Table 17. Estimated Seed Production (in quintals) of cooperative community-based seed enterprises in East Haraghe (2003-2007) West Haraghe and East Shoa (2006/2007) Zones

	Maize	Wheat	Sorghum	Teff	Pulses	Potato
Eastern Haraghe						
J. Gemechu	107.4	239.8	309.6	-	128.2	123.4
H. Gudina	37.5	131.5	501.0	-	161.0	237.0
J. Belina	1200.0	152.0	-	-	97.5	2.5
B. Jalala	-	105.0	-	-	-	245.0
Wonagle	960.0	-	5,190.0	-	197.0	-
Western Haraghe						
Hargeti	Na	-	Na	-	-	-
Bilibo	Na	-	-	-	-	-
Others*	1262.5	627.5	246.0	251.0	28.0	-
Eastern Shoa						
Biftu	-	2,188.3	-	-	410.0	-
B. Hawai	-	1,662.5	-	-	346.0	-
GRAND TOTAL	3,567.4	5,106.6	6,246.6	251.0	1,367.7	607.9

*Contracted seed growers at Koni, Dar, Labu, Tubu, and other locations.
Pulses= chickpea, haricot bean, lentil
Note: Seeds were provided in Hargeti and Biibo but not data yet available.

Table 18. Profiles of cooperative community-base seed enterprises in East Haraghe (2003-2007) West Haraghe and East Shoa (2006/2007) Zones

	J. Gemechu	H. Gudina	J. Belina	B. Jallalla	Wonagle
Basic General Data					
Foundation	Nov. 2003	Feb. 2003	June 2004	June 2004	March 2005
PA	Emerosudu	Ifa-Jallala	J. Belina	Fughan Bira	Wonagle
Woreda	Kersssa	Kersssa	Kurfachelle	Gursum	Gursum
Proximity to woreda main town	3 km	18 km	2 km	18 km	15 km
Accessability to zonal main town	41 km	58 km	57 km	93 km	80 km
Road condition	Good	Good	Good	Fair	Fair
Population PA	-	3,423	6,895	2,985	-
Population woreda	142,505	142,505	45,417	149,889	-
Human Resources					
WARDO experts	14	14	13	11	11
WRDO Das	16	16	19	13	13
CCBSE members	41	211	300	68	68
Members>4th grade	1	4	2	2	2
Crops and Facilities					
Major crops	Maize, potatoes	Maize, potatoes	Wheat, potatoes	Wheat, potatoes	Sorghum, maize
Communal seed farms	>5ha	>8ha	3.5ha	3.0ha	>10ha
Irrigation	Pump	Pump	Pump	Gravity	Pump
Seedling nursery	Yes	Yes	Yes	-	-
Processing equipment	-	Seed cleaner	Seed cleaner	-	Seed cleaner
Packaging and labeling	Weigh scale	Weigh scale	Weigh scale	Weigh scale	Weight scale
Seed storage	-	Seed store	Seed store	Seed store	Seed store
Village seed shop	-	Yes	-	Yes	-
Power source	-	Generator	Generator	-	Generator
Constraints (0=absent / 1 = low / 5 = high)					
Enforcement of agreements	4	5	5	0	0
Membership size	5	0	0	0	0
CCBSE leadership	2	5	5	4	2
Cooperative organization	2	3	3	0	5
Dependency syndrome	3	5	5	3	3
Contractual seed production	3	3	3	4	3
Communal land	0	0	0	5	3
WARDO technical support	4	4	4	3	4
Market orientation	0	1	2	3	0

d. CCBSE units' initial lack of financial capital to purchase all the seeds produced on a contractual basis;

e. priority to the collection of seed of improved crop varieties, primarily of cash crops such as potatoes and legumes, which have superior market value and generate better income;

f. poor follow-up by local government (woreda) staff coupled with the CCBSE members' initially limited experience of contractual seed production planning and management. However, during the last two years of the project the situation has improved, with the CCBSEs becoming more organized and accustomed to the seed production management, particularly in the new expansion areas in East Shoa zone.

Table 19. Profiles of cooperative community-base seed enterprises in East Haraghe (2003-2007) West Haraghe and East Shoa (2006/2007) Zones

	Hargeti	Bibilo	Biftu	B. Hawai
Basic general data				
Foundation	2006/07	2006/07	2006/07	2006/07
PA	-	-	-	-
Woreda	Mieu	Mieu	Lummee	Gimbichu
Proximity to woreda main town	25 km	13 km	5 km	2 km
Accessibility to zonal main town	50 km	38 km	60 km	90 km
Road condition	Seasonal	Seasonal	Good	Good
Population PA	-	-	-	-
Population woreda	-	-	-	-
Human resources				
WARDO experts	13	13	11	12
WRDO Das	23	23	26	31
CCBSE members	45	55	150	210
Members>4th grade	2	1	>10	>10
Crops and Facilities				
Major crops	Sorghum, maize, legumes	Sorghum, maize, legumes	Lentil, wheat, chickpea	Lentil, wheat, chickpea
Communal seed farms	>15ha	>15ha	5ha	2.5ha
Irrigation	Gravity	Gravity	-	-
Seedling nursery	-	-	-	-
Processing equipment	-	-	-	-
Packaging and labeling	-	-	-	-
Seed storage	-	-	-	-
Village seed shop	-	-	-	-
Power Source	-	-	-	-
Constraints (0=absent / 1 = low / 5 = high)				
Enforcement of agreements	3	3	0	0
Membership size	0	0	0	0
CCBSE leadership	2	2	0	0
Cooperative organization	3	3	1	1
Dependency syndrome	3	3	0	0
Contractual seed production	1	1	1	1
Communal land	0	0	3	3
WARDO technical support	4	4	3	3
Market orientation	2	2	0	0

3.4.6. Seed multiplication and varietal demonstration plots

Seed multiplication and demonstration plots were established, in cooperation with national technology generation and transfer institutes to enable participating CCBSEs to have access to improved varieties and other seed production technologies. The plots were useful for the selection of improved varieties and indigenous germplasm accessions of food and cash crops.

The trials were setup for testing maize, wheat, haricot bean, potato, chickpea and onions varieties and accessions. To demonstrate and promote crop diversification of export cash crops, seedling nurseries for vegetable and other horticultural and forest crops were established at each CCBSE seed

farm to provide planting material (seedlings) for orchards and gardens. Seeds of potential export vegetables, including carrot, onion, Swiss chard, eggplant, cabbage, tomato, cauliflower, beetroot, leek and lettuce were distributed for plantation and demonstration purposes. The numbers of seed varieties established in CCBSE multiplication and demonstration for the project's three zones are presented in the table below.

3.4.7. Crop biodiversity maintenance and on-farm conservation

On-farm conservation and maintenance of indigenous crops and local varieties is essential for stabilizing and improving crop productivity. It is a mechanism for coping with the risk of drought-induced crop failure and eventual seed insecurity. The project model emphasized on-farm conservation of crop biodiversity through on-farm multiplication of local varieties. In collaboration with the Institute of Biodiversity Conservation (IBC), the project collected, cleaned, and multiplied local varieties. These were then disseminated to farmers and this process was documented.

One-hundred and sixty one germplasm accessions were reintroduced that were originally grown in Kersa and other neighboring local government areas. These re-introductions included sorghum (48), maize (8), wheat (44), barley (10), fenugreek (22), haricot beans (9), field pea (8) beans (2), sesame (6) and sunflower (4). These accessions were included in a demonstration plot for farmer observation at *in east and West* Haraghe and East Shoa Zones between 2003 and 2007 (Table 20). The reintroduced local varieties were also used for participatory varietal selection, multiplication and utilization.

3.4.8. Lessons learnt and options for application of the model in other regions

A model for establishing CCBSEs was tested and refined on the basis of this project: community based, owned and managed schemes for seed multiplication that promote crop diversification, on-farm conservation of biodiversity, and use local resources as well as simple and affordable technologies. In a short time frame, CCBSEs have improved seed security for rural communities. They have contributed to increasing crop productivity, diversification, and seed system development.

The project model was highly appreciated among rural communities and good progress has been made in strengthening institutional linkages at the community level. This project proved that it is possible to establish CCBSEs with the full participation and ownership of the community. CCBSE success depends on communities with a strong history of working together in community activities. One community came to the project to request assistance and ended up being one of the most successful CCBSEs because of strong community leadership and cohesion.

Extension staff had a difficult time to collect and document precise data on seed production and marketing. Nearly all of the seed produced was marketed directly in the community served by the CCBSE.

An analysis of major differences between woredas and agro-ecological zones – in terms of the establishment of CCBSEs – indicated that the poorer and more drought-prone zones were less likely to establish viable CCBSEs. This was attributed to several factors, including the erratic nature of the rainfall, poor access to markets, and the lack of cash crops.

For CCBEs to be successful they need to collaborate with and develop strong working relationships with critical agricultural stakeholders at the local level (Bureau of Agricultural and Rural Development, Agricultural Cooperative Commission) as well as among formal seed system actors (Ethiopian Institute for Agricultural Research, Ethiopian Seed enterprise, and universities), and farmers in the informal seed system.

CCBSEs, and projects supporting their development, should maintain vital linkages and be integrated within the formal and informal seed system. Institutional sustainability at all levels is of vital importance for impact and scaling.

Table 20. Number of varietal seed multiplication/demonstration plots established by cooperative community-based seed enterprise in east and West Haraghe and East Shoa Zones (2003–2007)

	2003	2004	2005	2006	2007	Total	Source
Cereals							
Wheat	7	14	-	3	7	31	
Wheat*	44	-	-	-	-	44	
Durum wheat		-	-	-	2		
Maize	13	17	-	3	-	33	
Maize*	8	-	-	-	-	8	
Sorghum	11	14	-	9	-	34	
Sorghum*	48	-	-	-	-	48	
Teff	-	-	-	5	4	9	
Barley	-	-	-	2	-	2	
Barley*	10	-	-	-	-	10	
Legumes							
Haricot	6	19	-	12	-	37	
Haricot*	9	-	-	-	-	9	
Lentil	-	-	-	4	-	4	
Chickpea	3	1	-	4	-	8	
Faba bean	-	-	-	3	4	7	
Faba bean*	2	-	-	-	-	2	
Field pea	-	-	-	2	4	6	
Field pea*	8	-	-	-	-	8	
Fenugreek*	22	-	-	-	-	22	
Vegetables							
Potatoes	4	14	-	-	6	24	
Onion	1	4	-	-	-	8	
Oil crops							
Sesame	4	15	-	-	-	19	
Sesame*	6	-	-	-	-	6	
Groundnut	6	15	-	-	4	25	
Groundnut*	1	-	-	-	-	1	
Sunflower	4	-	-	-	-	4	
Grand total	217	119	-	47	31	414	

For building institutional sustainability, the following factors must be considered:

1. It is essential that there is substantial ownership, leadership and follow-up from the agriculture and rural development bureaus and offices at regional, zonal and woreda levels.
2. Integrating CCBSEs into relevant government (and other key stakeholder) structures will improve their effectiveness, sustainability, and expansion to new seed insecure areas.
3. CCBSE agreements should aim to foster and govern community participation and commitment.
4. There should be clarity on the concept of CCBSEs; they are private community-based, community-owned and community-managed businesses.

5. CCBSEs need to have strong linkages with the formal and informal seed systems: research, extension cooperatives, as well as credit and marketing systems.
6. Farmer capacity must be strengthened to organize, manage, and lead seed-related agro-business activities, with particular emphasis on the entrepreneurial skills of CCBSE members.
7. The prevalent dependency syndrome must change so that communities evolve from a relief mindset to a development/business orientation.
8. Simple and affordable local rural technology and inputs should be used as much as possible.
9. CCBSE expansion to new areas can be supported by ensuring that the government has a central role in project ownership, leadership, planning and management.

The experience of this five-year project should motivate other organizations supporting the development of small-scale and community-based seed enterprises.

Seed quality standards and certification should be part of the project, but this component needs more attention so that farmers will have confidence in certified seed. It is expected that acceptance of seed quality standards will eventually develop along with knowledge about seed, experience of seed production, and the competition between the CCBSE units and other seed suppliers.

The FAO 'Quality Declared Seed Standards' offer a reasonable option for dealing with seed quality in the context of informal seed multiplication. These standards should be formally recognized in national seed policy to promote informal seed multiplication.

These lessons learnt suggest that, to develop institutionally sustainable CCBSE units, it will be necessary to adopt a business model, and to transfer business skills to the units and help them to develop the marketing structures required for success.

For the CCBSEs to become economically viable organizations, they need to develop into profitable and effective business entities able to offer the required services to the target rural communities.

3.5. Smallholder Farmers' Participation in Legume Seed Supply in Kenya – *Mburu et al.* ICRISAT: Project analysis of the USDA funded Lucrative Legumes Project (2007)

The objective of the Lucrative Legumes Project (LLP) was to address constraints along the value chain from production to market while promoting the development of a seed supply to deliver high quality legumes to farmers. Funded by the United States Department of Agriculture (USDA), the project ran from 2005 to 2007, and was implemented by TechnoServe (TNS) in partnership with Catholic Relief Services (CRS) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Individual partners collaborated with a range of private and public institutions. The project was implemented in five districts in Western Kenya within the Lake Victoria basin (Siaya, Busia, Teso, Homa Bay, Suba, and Bomet) and four districts in Eastern Kenya (Machakos, Makueni, Kitui, and Mbeere). More than 17,800 farmers (65% of them women), formed into 679 farmer groups, were directly involved in this project. In the project's target areas, poverty is high (40–70%) with more than 50% of the households living below the poverty line. Soils are infertile and most farms are low in soil organic matter, nitrogen and phosphorous. Legumes are mainly intercropped with cereals (maize or sorghum) with no external fertilizer inputs on small-sized farms (<2 ha).

Groundnut and pigeonpea are important crops in western and eastern Kenya respectively whereas chickpea is grown in Bomet and parts of Mbeere. Eastern Kenya produces 99% of the country's pigeonpea (190,000 t), while Western Kenya (Nyanza and Western provinces) produces 59% of the national groundnut crop. Chickpea fits easily in the maize-based production systems of Mbeere and Bomet as a rotation crop that grows on residual soil moisture. Kenya is a net importer of chickpea; hence its promotion benefits both local and export markets. Legumes in Kenya are traditionally grown as a subsistence crop with seed supply dominated by the informal seed system. They are characterized by low yields and subsequently low volumes of marketable surpluses are produced,

making commercialization difficult. The key production constraints to legumes are the use of disease-susceptible (low quality) seed and poor crop management practices. Capacity building and improved linkages among producers, traders, and processors, combined with an increased availability and use of high-yielding disease-tolerant varieties (with traits acceptable to both farmer and the market) are necessary to increase yields and raise productivity.

Reliable production of high-quality legumes requires a stable supply of quality seed. The overwhelming majority of most smallholder farmers in the project area source legume seed from their own stock, social networks, or from local markets. Often, but not always, this local seed is of excellent physiological quality in terms of germination potential. However, to access high value legume markets farmers typically must source a specific variety possessing traits sought after in the market. One of the aims of this project was to increase farmer knowledge and access to new legume varieties. At project inception, there was low availability of improved legume varieties in target areas despite these regions having a comparative advantage for legume production and good access to urban markets. Farmer investment, labor – land – risk – money, in a new variety depends on their return on investment. To achieve an effective return on the investment of a new variety, farmers often need to make complimentary investments in production (labor, land, and other complimentary inputs to achieve the genetic potential of the germplasm). They may also need to make investments in post-harvest technologies to reduce loss, gain higher unit yields, and sell their increased marginal production.

ICRISAT developed pigeonpea, groundnut and chickpea varieties with desirable market traits that are tolerant to both the most prevalent diseases and drought. In addition to providing improved germplasm, ICRISAT was responsible for developing a functioning seed supply system and a basic agronomic package to accompany the seed. ICRISAT demonstrated that with right variety, promotion and price, farmers are willing to pay for small packs of high quality seed. Smallholder farmers can produce high quality legume seed if they have access to and knowledge on new varieties, can practice good agronomy, and are able to identify and manage common pests and disease. Collective action was the strategy used for seed distribution through a combination of capacity building and marketing with existing smallholder farmer groups and project partners adopted a participatory multi-institutional approach involving several collaborators from public and private sector institutions.

3.5.1. Seed supply model

The seed supply model combined informal farmer managed seed production with linkages to the formal system for new varieties. It included farmers and their institutions, i.e. groups and marketing associations, seed companies and research institutes (i.e., ICRISAT, Kenya Agricultural Research Institute) and quality regulatory bodies (i.e., Kenya Plant Health Inspectorate Services). The objective was to create a demand driven seed supply chain from breeding and seed maintenance to a commercial seed company marketing certified seed to farmers through the Kenya Smallholder Farmer Investment Company (KESFIC), who in turn sold seed to producer marketing groups (PMGs).

KESFIC maintained two supply channels, one for seed and one for grain, which supplied second and third generation seed to farmers. When the seed was no longer of acceptable quality, it was purchased from the commercial seed company. Groundnut, bulky with a lower seed multiplication rate relative to other legumes, is less commercially viable as seed. If farmers are to access high-value legume markets, there needs to be a system to efficiently renew seed stocks periodically (if the physiological degeneration to pest and/or disease warrants it) and/or access new varieties demanded by the market.

3.5.2. Project outcomes

The Lucrative Legumes Project mobilized more than 17,000 farmers and supplied improved legume seed to all of them over a period of two years. In turn, these farmers loaned, donated or sold the seed to non-participating farmers, which induced a ‘spill-over effect’. The project trained over 50% of participating farmers who demonstrated good crop husbandry practices, value addition, group

management and marketing. Farmers trained in seed production were contracted by a seed company to produce seed commercially. Groups were also trained in management, which was appreciated, but the impact of this training was not documented. Additionally, 11 post-graduate students participated in various aspects of crop productivity and marketing research. Most importantly, farmers were able to collectively market their produce at competitive prices. They also established direct links with grain traders. Table 21 below presents a number of constraints and opportunities that were identified in the project.

Table 21. Constraints and Opportunities Identified by the Project

Limited quantities of high quality seed were available from ICRISAT and the seed company.	Farmer multipliers were well identified and supported to produced quality seed.
Unreasonable farmer price expectations.	Seed supply through informal farmer network.
Poor distinction between grain and seed among farmers in the informal sector.	Need to train farmers on market forces and expose them to markets with structured visits.
Inadequate grain volumes to sell through formal marketing channels due to home consumption.	Develop links with commercial seed companies to produce high quality seed having a demand.
Documentation of actual production and marketed produce - farmers withheld information.	Farmers will pay more for seed if packed in small quantities and sold through formal channels.
High illiteracy levels among the farmer groups members compromised record keeping.	Increase production at HH level via raising productivity through better agronomic practices.
Seed consumed as food limited project expansion but improved HH food supply.	Develop M&E strategies at the onset of the production process, train farmers to keep records.
Not enough groundnut shellers.	Market opportunity to develop and sell shellers.
Farmers lack patience when formal collective marketing is done.	Mentor and link entrepreneurs to farmers and their associations.
Project was short duration – gains not consolidated.	Solicit more donor funds. Link groups to public and private institutions for continue service support.

3.5.3 Key outcomes of the forward

The project promoted an increased awareness among farmers of the performance and market for improved legume varieties. Farmers demonstrated a willingness to purchase seed, proving the commercial potential of legume seed, even among low-income farmers. But this commercialization process is not easy. It requires a strong working and effective relationship among both public and private actors and enabling policies that are relevant to small farmers who account for the bulk of legume seed production. A critical lesson from this project is the value of training farmers in production, processing, record keeping, business basics, collective marketing, establishing and managing contractual relationships with buyers, and in promoting linkages with research to increase access to new varieties and production enhancing technologies.

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Review of Community Seed Production Practices in Africa Part 2: Lessons Learnt and Future Perspective

Stephen Walsh[1], Tom Remington[2], Samuel Kugbei[3] and Chris O. Ojiewo[4]
[1]Catholic Relief Services (CRS), Nairobi, Kenya
[2]Catholic Relief Services (CRS), Lilongwe, Malawi
[3]Food and Agriculture Organization of the United Nations, Rome, Italy
[4]ICRISAT-Ethiopia (c/o ILRI Ethiopia) Box 5689, Addis Ababa, Ethiopia.

Correspondence: Samuel.Kugbei@fao.org

Summary

Within the context of the case studies presented, there are clear lessons learned and the second section of the review (Part 2) draws out those lessons in looking at seed and variety, description of community seed production, the support role of public, private, and civil society actors, the role of subsidies and technical support, farm level impact, and sustainability. A general theme running through all of these case studies is improving farmers' access to quality seed of desired varieties. Topics include varietal identification, seed production, seed quality, seed policy, and seed marketing. The main conclusions are: Community seed production is necessary to improve formal and farmer seed system links; community seed production objectives should be explicit and include coherent activities for closing out, transitioning into commercial entities, or linking with publicly funded programs; community seed production is more effective when there is strong collaboration between the public sector, the commercial sector, and civil society/NGOs; The lack of standard ex-ante seed system diagnostics, including economic analysis to justify the scale and scope of interventions, significantly limits the capacity of donors and seed practitioners to make rational investments and intervention design decisions.

1. Key results from the review of community seed production practices in Africa

1.1. Seed and Variety

"Don't judge each day by the harvest you reap but by the seeds that you plant."

Robert Louis Stevenson[3]

The identification of varieties for promotion and production and the management of seed varied considerably across the five case studies, reflecting the context and crop, but some clear lessons emerge. Across the case studies, the focus was on facilitating farmer access to improved, higher yielding, shorter duration varieties and key activities included variety identification and seed multiplication. There was little reference or discussion in any of the case studies on variety maintenance, selection, or handling of local varieties. At the micro-level, none of these community seed production case studies described an explicit process for identifying varieties promoted or valuing the benefits of new and improved varieties at farm level. At the macro-level, none of these case studies followed an explicit process to understand and describe the role of variety and seed quality for key crops, to identify the main seed system constraints and opportunities in terms of variety (trait) and seed quality.

The Uganda case study of common bean involved two bean varieties (K132 and K131) that were released in the same year that the farmer seed enterprise (FSE) began production with the same varieties. These varieties were identified for production because they had similar characteristics to a widely grown and marketable variety (K20) but with higher on station yields. Farmers were given the choice of multiplying local land races but preferred K132 and K131 due to better yield performance

of K132 versus K131. FSE fields were not inspected but health testing was conducted to assess pathogen infection levels and germination. FSE recorded germination rates were 20% higher and had lower pathogen infection compared to other commercial sources but the project did not compare germination rates or pathogen levels to bean seed from farmers.

The Tanzania case study of improved pearl millet (Okoa) and sorghum (Pato and Macia) describes an explicit focus to increase farmer access to improved varieties in semi-arid areas. The varieties were developed by ICRISAT and were officially released by the national program. Key attributes of all varieties was shorter duration and higher yield. One variety – Macia – proved vulnerable to birds and ultimately had very low rate of adoption. A quality control measure – field isolation – was promoted. While seed producers were confused on recommended field isolation distances and there was high variability in application, post project surveys of seed producers showed a change in seed production standards.

The Sudan case study involved the promotion of early maturing/drought tolerant varieties of sorghum, millet, groundnut and sesame in a conflict-prone area on the northern edge of the savannah belt of central-western Sudan, but did not specify the varieties. A lack of seed availability was identified as the main constraint for all crops, including early maturing/drought tolerant varieties. The study did not discuss disease issues or post-harvest handling of seed. Seed producers were trained on quality standards and the project supported inspection but no information was provided on the quality of seed produced versus that of other non-project sources or that of farmers. Varieties promoted were identified by the agricultural research station under the Ministry of Agriculture.

The Ethiopia case study involved a variety of crops and the focus was to improve farmer access to both improved and local land races and increase diversity in a remote semi-arid region. Varieties were identified with national research institutes and more than 200 varieties of cereals (wheat, maize, sorghum, teff, barley), 60 varieties of pulses (common bean, lentil, cow pea, chickpea), 30 varieties of vegetable crops (potato and onion) and more than 40 varieties of oil seeds (sesame, groundnut, sunflower) were reportedly established in multiplication and demonstration plots across nine seed cooperatives. The study does not present information on the process of setting standards for the seed cooperative growers but notes that a large number of seed producer fields were rejected due to quality.

The Kenya case study involved promoting a seed supply network of pigeonpea, groundnut, and chickpea varieties with desirable market traits. Varieties were identified by ICRISAT and the national research organization. Two qualities of seed were marketed, one considered 'first generation' and a second called 'grain', which was described as 2–3 generation.

1.2. Description of Community Seed Producer (CSP)

"A proper community, we should remember also, is a commonwealth: a place, a resource, an economy."

Wendell Berry[3]

The five case studies took different approaches to community seed production. This reflects the operating environment, socio-political systems and norms, cropping systems, and aim of the study protagonists. CSP was employed differently as a function of the situation.

Institutional and economic sustainability of CSP groups was a key consideration in the Uganda study. The community seed producers were called 'farmer seed enterprises', they were groups of 10–12 women, the sites were identified based on anticipated demand for the seed promoted by the intervention, and minimal equipment was provided and on a cost share basis.

3 Poet, cultural critic, social activist, and farmer, 1934 – present.

CSP in Tanzania followed three models: 'lead farmers', 'farmer groups', and 'primary school gardens', each model reflecting desired outcomes of different donors. The church funded model was based on farmer groups at village level, one bilateral funded model focused on raising public sector capacities and targeted lead farmers for seed production, and a second bilateral funded model targeted school gardens. Government attempted to mandate the sourcing of Foundation seed at fixed prices. This was impossible to enforce (Foundation seed was priced at a multiple of five to certified seed and in some cases at a multiple of fifty to the local price of grain) and this led to a large variance in the prices for starter seed as reported by farmer groups, lead farmers, and schools.

CSP in the Sudan case study was organized through 'village agricultural committees' that were the focus of seed provision and training from extension staff and seed inspectors from the Ministry of Agriculture on agronomy, production, storage, and seed quality. Village agricultural committees were expected to identify lead farmers for seed production, distribute seed to other farmers through a repayment system, and keep records.

CSP in the Ethiopia case study was organized by 'cooperative community based seed enterprise', membership ranged from 40–300 across nine cooperatives, with a median of 68. The communal farms size ranged from 2.5 ha to more than 15 ha, with a median of 5 ha. These cooperatives were furnished with seed, irrigation equipment, seed cleaning equipment, seed stores, as well as training from local government extension agents. Successful cooperatives were characterized by strong collaboration with public sector actors (research, local agriculture and development offices, national trade organization). This reflects the presence of strong cooperatives in Ethiopia.

CSP in Kenya was organized by 'producer market groups' that linked farmer groups with certified and commercial seed and with buyers of high value legumes. The groups were highly dispersed, operating across four districts and comprising more than 17,000 farmers, of which 65% were women. The community seed production efforts in Kenya promoted knowledge and access to new varieties through a value chain approach aimed at marketing seed and legumes by raising collaboration between producer groups, early generation seed producers, research partners, and buyers.

1.3. Support Role of Public, Private, Civil Society

"…the solution requires the creative complementarities of public–private cooperation that…[and] must include … not-for-profit sector (foundations, NGOs, civil society). This pathway can develop and deliver solutions to large numbers of small farmers […]"

Marco Ferroni[4]

The role of public, private, and civil society actors' support varied across each of the five case studies. However, all three actors – public, private and civil society – played essential roles in all of the case studies and the roles and interdependency between these actors depended on the context. The public sector, with external funding and donor influence on program design, was a driver in Tanzania, Sudan, and Ethiopia. This reflects the crops targeted and the seed constraint addressed but more importantly reflects the socio-political environment and status of civil society organizations that are non-governmental and able to function outside of the political sphere.

The private sector, with linkages made by international research partners and with national research partners' support, was a driver in the Ugandan and Kenyan case studies. This reflects the express aims of the protagonist to take a market-focused approach but also reflects a pre-existing market friendly or market-neutral environment where significant state engagement is not a pre-requisite.

Civil society actors – community based organizations, non-governmental organizations, village and church based groups – played an important role in organizing farmer aggregation and promoting linkages with public and private sector in all five case studies. This role changed considerably in each of the five case studies: in Sudan an international NGO was the project holder and a village agricultural committee, with significant state oversight, was the turn-key organization producing seed; in Ethiopia community cooperatives were the focal point of seed production but with

4 Executive Director, Syngenta Foundation for Sustainable Agriculture.

significant state over sight; in Tanzania farmer groups backed by a church-based NGO operated with significant latitude in comparison to similar programs run through state organizations; in Uganda farmer groups comprised almost exclusively of women operated with a large degree of freedom and with limited state intervention; in Kenya two international NGOs were the project holders with hundreds of farmer producer groups.

The role of national and international research organizations was prominent in all case studies but their specific contribution, Sudan and Ethiopia for example, was not always evident. In Kenya and Uganda, the international and national research role was in program design, identification of variety, and technical backstopping and training. For Tanzania, Sudan, and Ethiopia, national research was significant in identifying varieties for community seed producers where technical backstopping and training community seed producers was provided almost exclusively by state extension. This reflects the socio-political context of these countries.

1.4. Key Areas of Support – Identification of Seed and Variety, Technical Support in Production & Marketing, Credit and Capital

"Quality in a product or service is not what the supplier puts in. It is what the customer gets out and is willing to pay for."

Peter Drucker[5]

The overall focus across the case studies reflected the objective of increasing the production of quality seed of improved varieties. This included support for inputs, training in seed production and seed quality control. The focus on supply was not matched with support for seed enterprise development and marketing. Marketing appeared more successful in vertically integrated schemes with few large buyers. While in many of the cases variety was the driver, in others it was seed.

In Uganda the key support provided was access to variety, training on seed production and post-harvest handling. There was limited to no support provided on marketing seed but community seed producers were identified in Eastern Uganda where demand for bean seed, and the new varieties, was considered strong. There was minimal capital/financial support as equipment provided was on a cost share basis and was relatively cheap.

In Tanzania key support provided was access to variety and training on seed production. The varieties promoted that fared well with farmers were released at least four years before the community seed producers in the case study began multiplying them and so had at least some track record of being appreciated by farmers. Minimal technical support was provided on marketing despite an expectation for sales to recapture costs that was implicit in the project design of all three models of community seed production. Seed sales was a major challenge and undermined the incentives of community seed producers, particularly the lead farmers who had higher input costs and were initially prevented from selling outside of their community. Where seed producers groups reported successfully selling seed, it was due to a large brokered sale, between the church organization supporting farmer groups and FAO, or where there was a high market demand and strong promotion, for example schools in Singida. Capital/credit was not provided besides buy back schemes for Foundation seed and this proved problematic.

In Sudan key support provided was access to seed. It is not clear from this case study if variety was critical but seed availability was a constraint in the project area. Training of seed producers in production and seed quality was referenced but not on marketing. A seed credit (pay back scheme) did not function well and was cited as a challenge. People affiliated with the community seed production reported not understanding how the buy-back scheme was supposed to work. Seed sales to organized buyers (NGO/government) was noted as a sign of success for one producer. The provision of capital and/or equipment and storage facilities for community seed producers was not noted in this case study.

5 Management consultant, author, and founder of modern management theory, 1909-2005.

In Ethiopia key support provided was access to seed. It is not clear to what extent variety was critical but a significant number of varieties for different crops were made available through the community seed producers. Seed availability, due primarily to chronic drought and secondly to the relative isolation of the geo-zone of the community seed producers, was noted as a big constraint in the project area. Training to seed producers in production and seed quality was referenced but not on marketing. Capital for equipment and storage was provided to all community seed producers but the pay back terms and issues of sustainability were not discussed.

In Kenya key support provided was access to variety, training on agronomy and seed production, and the facilitation of linkages between seed producers, seed consumers, public sector service providers, and output markets. No capital for equipment or storage was provided to any community seed producers. Challenges meeting contract terms was cited among producer groups.

In several of these case studies, key areas of support to community seed producers did not correlate clearly with what farmers would benefit, or potentially pay for, as a result of the services rendered by community seed producers. The primary customers of many of the services and support provided to community seed producers were not farmers, or even community seed producers, but parties gaining short-term benefits from a more vertically integrated seed supply chain.

The classic example is of seed agencies (Sudan, Ethiopia, Kenya, Tanzania) establishing certification schemes for community seed producers and then struggling to enforce by decree (Tanzania, Kenya, Ethiopia) as opposed to by farmer willingness to pay. One could conclude that farmers either did not value the certified seed or that the benefits of certified seed were not effectively communicated.

In the Tanzania case study where there was strong documentation on pricing, the vast majority of community seed producers did not pay the Foundation seed price, all community seed producers struggled to sell to farmers, and there was no evidence that those community seed producers who did pay for and/or source foundation seed had no easier time selling their seed that community seed producers who did not pay for and/or source Foundation seed.

1.5. Subsidies - Source Seed, Production Inputs, Conditioning and Marketing - Linking Producer and Farmer

"When we give a subsidy, the benefits to the public ought to exceed the benefits to the [subsidy recipient]…. When it doesn't, that's our definition of corporate [and government] welfare."

John Kasich[6]

Significant subsidies for infrastructure, inputs, training and quality control existed in all case studies. However, there was widely varying value and transparency in these subsidies.

In Uganda the total value of subsidy provided to the community seed producer was very small, an explicit aim from the design. Start-up seed (sourced from the Ugandan bean program) and equipment (threshing rack, sorter, and plastic sheet for drying) were provided on a cost share basis to all of the community seed producers. Payback performance of the groups was not noted but ¾ of earnings were held by the group, presumably to pay off inputs costs. Subsidies to seed conditioning were only related to training. There was no equipment and capital support for storage. Marketing was covered in training but farmer groups noted the need for more support on promotion and making linkages to sell seed.

For the Tanzania CSPs, the value of subsidies is difficult to assess but was limited to sourcing seed and training for producers. The Tanzanian seed agency attempted to set seed prices for Foundation seed at five times the suggested price for certified seed sold by community seed producers, with a result that Foundation seed sourcing and pricing was erratic. An assessment of seed sales across all three community seed production models in the same season indicated that a fraction of seed produced was sold whereas no sales of seed was reported by 1/3 of lead farmers, 1/4 of schools,

6 American politician. 1952 – present.

and 1/6 of farmer groups. Despite the fact that the national seed regulation in Tanzania forbade the sale of unpackaged and untreated seed outside the village of production, all three community seed producer models reported selling seed outside the village of production which was unpackaged and untreated. In most years, most of the seed produced in Tanzania under all three community seed production models was not sold, and was instead given away. Yet, none of these models reported having a plan or guidelines for allocating seed for free or at a deeply discounted price to vulnerable or cash strapped household and the intervention zones were noted for their high levels of poverty and farmer vulnerability to drought, which the varieties promoted were intended to address.

In Sudan, the value of subsidies is difficult to assess but seems to have been limited to training and source seed for CSPs that was provided under a seed pay back/seed loan repayment scheme. To the extent that repayment was a key strategy to achieve CSP targets of reaching 65,000 HH in Sudan, it fell short for all crops except for millet. Interestingly, millet reported seed loan repayment rate of 29% which may indicate that millet source seed was repeatedly provided to community seed producers in order for the CSPs in Sudan to have served the 92,000 HH they reported reaching with millet. Conversely, groundnut repayment rates were reported at 78% yet slightly less than 30,000 HH were reached with groundnut by the CSPs, which likely indicates a low level of starter material in the first season of this three year effort and much slower multiplication rate of groundnut compared to millet. CSPs in the Sudan case study received training on conditioning and seed storage but there is no reference to any equipment or subsidies related to storage. There is no mention of seed marketing training for the Sudan CSPs although the study references that some CSPs sold seed back to the project, to individual farmers, and to formal seed companies.

For the Ethiopian CSPs, subsidies were very high and included source seed, irrigation equipment, seed cleaners, scales, packaging machines, and generators. The total value of subsidy to each CSP is not stated but based on equipment provided it is estimated to be at least USD 5000. CSPs were expected to provide land, labor, and construction materials for simple storage facilities. While seed was provided for free to CSPs, it was to be paid back into a revolving fund. Seed production at CSPs was done on a contractual basis but no details were provided on the terms of supply contracts, the buyers, or the profitability of CSPs. While training curriculum of CSPs was robust on production and certification there was no reference to marketing or cost accounting despite the relatively large subsidies involved and the stated focus on supply contracts. Based on several references in this case study to the importance of linkages with state actors as driving the success of CSPs, it is assumed that the CSP seed was marketed to state channels.

In the Kenyan case study, the total value of subsidies is difficult to gauge but would appear limited given the orientation of a value chain approach and the aim to promote sustainable seed sales. Small starter packs of improved seed of quality legume varieties of pigeonpea, groundnut and chickpea varieties were sold to farmers in the CSP area but in order to bulk seed, the first identified producer groups in Kenya were initially provided source seed by the state parastatal on a contract basis with the expectation that they would sell product that met set standards to either legume buyers or back to the state parastatal if the seed was of high enough quality. Moreover, these producer groups were expected to be an emerging source of demand from the state parastatal as their initial seed declined in productivity. The scheme did not function as hoped. Many farmer groups did not hold up to their contracts and sold into spot grain markets while other farmer groups self-sourced over multiple seasons as opposed to buying again from the parastatal. Within the seed supply chain it was very difficult to track and uphold quality standards due to high transaction costs associated with large number of farmers, small size land holdings, many farmers new to working with quality standards, and competition with local food markets.

1.6. CSP Impact at Farmer and System Level

In all case studies, significant numbers of farmers were able to access quality seed from the CSPs. This increased overall varietal diversity and accelerated the adoption of new varieties.

In Uganda the three CSPs produced less than four metric tons of two varieties of improved bean varieties and sold them at a modest premium to the crop price in grain markets. The CSPs were provided with limited training on production, pest and disease management, and post-harvest handling as well as linkages with research. Two of the three CSP groups continued selling bean seed four years after the project ended.

In Tanzania these three CSP models played a role in greatly increasing the spread of improved millet and sorghum varieties in central Tanzania. An ICRISAT adoption study in 2001 estimated that in the mid-1990s approximately 5% of total sorghum and millet was allocated to improved varieties. The 2001 study indicated that more than 2/3 of farmers surveyed in Dodoma and more than 1/3 in Singida were planting improved sorghum variety Pato whereas pearl millet variety Okoa was grown by more than 1/4 of surveyed farmers in both Dodoma and Singida. So, in spite of the fact that only a fraction of the seed promoted by the models was sold by producers the evidence from the ICRISAT adoption study suggests that varieties were ultimately well diffused. Community seed producers in the Tanzania case study cited significant changes in seed production practices: field isolation, more careful site selection, harvesting when completely dry, drying on elevated structures, use of fertilizer. In 2001, TOSCA announced a new quality declared seed standard for pearl millet and sorghum with isolation distance of 100 m, where under the time of the CSP case study recommended isolation distances for certification was 300 m for pearl millet and 200 m for sorghum, which would suggest learning from the Tanzania case study in terms of the impracticability of large isolation distances for community-based seed producers.

In Sudan, the farm level impact was to help many communities have access to seed locally instead of sourcing at a great distance where they may have little recourse if there are issues related to germination or not being true to type. In addition, this would strengthen links within the supply chain from research to extension to seed inspection services to CSPs and ultimately farmers.

In Ethiopia the CSP model improved seed security in isolated chronically drought-affected communities through increasing the availability of seed. Actual numbers of farmers served are not indicated in the case study but based on the median CSP of 5 ha, we estimate 1,000 farmers were served annually per CSP. The biggest impact in Ethiopia is diversity as 414 varieties were demonstrated and/or multiplied among the CSPs.

In Kenya, more than 17,000 farmers were supplied with legume seed of improved varieties over a period of two years, which induced a 'spill-over effect'. The project trained more than 50% of participating farmers who demonstrated good crop husbandry practices, value addition, group management and marketing. Farmers trained in seed production were contracted by a seed company to produce seed commercially. Most importantly, farmers were able to collectively market their produce at competitive prices.

1.7. Sustainability – CSP financial analysis, economic analysis of CSP impact

"But now sustainability is such a political category that it's getting more and more difficult to think about it in a serious way. Sustainability has become an ornament."

Rem Koolhaas[7]

Defining sustainability as socio-economic justification for the intervention and the extent to which actors supported by the intervention continue to function, the results are mixed across the case studies. There is a lack of financial information (project cost of interventions and financial returns to seed producers) and economic information (social cost and benefits of interventions) to assess the socio-economic value of any of these case studies. This does not suggest all were not successes but rather the extent, value, and impact of that success is not clear.

7 Architect and design theorist, 1944 – present.

In Uganda these CSPs were functioning a few years after the project ended and the relatively small size of the start-up support associated with these CSPs in Uganda suggests that this sort of intervention could be easily replicable where there is a window of opportunity for CSPs between incipient demand for available varieties with desirable traits and farmers achieving high enough rates of adoption in the CSP region to lower demand.

In Tanzania it is not clear if any of the CSPs (school, farmer led, farmer group) continued to operate after project support from the main protagonists (ICRISAT, Ministry of Agriculture, Council of Churches) ceased. Fixed pricing for Foundation and Certified seed and a monopoly on Foundation seed provision was problematic in all CSP models in Tanzania and should not be pursued in other CSP efforts.

In the Sudan CSP case study, the seed pay back/seed loan repayment scheme appears to be the biggest impediment to this model functioning adequately over even a short time frame. Buy back schemes are a bad idea, their administration is costly and inefficient. While they do provide rent seeking opportunities for their administrators, there are more effective and efficient means to improve farmer access to seed and to increase seed availability.

Successful functioning of the Ethiopian CSP case study model seems contingent upon strong financial and technical support to the community cooperatives on the input and production side and much more explicit emphasis on seed sales and managing the balance sheets of the cooperatives. This model involves a relative high degree of subsidies and is by far the most public sector and project dependent of any of the CSPs. For these community cooperative models to break even financially and to make sound seed production investments, a significant percentage of seed produced (approximating total annual production costs for the cooperative) will need to be committed for purchase a year in advance by state agencies or development projects.

The Kenyan CSP case study achieved impact and scale in terms of increasing the availability of and improving farmer access to improved legume seed. However, a key stated objective was to create a demand driven seed supply chain from breeder seed to seed maintenance at producer group level to commercial seed supply for both provision of new varieties and for re-supplying producer groups when productivity lagged of existing varieties. The model had challenges on the demand and supply side. There was not effective demand to drive commercial seed supply as many producer groups self-sourced from the first year as they had enough seed. There was not effective supply to out-growers as many producer groups that were contracted as seed out-growers did not sell back to the project but sold into food markets.

2. Recommendations and Conclusions

2.1. Standard Frameworks to Conduct Ex-Ante Description and Diagnosis

There needs to be an explicit baseline assessment of the target seed system to inform the decision to first invest in CSPs and then to establish clear objectives. This framework should embrace the concept of 'integrated seed system development' and balance inclusiveness with long-term sustainability. The ex-ante assessment will determine why, where and which crops warrant an investment. Baseline analysis will lead to a seed system diagnosis and a decision-making guide that should be based on simple rules, to induce action without unnecessarily limiting options, and a checklist aimed at setting performance boundaries while leaving ample scope for flexibility. Seed system practitioners are reminded that most operating environments that justify a CSP investment are not stable and that as an environment's dynamism increases, flexibility grows in importance and simple rules become imperative.

2.2. Economic Value Attributable to Seed

Estimating the economic gains attributable to a new variety and to seed and varieties that have disease incidence and are physiologically healthy will help to prioritize the potential seed system

investments (crops, varieties, seed quality, agronomy) and help to identify and justify the magnitude of the investment opportunity for the private sector, public sector, and/or development entities. There is confusion over the respective potential of new varieties, existing varieties, and of quality seed on yields. The starting point is a simple cost-benefit model aimed at farmers to evaluate the productivity gains from different seed interventions in order to prioritize interventions and to explicitly estimate the total value of the productivity gap. This will also inform price, i.e., – what a farmer might be willing to pay. In unstable environments, the productivity targets should be aimed at modest increases to pre-shock yields.

2.3. Identify what pieces can be commercial and what pieces need subsidy

Once the scope of the opportunity is valued and priority areas of investment are identified, the potential role of private, public, and civil society or NGO entities needs to be considered. Where farmers are easily convinced that the varieties are superior to their current varieties or that purchased seed is of higher quality and results in higher yields than own saved seed, a focus on supporting private sector seed actors is fully warranted. For crops and varieties where there is a potential for commercial opportunities, CSPs should be closely linked to the private sector as out-growers. Where there is no or low potential for commercial opportunity, CSPs should be closely linked to the public sector. Where there are commercial opportunities, development actors should focus on promoting an enabling environment for nascent private sector entities but be cognizant of the tendency for elite capture.[8] Developmental support aimed at promoting an enabling private sector may include: direct support to the private entity to improve their business and/or seed production and quality capacity; and/or direct support to the public sector so that they can provide public goods (seed, quality control) to the private entity; and/or direct support to the consumer to raise demand through advertising, increasing access to demos, and couponing.

2.4. What Parts of CSP Most Needs Incentive Schemes for non-commercial purposes?

How can subsidies be used effectively when the objective is developmental and not commercial? Subsidies for developmental CSPs need to be targeted, explicit and of short duration. Continued support from the public sector is essential for the efficiency and viability of CSPs, more so with developmental CSPs which by nature provide public sector goods. Subsidies for developmental CSPs should be focused on training related to seed production, seed quality, and CSP management, and access to Foundation seed and of new varieties. Development entities are short-term catalysts to support the creation, management, and capacity of CSPs – to include training and especially linkage – but have no long-term role. Support to the public seed sector for development needs to be sustained.

2.5. Where does the CSP hinder growth and hurt consumers?

CSPs hinder growth and hurt consumers when they compete with or create an impediment to the establishment of a private seed company which is likely to deliver seed and related products more efficiently and more sustainably than the CSP. Unfortunately, much of the dialogue around private sector actors in seed systems is focused not on efficiency or the benefit accrued to consumers, but whether a private sector actor could potentially function in a given environment. Contrary to the current orthodoxy, private sector entities should not be cherry picked for investment where the public sector can deliver seed more efficiently and effectively and at lower risk to the consumer. The tendency for CSPs is to be subsidized too long, after the point at which varieties and productivity enhancing technologies have reached a tipping point in the target zone and their further adoption is no longer dependent on raising the availability of these technologies. CSP investments should be predicated on a clearly defined strategy that estimates the time frame for exiting the target zone.

8 Examples would be where a spouse, uncle, or friend of a project officer or project administrator starts a seed business due to preferential information and preferential access to subsidized capital (low or no interest loan), subsidized asset (equipment or land partially or fully paid for by project), and/or guaranteed output market for seed produced (percentage of production sold back to the project).

2.6. Conclusions

- Community seed production is necessary to improve formal and farmer seed system links.
- Subsidies for the establishment of commercially linked CSPs need to be targeted, explicit and of short duration.
- Community seed production objectives should be explicit and include coherent activities for closing out, transitioning into commercial entities, or linking with publicly funded programs.
- Community seed production is more effective when there is strong collaboration between the public sector, the commercial sector, and civil society /NGOs.
- The lack of standard ex-ante seed system diagnostics, including economic analysis to justify the scale and scope of interventions, significantly limits the capacity of donors and seed practitioners to make rational investments and intervention design decisions.

Local Seed Business in the Context of Integrated Seed Sector Development

Marja H. Thijssen*[1], Gareth Borman[1], Karen Verhoosel[1], Astrid Mastenbroek[1] and Willem Heemskerk[2]

[1]Centre for Development Innovation, Wageningen University & Research Centre, P.O. Box 88, 6700 AB Wageningen, The Netherlands; tel. +31 (0)317 486865;

[2]Royal Tropical Institute, The Netherlands

***Correspondence:** marja.thijssen@wur.nl

Abstract

Quality seed is a key input for agriculture, with a direct impact on agricultural production and productivity. Integrated seed sector development (ISSD) is an inclusive approach that recognizes and builds upon a diversity of seed systems in the sector. We use the ISSD approach to guide us in the design and implementation of seed sector interventions that are complementary to farmers' practices, with the main aim of increasing farmers' access to quality seed of superior varieties. In working with the ISSD approach, we recognize a number of guiding principles. In this paper, we describe these principles, and provide examples of how we work with the system of local seed business (LSB) in the ISSD programs in Ethiopia and Uganda. We recognize that LSBs offer an important service to communities by providing access to quality seed of crops and varieties that cannot be obtained reliably through other sources. The guiding principles help us to work towards the development of sustainable LSBs. Within the context of ISSD Africa we will continue to investigate and design interventions to address challenges in seed sector development, focusing on a select number of themes that are relevant to the LSB context.

1. ISSD and agricultural development

In many Sub-Saharan African countries, agricultural development is key to accelerating economic development and overcoming poverty. Increasing agricultural production and productivity is vital for food security, since it provides a source of food and generates income for smallholder farmers. Growth in agricultural production also stimulates growth in other sectors of the economy. Limited availability of, and access to, quality seed is often regarded as one of the main obstacles for increasing production and productivity levels.

Integrated seed sector development (ISSD) is an inclusive approach that recognizes and builds upon a diversity of seed systems in the sector. Rather than promoting linear, generic and/or independent development pathways, it promotes the complementary development of seed systems (Louwaars and de Boef 2012). We use the ISSD approach at the Centre for Development Innovation (CDI) of Wageningen University & Research Centre (Wageningen UR), and at the Royal Tropical Institute in Amsterdam (KIT), in collaboration with a range of international and national partners in Africa, to guide us in the design and implementation of seed sector interventions coherent with farmers' agricultural practices. We do this with the main objective of enhancing farmers' access to quality seed of superior varieties to contribute to food security and economic development. Superior varieties refer to both improved and local varieties favored by farmers.

In working with the ISSD approach, we have identified a number of guiding principles that help us in the design of seed sector interventions. These principles are as follows:

- foster pluralism and build programs upon a diversity of seed systems;
- work according to the structure of the seed value chain;
- promote entrepreneurship and market orientation;

- recognize the relevance of informal seed systems;
- facilitate interactions between informal and formal seed systems;
- recognize complementary roles of the public and private sector;
- support enabling and evolving policies for a dynamic sector;
- promote evidence-based seed sector innovation.

In this paper, we illustrate these principles with examples of how we work with the system of local seed business (LSB) in the national ISSD programs of Ethiopia and Uganda. These two programs specifically support farmers' groups in their development into LSBs, i.e. autonomous seed entrepreneurs, who produce and market quality seed for local markets at the professional level (see also those papers in the conference proceedings by Amsalu *et al.* and Mastenbroek *et al.*).

2. ISSD guiding principles: Supporting the development of LSBs in Ethiopia and Uganda

2.1. Foster pluralism and build programs upon a diversity of seed systems

This is our first guiding principle. In order to work with the ISSD approach we need to understand and acknowledge the coexistence of the seed sector's multiple seed systems. Seed systems can be characterized on the basis of the domains in which they operate (public, private, informal, formal, mixed); the type of crops involved (food crops, cash crops); the type of varieties used (local, improved, exotic, hybrid); and the type of seed quality assurance mechanisms (informal, truthfully-labelled, guaranteed/standard, quality declared seed, certified), and seed dissemination mechanisms (local exchange, seed fairs, agro-input distribution schemes, agrodealers), in operation. In reality, farmers gain access to seed from different seed systems, e.g., they may save their own seed of sorghum; access seed potatoes through community-based seed production schemes; buy hybrid maize seed from national seed companies, or onion seed from international seed companies. Each seed system has its own values and limitations and requires a unique approach towards strengthening it.

The ISSD programs in Ethiopia and Uganda strive for the development of LSBs. Using non-program jargon, the programs support farmers' groups in the process of developing their organizations into community-based small business enterprises for the production and marketing of quality seed. The programs recognize the specific niche for these LSBs in providing farmers with access to quality seed of those crops and varieties that have high local demand and are often extremely important for local food production and cultural practices, but are ignored by the larger private and/or public companies because the demand and profit margins are too small. The LSBs provide a service to the community in making affordable quality seed of these crops and varieties available and accessible (MacRobert 2008); when seed production and seed quality control are conducted at local level, the costs normally associated with seed transportation and centralized seed certification are reduced.

2.2. Work according to the structure of the seed value chain

A seed value chain covers the process of activities from plant genetic resource management, variety development, early generation seed production, and seed multiplication to seed distribution and marketing. We map the operators, service providers and the institutions of the enabling environment in specific seed chains, which differ between crops, but most significantly between different seed systems. The objective is to design strategies to enhance the efficiency of the seed value chain. The importance of farmers as seed users and drivers of the chain is emphasized.

In Ethiopia, we consider the seed production and marketing activities of LSBs through a value chain perspective. One key intervention area of the program is that of supporting LSBs in their

identification of strategic linkages to important input and service providers, and to markets that sustain the organization in its business operation and control. We facilitate linkage between LSBs and agricultural research centers for gaining access to new varieties and early generation seed as an input for commercial seed production. We also support LSBs in the process of identifying and supplying their products to different seed buyers and markets. Local partnerships are established, through memoranda of understanding with local governmental and non-governmental organizations, for the effective and efficient division of responsibilities in support of local seed business plans.

Since the ISSD program in Uganda only started in 2013, our focus has been on understanding seed value chains of crops with local demand. Crops such as bean, groundnut, cassava, rice and potato emerged as crops with potential for LSB seed production. For these crops, value chain analysis is in progress with the aim of supporting farmers' groups in linking with actors higher up the value chain. Linkages between agricultural research, public breeders, government extension service providers, agro-dealers and farmers are created through various multi-stakeholder forums.

2.3. Promote entrepreneurship and market orientation

The value chain approach is linked to the guiding principle of promoting entrepreneurship and market orientation. We see entrepreneurship as a way of making a business out of seed production and distribution, and/or related seed services. We focus on entrepreneurship since, by its definition, it is market oriented and an important incentive for sustainable development. Entrepreneurship and market orientation can be promoted in both formal and informal seed systems, for private as well as public actors in the seed value chain.

In ISSD Uganda and Ethiopia, we see LSBs as community-based seed production models implemented by entrepreneurial farmers, who see business opportunities in the production and marketing of quality seed, fulfilling a niche in the market. In Ethiopia, a PhD study examines the market orientation of LSBs and investigates the commercial sustainability of the LSB model.

In Uganda, the program recently conducted a household survey on access to seed, and developed seven seed value chain studies for respective seed commodities to reveal farmers' contemporary sources of seed, and to identify which crops and varieties have clear market demand. Findings relate to the types of seed that farmers within and outside the community are willing to buy, what price they are willing to pay, and how stable the demand is. We realize that the farmer-saved seed system is the biggest 'competitor' to LSBs, as the farmers are highly effective in disseminating promising varieties. Care has to be taken that distribution of free seed by the government and its development partners does not bypass local business initiatives, and that the development of a market-oriented seed sector is promoted.

2.4. Recognize the relevance of informal seed systems

Despite all past public and private efforts in seed sector development, informal seed systems continue to dominate in most developing countries, supplying more than 80% of the total seed used by farmers. Farmers rely on the farmer-saved seed system, in which seed production is integrated into crop production for many locally important crops, as seed is simply not available through other sources. Informal seed systems are key for smallholder farmers in relation to food security and promoting resilience in the face of increasing uncertainty.

Local seed businesses form an important bridge between the formal and informal systems. Linked to public breeding programs, LSBs are a vector for introducing improved varieties to farmers, who, in turn, save, recycle, share and exchange seed. In Ethiopia, seed producer cooperatives, have played a pivotal role in introducing the highly productive teff (*Eragrostis tef (Zucc.) Trotter*) variety called *Kuncho* to farmers; access to this new variety through LSBs has meant that farmers have been able to widely disseminate the germplasm of this promising variety through various informal channels. Since LSB members are also farmers, who maintain and exchange their own saved seed, they possess key market intelligence for commercializing promising seed technologies. Informal systems house

considerable knowledge on genetic resource management and use that can be used to identify which genetic traits are preferred within the community, and are most suitable for local agro-ecological conditions; and to understand traditional farming practices (De Boef *et al*., 2013).

In Uganda, the distance to agro-input dealers, the questionable reputation of seed supplied by the formal sector; and the non-availability of the requested variety, provide significant motivation to farmers to buy seed from LSBs. At the same time, the market survey showed that the lack of access to credit to buy quality seed and other agricultural inputs deters farmers from becoming customers of LSBs.

2.5. Facilitate interactions between informal and formal seed systems

Farmers and formal sector professionals may be linked in various ways through different components of the seed chain. For example, in genetic resource management the systems may be linked through supporting community biodiversity management (CBM). In variety development, professional breeders and farmers may interact through participatory variety selection (PVS). In seed production, farmers' seed management practices may be strengthened through seed advisory services and linkage to formal research and seed technology development centres. In seed dissemination, informal and formal systems may be linked through the establishment of local seed outlets in farming communities.

In ISSD Ethiopia, PVS has become common practice in local seed business (Mohammed *et al*., 2013). Participatory variety selection is a practical means of developing the crop variety portfolios of LSBs. Diversity in their portfolios has proven paramount to success and sustainability; the knowledge and capacity required to produce and market a wide range of products suitable for local production systems that are dynamic and challenged with uncertainty keeps them competitive in their business. Producing seed of vegetatively propagating and self-pollinating crops, which the farmers themselves can also easily reproduce, requires that LSBs have access to a continuous influx of new varieties that are not yet on the market.

2.6. Recognize complementary roles of the public and private sector

Different stakeholders in the sector have different objectives and interests in seed sector development, but also complementary roles to play; the same applies to the public and private sector. Generally speaking, two main forces are at play: development-led and market-led seed value chain operation. The public sector follows a development agenda on seed and food security, focusing on the production of quality seed of improved varieties of the main food crops. The private sector strives for efficiency and effectiveness in product development for maximizing profit, and thus has a generally good understanding of what the market demands. It is the government's role to create an enabling environment for quality seed production by integrating food security and economic development objectives.

In Ethiopia, public organizations are quite dominant in the seed sector, making use of considerable state and donor investments in the governance and coordination, as well as the operation, of seed value chains. They are also faced with many challenges, and are limited in their capacities to implement activities effectively and efficiently. Supporting the emergence of local private enterprises, including those of farmers' organizations, can complement, strengthen and optimize the utilization of public resources. An emerging private sector shares in the capital investment and risks taken by the Ethiopian Government and its development partners. Furthermore, refocusing the existing allocated budget to support emerging enterprises like LSBs in a more demand driven way can, in turn, lead to greater market orientation in the delivery of quality seed to smallholder farmers. As opposed to public organizations taking the lead in producing seed for the local market, LSBs are well positioned to do so in an entrepreneurial way. This is evident in how public-funded input and service delivery in Ethiopia assists LSBs in producing and marketing locally preferred seed products at a price still affordable to the smallholder farmer.

In Uganda, breeding is almost exclusively carried out by the public sector. For commercial crops, the Alliance for a Green Revolution in Africa (AGRA) encourages public breeders and private companies to collaborate in the production of Foundation seed. Particular varieties are allocated to specific seed companies, which produce agreed quantities of Foundation seed under the supervision of the breeder. The ISSD program has adopted a similar approach for food security crops that have a lower commercial value and are not interesting for the private sector. One LSB has started producing Foundation seed for other LSBs to multiply commercially.

2.7. Support enabling and evolving policies for a dynamic sector

With ISSD we aim to make seed policies more coherent with the practices and realities of farmers, and advocate for enabling and evolving policies that support a dynamic sector. Policy frameworks should support the strengthening of multiple seed systems and not strive single-mindedly towards one general presupposed norm or ideal. Appreciating the dynamics of the agricultural sector, these policies need to be able to accommodate changing circumstances (Louwaars *et al.* 2013).

In Ethiopia, the recently approved Seed Proclamation and the amended Proclamation on Plant Breeders' Rights (in draft) recognize the interests and importance of both formal and informal seed systems. Currently, the ISSD Ethiopia programme is working on the development of technical guidelines for quality declared seed (QDS), as a less intensive, less costly, and more decentralized system of seed quality control. Quality declared seed should provide LSBs with an alternative means to ensure the quality of their products at a lower cost, thereby increasing the availability of quality seed in the market at a more affordable price. As in Ethiopia, discussions are taking place between different stakeholders in the Ugandan seed sector on how to include the informal seed systems in national seed policy, and how to acknowledge the value of seed produced by LSBs through a formally recognized, albeit more decentralized, system of external quality control.

2.8. Promote evidence-based seed sector innovation

Last, but not least, through the ISSD approach we promote evidence-based seed sector innovation, supported by multi-stakeholder seed sector innovation platforms at various levels. We support research and studies that provide evidence for the design and implementation of seed sector interventions. We facilitate stakeholder partnerships to jointly experiment with innovative approaches towards solving key seed sector bottlenecks. Accordingly, knowledge institutes are natural partners in ISSD.

Through the coordination role of five universities in ISSD Ethiopia, the program easily links research and innovation to practice and policy in the seed sector. One example relates to the involvement of Wageningen University Marketing and Consumer Behaviour Group, which assisted in the development of a framework of critical success factors for local seed business, based upon the seminal works of Cooper (1999). Cooper analyzed the critical success factors that set successful businesses apart from their competitors. Complemented by De Boef *et al.* (2010), who analyzed the principles of robustness within seed systems, indicators were developed, and the framework was used in LSB baseline and subsequent monitoring studies, providing an evidence basis for developing joint action plans (Subedi and Borman 2012).

3. Conclusions

ISSD programs aim to strengthen different seed systems and support the development of a vibrant, pluralistic, and market-oriented seed sector. By cultivating an enabling environment for innovation and the coexistence of different seed systems, a wider range of farmers and seed entrepreneurs can benefit. Increased access to quality seed will support food and nutritional security and economic development through agriculture. We use the guiding principles as a tool to help us in the design of such effective seed sector development programs.

In the ISSD Ethiopia and Uganda programs, the guiding principles help us to work towards the development of sustainable LSBs that provide an important service to communities by improving their access to quality seed of crops and varieties that cannot be obtained reliably from other sources. Currently, a PhD student is researching the market orientation and sustainability of the LSB model in different contexts. We are also in the process of designing an ISSD program for Ghana, with a strong emphasis on informal seed systems.

At a continental level, the ISSD Africa program (ISSD Africa 2012; 2013) has assessed the seed sectors of eight countries (Burundi, Ethiopia, Ghana, Mali, Malawi, Mozambique, Uganda and Zambia), using consultants and national task forces. The assessments identify bottlenecks obstructing integrated seed sector development, but also opportunities for promoting entrepreneurship across a number of seed value chains in the seed sector. Here, the system of LSBs was evaluated in several different contexts. The results are published in briefing notes aimed at informing policymakers and practitioners of the realities faced by farmers in gaining access to quality seed.

By applying the ISSD approach, the ISSD Africa program will continue to investigate and design interventions for challenges in seed sector development, focusing on a select number of themes. These themes include: (i) addressing common challenges in promoting entrepreneurship in seed value chains; (ii) promoting access to varieties in the public domain; (iii) matching global policy commitments with national realities; and (iv) supporting seed sector development in the context of the African Seed and Biotechnology Programme (ASBP) of the African Union Commission, and the Comprehensive Africa Agriculture Development Programme (CAADP) of the New Partnership for Africa's Development (NEPAD). All four of these themes are relevant to the LSB context, whether it be through creating an enabling environment with incentives for strengthening entrepreneurship in this system; ensuring that public investments in the development of improved seed technologies benefit the intended end users; or through combatting the counterproductive implementation of state policy commitments that are linear in their perspective on strengthening formal seed systems, regarding themes i. through iii., respectively. With special emphasis on the process towards national CAADP compact ratification, targeting such significant investments in African agriculture, and aiming to achieve annual productivity increases of no less than 6%, cannot be achieved without a strategic outlook on the development of seed systems and the contribution that smallholder farming systems can play in transforming this sector.

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A framework for Understanding Sustainability of Community-Based Seed Production System

Keshav L. Maharjan and Narayan P Khanal
Graduate School for International Development and Cooperation, Hiroshima University; Japan.

Correspondence: mkeshav@hiroshima-u.ac.jp

Abstract

Community-based seed production (CBSP) system is considered to be an important strategy to increase farmers' access to diversified crop varieties in rural areas by bridging the gap between formal and informal sectors. The value of this system has been realized to be more important in open-pollinated crop varieties of cereals, which despite being crucial for food security of resource-poor farm communities have by and large been neglected so far. There is limited understanding about the functioning of the CBSP system and its sustainability. This paper proposes a framework for the system that includes the seed producers and consumers and the benefit to be realized by them as the outcome of the system's functions. These benefits could range from economic, social and environmental that would make the system function sustainably for longer period. The functioning of the system is discussed from the aspect of system, contingency and political economy.

1. Background

Food insecurity is the global concern (Asian Development Bank - ADB 2012). Previous conventions, such as, 'The Earth Summit' held at Rio de Janero, Brazil, in 1992, 'World Summit' / Rio+10 held at Johannesburg, South Africa, in 2002, and 'Earth Summit' / Rio+20 at Rio de Janerio at Brazil in 2012 recognized that food insecurity/hunger is one of the major challenges for the realization of sustainable development in the world (UN, 2012). An assessment of the Food and Agriculture Organization (FAO) shows that people suffering from hunger are increasing in the world, especially in the developing countries (FAO 2010a). For example, in 2010, 925 million people suffered from hunger (under nourishment), and this figure is 17% higher than that of 1995. Major reasons for increasing hunger are population growth, economic crisis, market speculation and poor performance of food crops. Among these reasons, the last one is more important in the rural areas of the developing countries due to poverty, poor market penetration, subsistence agriculture and climatic factors. Increased farmers' access to improved seeds of diversified crop varieties is one of the important strategies to address the above issue. To facilitate this objective, a community-based seed production (CBSP) system has been popular in recent years for seed production and marketing of low volume, low value crops' seed such as some cereals. This paper discusses the concept of CBSPs, summarizes the concerns in sustainability analysis, highlights the factors leading to success of CBSPs, and finally presents a framework to understand sustainability of CBSP system.

2. Concept of community-based seed production

Community-based seed production is a system of producing and marketing seed by the farmers, also known as farmers' seed production (Almekinders and Louwaars 1999), informal seed production (Cromwell and Wiggins 1993), small-scale seed production (Lyon and Danquash 1998), and local seed production (Almekinders, Louwaars and Bruijin. 1994). In this system, farmers' residing in the same geographical area and organized in 'group' or cooperative do seed production and marketing activities (Cochrun 1994). Seed production is a household level activity and it is the responsibility of households to manage resources in seed production. However, seed marketing (collection, processing, storage and distribution) is handled by their organization (also called community-based seed producer organizations – CBSPOs). All the seed growers are the owners of CBSPOs. Members participate in organizations' decision making process, and share costs and benefits of their

organizations' activities. The CBSP is also called an intermediary system (Bishaw and van Gastel 2008) considering its role to link formal institutions (government agencies and private companies) and local farmers to exchange germplasm and knowledge.

The concept of CBSP came in literature as a response to the failure of the formal system to supply seeds of diversified varieties in a cost-effective way in the rural areas. For example, in 1970s, international agencies supported government corporations (parastatals) in the developing countries to establish organized seed production, processing and marketing facilities. This program could not supply sufficient quantity of seeds of the different crop varieties in the rural areas due to ineffective management, lack of marketing strategies, and high costs involved in the production and marketing. Similarly, the narrow range of crop varieties developed and tested by parastatals using package of practices (e.g., fertilizer, pesticides) could not be applicable to the resource-poor farmers. This resulted into the low adoption of these varieties, especially in the case of small farmers. Then, in 1980s the international effort was turned towards promoting private seed companies to address the seed delivery issue in the rural areas. Again, this approach could not supply appropriate varieties to resource-poor farmers as in the above case. The private companies opened with the objective of supplying cereals seed in the rural areas focused their activities only on hybrid seeds (especially vegetables) due to low profit margin in (non-hybrid) cereal seeds (Mywish, Julie and Ducan 1999, Shrestha and Ednar 2007).

It is believed that CBSPOs could address the problems faced by the private companies and parastatals, and increase farmers' access to diversified varietal choices. The reasons behind the argument are as follows. First, these organizations could minimize costs in production and marketing because both production and marketing activities are handled at a local level with low transportation and management costs. Similarly, being an intermediary/less formal sector, CBSPOs do not require to go through the complex (long seed certification procedure adopted by government agencies) seed certification scheme (David 2004). Rather, the trained members of CBSPOs monitor the seed production plots, and apply quality assurance techniques such as truthful labeling (the technique where the producers declare the quality of their produce themselves). These conditions help them to reduce costs in the production phase. Third, CBSPs are allowed to produce and sell seeds of the local varieties evolved through farmers' innovations in addition to the modern varieties developed by research organizations. This helps CBSPOs to supply diverse crop varieties in accordance with the local needs that vary across the socio-economic and geo-physical settings (Joshi *et al*., 1997, Setimela, Monyo and Banziger 2004).

3. Concept of sustainability

The term 'sustainability' is derived from the Latin word Sustinere, meaning to sustain, endure or support or continue (Onions 1964). Though the idea of maintaining or sustaining the benefits of any initiative is not new, the word 'sustainability' started appearing frequently in the literature from 1970s to address the preservation of ecology for maintaining ecosystem services. Later, 'ecology' was merged with 'development' in the form of 'sustainable development' when Brundtland commission defined sustainability in the form of sustainable development considering the role of economy and society. According to the Brundtland report, "Sustainable development is the development which meets the need of present without compromising the future generation to meet their needs" (WCED 1987:43). This definition addresses the intra-generational and intergenerational equity. The intra-generation issue highlights the need to address the issues of poor people in the current generation whereas inter-generational equity focuses for maintaining the regenerative capacity of the ecological system under different shock situations, and enhancing the innovation capacity of social system. The term 'development' is a dynamic concept, and it implies that the socio-ecological system needs to address human needs in the changing contexts. Sustainability can be analyzed from the perspective of weak (economic oriented) or strong sustainability (ecology oriented) perspective but the concept of socio-ecological system combines both of these concepts.

The system describing concept interprets sustainability as the ability of the system to produce output that is well valued by actors and sufficient input is supplied and continuity of output for long time (Lewandowski *et al*., 1999). Seed production and management activities are primarily related to agriculture. So, it might be wise to introduce and apply the concept of sustainable agriculture in the analysis of sustainability of CBSP system. There are several definitions of sustainable agriculture under the system describing concept, and the broad consistency among the definitions is that 'sustainable agriculture is the use of resources to produce food and fiber in such a way that the natural resource base (such as biodiversity, soil quality, forest, water and air quality) is not damaged, and that the needs of producers and consumers can be met over the long term (Schaller 1993).

4. Perspectives in analysis of sustainability of agricultural system

In the agricultural sector, producers and consumers are the major actors. Producers intend to maximize the benefit from agricultural production whereas consumers' interest is to access quality product at a cheap price. However, in sustainability analysis it is difficult to demarcate whose benefits to be measured in the production and consumption chain of agriculture outputs. From the shareholders' perspective, benefits of seed producers might be more important but if we look at the same issue from stakeholders' perspective, issues of grain consumers (which might not be necessarily the farmers) need to be addressed. However, diversity of rice varieties at a cheap price could address this issue. Similarly, how long the current level agricultural benefit continues is complex in the changing context. It is difficult to precisely estimate benefit in the changing contexts. The logical way to address this problem is to determine how agricultural activities could minimize their impact on natural resources and how to enhance the innovation capacity of people so that they could mitigate risk or maintain the regenerative capacity of socio-ecological system in a short period.

Sustainability can also be discussed at the organizational level. Organizations are role-oriented institutions and they are formed according to government policy, and in this sense they are sustainable (Huntington 1968). However, structures and activities of organizations might be changing in accordance with the needs of their stakeholders. Researchers dealing with sustainability of agricultural organizations are concerned with whether these organizations could cover their full/partial operating costs or whether or not they can address the equity issue (i.e., the concerns of poverty), whether they have developed strategies to address the risk situation (Mac *et al*., 1989). The sustainable performance of people/organizations is measured using three indicators: economic, social and environmental.

The efficiency gain by producers would contribute towards paradigm shift of seed industry into other stages. Looking at the example from maize seed industries of United States of America, though maize seed industries were set up in 1930s, the seed industries made significant progress only after 1970 due to the implementation of patent right concept. This encouraged the private agencies to invest on research and development of new hybrid varieties using biotechnological and field experiments. It is not necessary that seed industries in each country follow the same path due to variation in production and consumption environment as well as types of crop varieties CBSPOs deal with. For example, farmers intend to replace the seed stock faster in a cross pollinated crop but it might be different in the case of self-pollinated crop species. However, researchers argued that the major driver of the change from one stage to another is efficiency gain by producers and consumers.

5. Factors affecting performance of CBSPs

The available literature suggests that cereal seed industry in the developing countries is in pre-industrial stage or emergence stage (Morris, Smale and Rusike 1998). In these stages, agriculture is mainly subsistence in nature and very few farmers adopt modern varieties. Development projects implement awareness raising projects to motivate farmers for the production and consumption of seed. Some farmers might start seed production activities in the form of groups or cooperatives but due to differences in their socio-economic status, all might not be ready for selling seed in the

market. So, it is important to analyze the performance of seed producers in the production phase and the marketing phase separately to capture the benefits they intend to get from these two phases. In the production phase, farmers could increase crop production volume and they will be benefitted even if they are unable to sell seed in the market, and the produced output will contribute to their family consumption. Potential factors affecting the performance of CBSPs are divided into external factors and internal factors.

5.1 External factors

External factors are those that are out of the control of seed producers. These factors include the policy and programs of the government as well as non-government organizations (NGOs), which are the major service providers for seed growers and their organizations. Seed consumers, also called demand actors, could also influence the behavior of seed producers. So, how policy environment and consumers influence the performance of seed producers is discussed here.

5.1.1 Policy environment

Government agencies and NGOs are the major service providers for CBSP in the early phase of development. Rules, regulations and strategies adopted by these organizations while delivering extension services serve as policy guidelines in seed production and marketing stages. The issues associated with government agencies are provision for source seed, seed testing facility and trainings about technical and managerial aspects of seed production and marketing.

Government owned research farms develop crop varieties and provide source seed to farmers for seed production. The associated issue is whether the varieties developed by government research organizations could address the demand of different categories of farmers. Almekinders, Louwaars and Bruijin (1994) reported that in many developing countries still the variety development task is limited on government agencies. The varieties developed by these organizations are evaluated considering the resource rich farmers using package of practices (combination of recommended inputs), which could not be practiced by the small/resource-poor farmers. In recent years, participatory plant breeding approach (the method of developing varieties in partnership with farmers using inputs used by farmers) is recommended to address this issue (Witcombe and Virk 1997, Joshi *et al.* 1997, Joshi *et al.* 2012). In this approach, farmers learn about plant breeding techniques including strategies to be adopted for the maintenance of genetic purity. However, participatory plant breeding is still limited in the activities of NGOs, and it is yet to be institutionalized in government policy in many countries. For example, seed policy in Vietnam does not allow for registration of farmers' bred varieties (Witcombe and Virk 1997). Unless the approach is clearly mentioned in the government policy it is less likely that projects/programs implemented by government agencies adopt the approach. In Nepal, participatory plant breeding has been institutionalized in the government policy which is seen from the release of rice varieties developed from this approach (Joshi *et al.* 2012).

The second policy concern is provision of skills (technical and business). The provision of these skills is based on how the provision of these services is integrated into the government policies. Almekinders, Louwaars and Bruijin (1994) argued that normally development projects designed in line with government policies are less worried about the capacity building of seed producers but are more focused on how they could achieve their development goals by mobilizing the seed producers. It is because the major objective of these agencies is to cover a large number of beneficiaries/ farmers by distributing improved seed, and strengthening the capacity of seed producers would not be their priority. However, development projects mobilize CBSPOs in distributing seed in local areas and/or in multiplying seed as per the demand of development projects, which CBSPOs could accomplish rather cheaply. David (2004) argued that there should be a provision of supporting extension service to CBSPOs by government agencies even if these organizations are empowered by NGOs. However, the nature of supports might vary with the stage of seed industry development in

the concerned countries. The possible supporting areas are training on business plan development and its implementation for the production and marketing of seed, subsidy for the development of physical structures (such as grading machine, seed storage building), provision of credit facility on low interest rate, and contribution in creating demand of seed produced by CBSPOs through demonstrations /networking (Witcombe, Devkota and Joshi 2010).

5.1.2 Seed demand characteristics

In rural areas, there is heterogeneity of farmers in terms of their socio-economic characteristics such as land size. Normally, larger farmers tend to adopt modern/hybrid varieties in combination with other agricultural inputs such as chemical fertilizers/pesticides and so on. On the other hand, small farmers' priorities might be to grow crop varieties that need less external inputs and are more risk averse in nature. Similarly, the price of seed, characteristics of the varieties, cropping pattern, land characteristics, etc., affect the behaviors of farmers buying seed from the market (Nkonya and Norman 1997, Paudel and Matsuoka 2008).

5.2 Internal factors

5.2.1 Socio-economic characteristics of seed growers

Previous studies have shown that demographic (age and education of household, family size), economic (operational land, irrigation facility, fertilizer, soil or land characteristics, etc.), and institutional (membership in the organization, access to training, etc.) variables are associated with their efficiency in utilizing resources and participation of farmers in the market (Rana *et al.* 2007, Idiong 2007, Piya, Kiminami and Yagi, 2012, Khanal and Maharjan 2013).

5.2.2 Organizational management

In general, in CBSPs, seed production is carried out at household level but marketing through their CBSPOs. The marketing activities of CBSPOs include collecting raw seed from individual growers, processing, storing and distributing to the consumers. They also provide technical services to their members through training or monitoring visit (Kugbei 2007, Witcombe, Devkota and Joshi 2010). To handle all these activities, CBSPOs form executive committees from the members following democratic principles. The committees take the overall responsibility to make necessary decisions in the organization respecting their members' views. CBSPOs in developing countries are in the form of groups or cooperatives, and in many cases these structures are the continuity or some modification of the traditional social organizations whose objectives would be primarily of overall socio-economic development of the members. The challenge for these cooperatives would be the issue of free riders, horizon, control and influence cost (Acharya 2009) for their sustainability. The issue of common property (free riders) problem might arise when property rights are not sufficiently defined to ensure that the individual bears the full cost of action or receive benefits from their actions. The horizon problem arises when cooperatives address only short-term benefit at the expense of long-term viability of the cooperative. For example, one one-member one vote principle might not motivate the members to invest in the organizations, and as a result organizations could face shortage of financial resources. To address these problems, CBSPOs form an executive body from members who lead the organization, initiative activities, create policies and problems, defend the policies and programs with their members, and coordinate with service providers such as government agencies (Chand and Karki 2005).

Another challenge of the executive committee is how to develop policies that are suitable for heterogeneity of their members. It is because many of the cooperative organizations in the developing countries have been promoted from the perspective of poverty reduction rather than their interest or potential or challenges while starting seed production and marketing activities (Acharya 2009). It means poorer members might face difficulties if organizations demand large

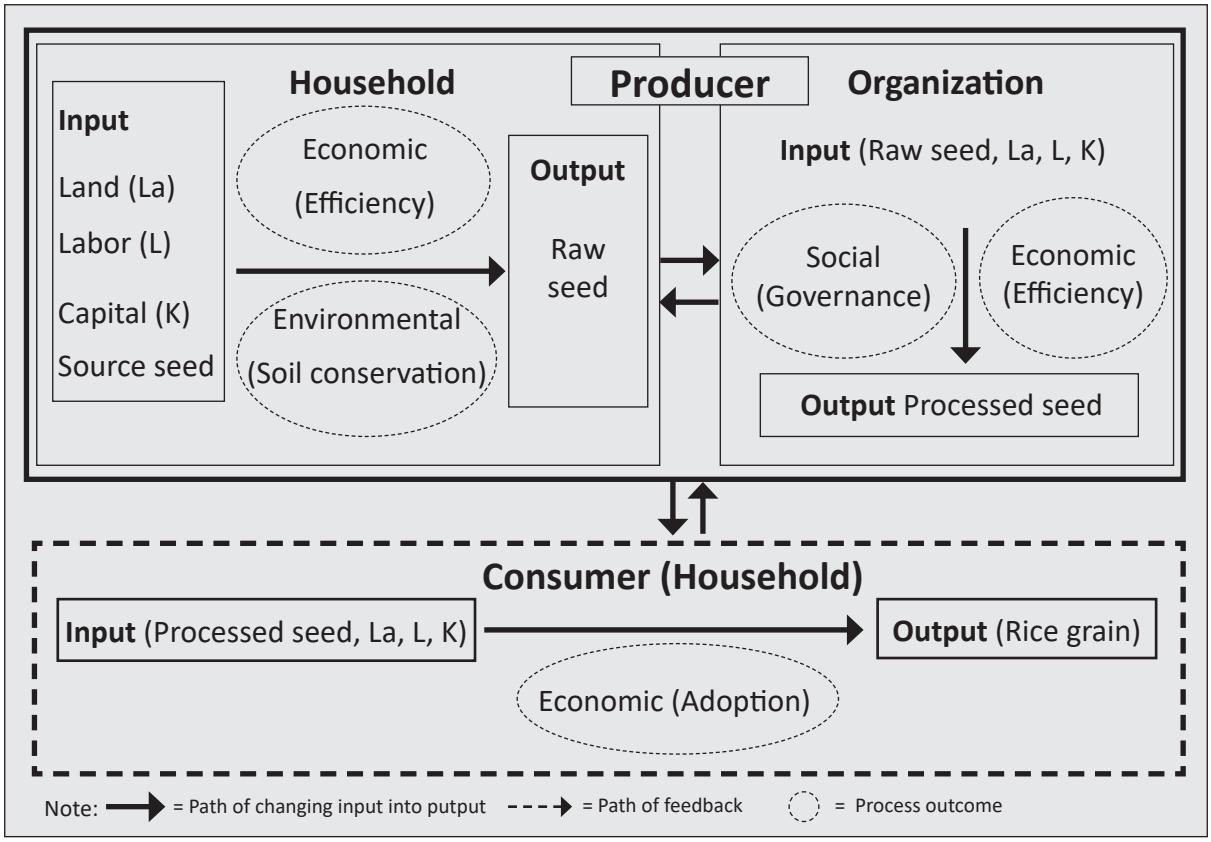

Figure 1.

amounts of money to start up their business activities, and sometimes members might leave the organizations not being able to pay for the fee set by their organizations. This implies that the 'executive committee' needs to address the interest of all categories of their members to enhance their loyalty and accountability towards their organizations.

Similarly, the executive committee might face the conflict on 'conformance role' vs. 'performance role'. The conformance role requires that the executive committee needs to work for the welfare of their members, especially for poor people, whereas the performance role requires them to demonstrate the performance of their organizations (for example, organizations' physical structure development, efficiency in marketing, etc.). The executive committee might face challenges from the government when they are evaluated for the benefit they have created for the local community in accordance to the expectation of consumers towards seed producers in getting quality seed in cheap/reasonable price. So, the organization could handle these issues by enhancing economic efficiency in marketing, and designing policies for good governance in the organization. Good governance in CBSPOs could be understood by analyzing the capacity of the executive's members in designing and implementing policies for participation, planning, business plan development and linkage with service providers (Gray and Kraenzle 1998, David 2004, FAO 2010b). Previous studies have shown that education, training, previous business experience of leaders, and physical structure of organizations would have significant positive impacts on organizational performance (Setimela, Monyo and Banziger 2004, Bishaw and van Gastel 2008). Kugbei (2007) argued that it might be difficult for CBSPOs to implement their activities in a timely manner unless they prepare business plan as it guides them on what activities to be implemented when and by whom. Similarly, the case of Nigeria shows lack of business plan was the major reason behind the low performance of CBSPs (FAO 2010b).

6. Framework for understanding sustainability of CBSP system

6.1. Components of the framework

Producers: Producers represent rice seed producing households having membership in CBSPOs. Since seed production is carried out at household level, it is the household decision on how to convert inputs (land, labor, capital and source seed) into raw seed using technology (scientific knowledge) and achieving economic and environmental performances (Figure 1). The economic performance gained by household is efficiency, whereas environmental performance (here it is adoption of soil conservation practice) shows the basis for continuing efficiency for long time. After producing raw seed, the household supplies it to their organization (CBSPOs) for marketing (market research, collection, processing, storage and distribution). Then, CBSPOs convert it into processed seed and sell seed to the consumers. The performance of CBSPOs in marketing can be measured in terms of efficiency and governance. The governance of CBSPOs is mainly related to how the organizations form rules and regulations in line with achieving efficiency in marketing. Good governance in the organization is also needed to manage conflict/risks that emerge from internal and external factors. This is because it defines incentive system for members to work for their benefits in a collective way. Governance also affects the flow of information within the organization, and makes the basis for implementing monitoring and evaluation system. Moreover, it also guides how democracy is implemented in the organizations. Participation of members in the decision-making process is the major way of applying democratic principle in the organization. However, it is integrated in the governance system as a means to reducing risk against inefficiency of organization in rice seed marketing.

Consumers: Consumers are also rice farming households residing near the seed producers but they grow rice for food and not for seed. These households serve as potential buyers of seed produced by the seed producers. These farmers might get processed seed from CBSPOs and convert it into rice grain using internal resources. In the process of conversion if they realize a benefit it is more likely that the consumers would continue buying seed from the seed producers (adoption). The benefit might be in the form of crop yield, straw yield or suitability of rice varieties in the cropping pattern or market price. However, diversity and cheap price could address the consumers' concerns. The adoption of seed/variety is an economic issue, and environmental and social issues are not focused at this level.

6.2. Relationship between producers and consumers

Three theories (system theory, contingency theory and political economy) explain the relationship between producers and consumers. The system theory discusses how formal collectivities to informal code of conducts work in the process of converting source seed into processed seed. Secondly, system theory is concerned simultaneously with the internal process and the relationship between the system and its environment. It thus forces us to think about a wide variety of social, economic, political, technical and other factors that affect sustainability. In other words, it enables us to merge agro-environmental, economic and managerial aspects in sustainability analysis.

System theory, however, provides little guidance about how to portray internal system processes or changes in response to externality. It is because the optimal structure or management styles of the production system are contingent on uncertain and exogenous conditions. Contingency theory thus shares with system analysis a concern for environment. The assumption in the theory is that any human aggregation or pattern of behavior has to be seen in relation to the complex of outside forces that threaten or promote its survival and expansion. The contingency theory fills this gap and demonstrates how producers can best attain congruence with the influences of external factors.

Producers can also impart direct influence on consumers. For example, marketing strategies such as seed quality, quantity, location, time of distribution, publicity could change consumers' behavior

in buying seed. While it is difficult for household to do these activities individually they could do by organizing themselves in groups or organizations. The households' phenomena to organize in groups/ association can be discussed with the help of political economy. For example, farmers organized in organizations could improve their economic activity by reducing transaction (marketing) cost and enhancing bargaining power with service providers. So, the above framework addresses three pillars (economy, environment and society) of sustainable development.

7. Conclusion

Sustainability issue of CBSP system has emerged mainly from the perspective of poverty and poor capacity of farmers' organization in seed marketing. It is a challenging task to make sure that resource-poor farmers with diverse socio-economic backgrounds can address members' interest. However, CBSPOs available in the form of groups or cooperatives serve as a platform to empower farmers in technical and managerial skills of seed production and marketing through self-help approaches, and some of the organizations could evolve into private companies later on. Consideration of profitability issue might be straightforward to assess whether the organizations cover their cost or not. However, this concept is very difficult to materialize in the newly formed CBSPOs because it is quite difficult to estimate the costs for subsidy and voluntary activities implemented by farmers. In this context, the framework proposed in this paper could be useful to understand the sustainability of newly formed CBSP system as it captures the benefits to be realized by seed producers indirectly in the form of efficiency, and it is linked with environmental and social benefits.

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Are Farmer-Based Seed Enterprises Profitable and Sustainable? Experiences of VBSEs from Afghanistan

Zewdie Bishaw[1] and Abdoul Aziz Niane[2]
[1]ICARDA, Addis Ababa, Ethiopia
[2]ICARDA, Beirut, Lebanon;

Correspondence: z.bishaw@cgiar.org

Abstract

Farmers are the main producers and users of seed for the millennia. Empirical evidence shows ample experiences of farmers' knowledge of on-farm seed management practices such as plant and/or seed selection, cleaning, treatment and storage for own use or local exchange. Traditionally, grain production and seed production is an integrated activity at the farmer level. This still continues for many crops in the developing world where the introduction of modern agriculture; classical plant breeding coupled with mechanization, fertilization or commercialization is yet to be widespread. Along this evolutionary path from traditional to modern agriculture, emerged the first farmer entrepreneurs who took up seed as a secondary business, planting the embryonic stage of organized seed industry. Over time these local farmer entrepreneurs (seed producers, users and sellers) within the community evolved into small-scale seed enterprises, with sole interest in seed business gradually developing into medium and later to larger seed companies. In this transitory phase from seed producers/ users/ sellers are still a plethora of community seed producers of different shapes and sizes involving farmers and supported by a variety of development organizations throughout the developing world. To date, it is common to see a multitude of community seed production schemes operating across countries in areas where the formal sector is absent. In broader terms these community seed production activities can be collectively called farmer-based seed production and marketing schemes with many variant names and arrangements. In this paper, ICARDA's experience in organizing village-based seed enterprises (VBSEs) underpinned by sustainability will be presented using examples from Afghanistan and elsewhere in the Central West Asia and North Africa region.

Key words: Afghanistan, village based seed enterprises, profitability, sustainability

1. Introduction

In 2002, Afghanistan emerged from more than two decades of conflict and since then, rehabilitation of the agricultural sector has become a priority for ensuring national food security and improving farmers' livelihoods. ICARDA (the International Center for Agricultural Research in the Dry Areas) led the Future Harvest Consortium to Rebuild Agriculture in Afghanistan (FHCRAA) supported by USAID (United States Agency for International Development). The ICARDA-led need assessment on crop improvement and seed supply situation in 2002 showed that most farmers were growing "obsolete" improved or farmer's varieties of barley (*Hordeum vulgare* L.), rice (*Oryza sativa* L.), maize (*Zea mais* L.), chickpea (*Cicer arientum* L.), and potato (*Solanum tubrosum* L.) except for irrigated wheat where 45% use improved varieties (FHCRAA 2002, Kugbei *et al*., 2005). Moreover, a country-wide survey revealed that the informal sector provided more than 92% of the planted seed (FHCRAA 2002). Lack of quality seed of improved varieties was cited as one of the most important agricultural production constraints by farmers.

In the absence of functional organized formal sector, a feasibility study was conducted to assess the potential of village-based seed enterprises (VBSEs) as alternatives for seed production and delivery. The results showed that at prices prevailing then, successful enterprises would breakeven at about 7.5 hectares and that considerable economies of scale would be earned at the optimum farm size of 20 hectares for wheat and rice. Enterprises that would be capable of expanding their cultivated area and sell all the seed they produce would benefit even more.

Cognizant of this, ICARDA, under the Rebuilding Agricultural Markets Program (RAMP, 2003/4–2005/6) and Alternative Livelihoods Program–Eastern Afghanistan (ALP-E, 2005/6–2007/8), initiated an alternative approach of establishing farmer-led VBSEs to ensure rapid access to quality seed of new crop varieties (Bishaw and van Gastel 2008, Srinivas *et al*., 2010). The RAMP project was implemented in Ghazni, Helmand, Kunduz, Nangarhar and Parwan provinces whereas the ADP-E project was focused in Nangarhar, Laghman and Kunar provinces in eastern Afghanistan. Apart from Afghanistan, the VBSE concept operated in other countries that include Algeria, Eritrea, Morocco, Pakistan, Palestine, Tunisia and Yemen with appropriate adjustments to each country's situations. However, this report will only concentrate on work done in Afghanistan.

2. Why VBSEs?

In many developing countries, with exception of a few major food crops such as wheat, rice and maize and in favorable environments, the performance of the formal seed sector is disappointing in terms of varietal choices and seed supply. The majority of farmers still depend on farm-saved seed and local varieties. Farmers save their own seed for many reasons: (i) security – seed is available and accessible when they need it; (ii) economic – low or no transaction costs for seed acquisition; (iii) trust – they have confidence in the quality of their own seed.

There is a dilemma as neither the public sector nor the private sector is able to provide small-scale resource-poor farmers in less favorable environments and remote areas with a diverse choice of varieties and seeds for most food security crops. On one hand, the liberalization and privatization of the seed sector have substantially reduced seed production and marketing by the public sector. On the other hand, the private sector has limited interest in providing seed to subsistence farmers because of low profit margins for most food security crops. A flexible alternative seed delivery is therefore required to cater to the needs of these farmers. Bottom-up approaches involving farmers appear to be more appropriate because they have the potential of building upon existing traditional knowledge, skills and experience. To date there is a plethora of community seed producers of diverse form involving farmers and supported by a variety of development organizations throughout the developing world (Thijssen *et al.* 2008). In broader terms these community seed production activities can be collectively called farmer-based seed production and marketing schemes with many variant names and arrangements (Yonas *et al.* 2008).

3. What are VBSEs?

The VBSEs are farmer-based seed production and marketing schemes that undertake seed business with view to make profit (Bishaw *et al*., 2008; van Gastel *et al*., 2008)). They are farmer groups or individuals operating at local level to ensure availability and access of varieties and seeds to farmers in the absence of formal sector or in less favorable environments and remote areas. VBSEs tend to compliment the formal sector and focus on crops neither handled by the public sector nor the private sector. The VBSEs are characterized by the following:

- Participatory – mobilize and involve small farmers in target environments;
- Decentralized – multiply well adapted and farmer preferred varieties at local levels;
- Business oriented – production is linked to seed demand from local and nearby communities;
- Cost effective – lower transport, marketing and distribution costs, thus reducing seed prices;
- Relevant quality – adopt seed quality standards appropriate to farmer requirements;
- Appropriate technology – use low-cost cleaning/treatment equipment to improve seed quality;
- Sustainability – ensure farmers' empowerment and ownership in seed business;
- Evolution – develops into small, privately owned small to medium scale seed enterprises.

4. Methodological Approaches

The methodological approach for establishing VBSEs as alternative seed delivery option was described by Bishaw and van Gastel (2008), its conceptual and organizational approaches and the linkages and support required from formal sector institutions elaborated.

4.1. Status of seed supply in target regions

In both projects a baseline survey was carried out to collect information on household characteristics, production practices and constraints with particular reference to crops, varieties and seeds. The main objective was to determine farmer's practices and preferences and demand for varieties and seeds as well as for recording benchmark indicators for measuring project achievements.

In 2005, a baseline survey showed that overall, 94% of respondents cultivated wheat, 59% onion, 46% tomato, 29% potato, 23% mung bean, and 18% rice in five target provinces (Table 1). The majority of farmers (69%) are using seed from the informal sector: i.e. 49% own saved, 12% from neighbors, 8% from local markets. Based on area under improved varieties, it was estimated that average household effective seed demand was 116.7 kg for wheat, 80 kg for rice, 9.8 kg for mung bean and 321 kg for potato. Unavailability of quality seed and lack of access to credit for quality seed and fertilizers were identified as major constraints for crop production.

Table 1. Farmers' seed sources (%; n = 675) in Afghanistan (2005)

Seed source	Kunduz	Nangarhar	Ghazni	Helmand	Parwan	Total
Own source	44	28	44	80	75	49
Neighbors	6	18	9	17	2	12
Markets	27	13	7	1	2	8
NGOs	6	18	17	1	5	12
ICARDA	10	21	22	1	11	16
FAO	4	1	1	0	4	2
Government	4	1	0	0	1	1
Total	100	100	100	100	100	100

In 2006, a similar baseline survey was also conducted in eastern Afghanistan. In terms of area coverage, wheat was a major crop followed by rice, potato and mung bean. The informal system was the major seed supplier across all provinces and crops, i.e., 44% own saved, 16% other farmers and 14% local markets (Table 2). The majority of wheat (91%), potato (70%), rice (36%) and mung bean (26%) farmers were interested to buy seed of improved varieties. The effective average demand for improved seed per farm household was estimated at 133, 100, 22, and 1,073 kg for wheat, rice, mung bean and potato seed, respectively. However, unavailability of seed and high cost and lack of credits reported as constraints for crop production.

Table 2. Farmers' seed sources (%; n=480) in eastern Afghanistan (2006)

Seed source	Wheat	Rice	Mung bean	Potato	Total
Own-saved	53	61	44	18	44
Other Farmers	20	28	10	5	16
Local market	7	3	10	38	14
Seed traders	1	1	29	34	16
MAIL	1	0	0	1	0.5
NGOs	18	7	7	4	9
Total	100	100	100	100	100

4.2. Formation of VBSEs

A rapid analysis of seed system was conducted to assess whether access to varieties and seeds was a real constraint and if there would be a market for seed produced by the enterprises in target districts. This was coupled with a simple feasibility study of the enterprises. The outcome of the study and the initiative of enterprise formation were shared with farmers in local communities and key stakeholders. Those well experienced and progressive farmers, who showed interest in working together and had the minimum resources such as land, irrigation water, prior experience in seed or crop production etc., were organized to form an enterprise.

In each target province, four major crop producing districts were selected and VBSEs were established both under RAMP and ALP/E projects. In total, 21 VBSEs under RAMP and 17 VBSEs under ALP/E were supported (in Nangarhar, five former VBSEs established by RAMP were also retained, bringing the total to 17 VBSEs). Under ALP/E project, VBSEs in each province were grouped into Provincial Agricultural Companies, *viz.,* Nangarhar Agriculture Company (NAC), Laghman AC and Kunar AC. All VBSEs had been registered under the umbrella of the provincial agricultural company as legal entities with the Ministry of Agriculture, Irrigation and Livestock (MAIL) and Afghanistan Investment Support Agency (ASIA) within the cooperative law to operate as enterprises, receive government support and access financial credit.

4.3. Provision of seed, inputs and facilities

Each VBSE was provided with initial inputs and seed for multiplication and marketing of well adapted improved varieties. Under ALP/E, VBSEs were also provided with farm machinery (tractors, threshers, sprayers) and mobile seed cleaning and treating equipment.

VBSE members were responsible for seed production, processing, storage and marketing operations with technical advice from ICARDA and the MAIL. Seed production fields were inspected and harvested, cleaned and treated and packaged. The seed lots were tested for quality (physical, physiological, health) to meet Quality Declared Seed (QDS) standard (FAO 1998) and stored until planting time. Each VBSE marketed quality seed directly to other farmers, development agencies, government and NGOs in their districts and beyond.

4.4. Capacity strengthening

Several trainings were conducted at regular intervals throughout the project period to enable VBSE member farmers to manage their seed enterprises and for professionals from partner institutions, such as MAIL (research, development, extension, and quality control), NGOs, and donors to provide the appropriate technical support required by a particular VBSE.

In technical sessions, the emphasis was on principles and techniques of seed production (varietal choice, source seed, land selection, planting, fertilization, weed control, roguing), seed processing (cleaning, treatment, packaging), seed storage (spraying, fumigation) and quality assurance (field inspection, seed testing, labelling). In financial and enterprise management sessions, emphasis was given to business planning, record keeping, promotion and marketing.

4.5. Seed demand survey

Seed demand surveys were also carried out to determine the demand for improved seeds on the basis of which production operations of VBSE could be adjusted. The majority of farmers are aware of improved wheat varieties compared to that of rice, potato and mung bean. Most farmers used own saved seed, but also source seed from other farmers, local markets, government programs and NGOs and reported availability as constraints for use of quality seed and adoption of improved varieties of target crops (wheat, rice, potato and mung bean). The demand of seed and farmers willingness to pay for quality seed is an opportunity of local seed production by farmer groups.

4.6. Business plan preparation

The project supported VBSEs in the preparation of business plans where VBSE representatives and members participated actively. VBSEs used these business plans in conducting their operations. Separate business plans were also prepared for the three Agriculture Companies before the start of each cropping season

4.7. Monitoring operation of VBSEs

After formation of VBSEs, an operation calendar was developed and monitoring system installed and implemented during seed production and marketing. All field operations (land selection, planting, fertilization, weed control, rouging, harvesting, threshing), seed processing (cleaning, treatment, packaging), seed storage (spraying, fumigation), quality control (field inspection, seed testing, labelling), and seed marketing were documented, monitored and evaluated.

4.8. Analysis of performance and profitability

The overall performance of the enterprises can be measured by the amount of quality seed produced and marketed and profits made by VBSEs. To assess the performance of the VBSEs, both technical and financial data were collected throughout the year. Hence, technical performance (quantity and quality of seed) and profitability analyses were conducted for consecutive years of seed business operations.

5. Steps for establishing VBSEs

The approach to initiatives involving farmers is often top-down, based on the assumptions of development agencies rather than critical appraisal of existing situations. Below a number of steps are given, to be followed for successful establishment of a VBSE (Figure 1).

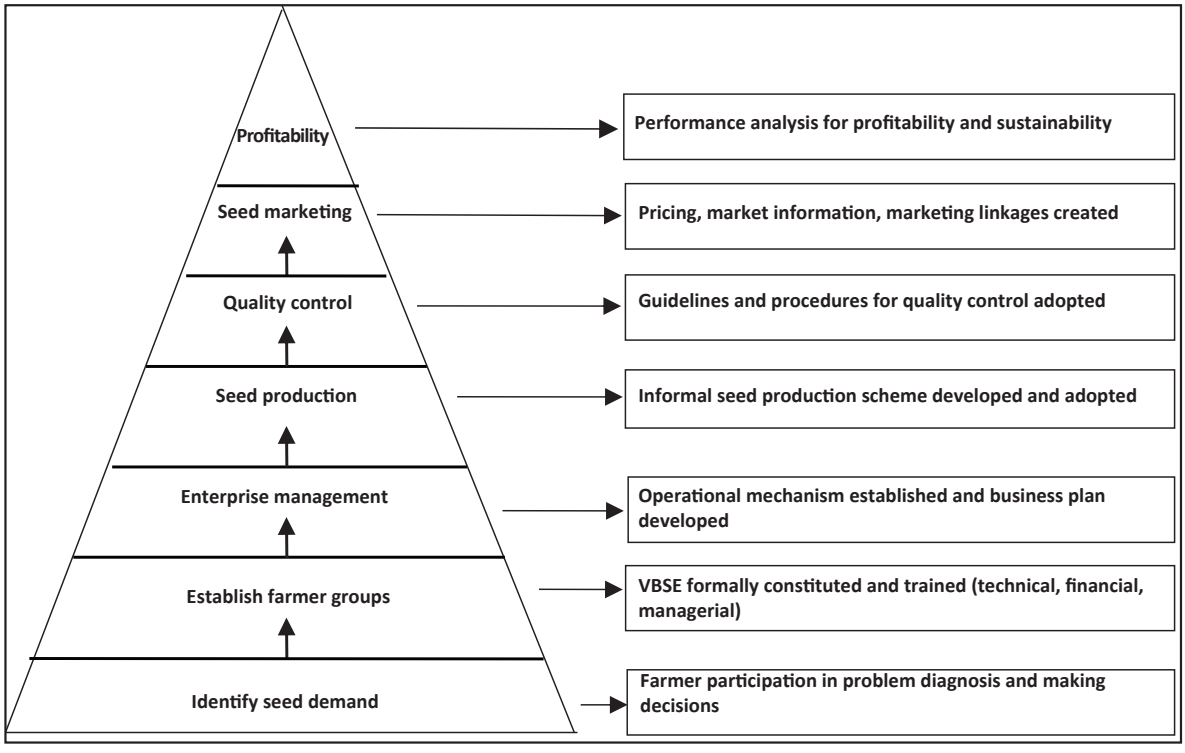

Figure 1. Steps in establishing village-based seed enterprises (from Bishaw et al.*, 2008)*

- Seed system analysis: The seed system analysis should be conducted before establishing VBSEs to assess whether there is a seed demand or 'seed gap'. A simple feasibility study would be useful to see the profitability of seed business.
- Stakeholder's consultation: Have a stakeholder's consultation to identify those interested supporting VBSEs; and determine their roles and responsibilities in implementations.
- Identifying target areas: VBSEs should target (a) farmers lacking access to improved crop varieties and seeds, (b) less favorable, remote and isolated areas with limited infrastructure, and (c) resource-poor small-scale farmers with limited opportunities.
- Selecting farmers: Participating farmers must be interested and committed to setting up seed business; and must have reputation in the community, experience in farming and seed production, relatively bigger/better land holdings, possession of key facilities, entrepreneurial skills and financial resources.
- Forming seed producer groups: Farmer participation and empowerment are key elements of the VBSE program. Farmers should take responsibility and leadership and elect their own leaders whereas partners facilitate, provide guidance and advice.
- Selecting seed production sites: The land selected must be suitable for quality seed production: better/fertile soils, reliable rainfall (or irrigation), low incidence of diseases, pests and parasitic weeds, proximity and accessibility to main roads/facilities.
- Preparing a business plan: Develop a business plan that serves as a guide to the enterprise—products (crops, varieties), potential markets, costs, sales and profits. It also includes risk assessments and details of ownership, management, legal structure, staff, equipment, and the budget.
- Producing and marketing seed: All seed production and marketing operations are carried out by the members of the VBSE. Promotional efforts and marketing are prerequisite to ensure success.

6. Performance of VBSEs

6.1. Technical and financial performance

Under the Rehabilitation of Agricultural Markets Program (RAMP), 21 VBSEs were established in five target provinces over a three-year period. Each VBSE allocated on average, more than 20 ha of land and produced more than 100 tons of quality seed of four major food crops (wheat, rice, mung bean, and potato) for income diversification (Table 3).

Table 3. Amount of seed produced and marketed by VBSEs (t) from 2004-2006 under RAMP in Afghanistan

Year	Active VBSEs	Wheat	Rice	Potato	Mung bean	Total
2003 /04	6	753	525	-	-	1,278
2004 /05	17	2188	651	752	325	3,916
2005 /06	21	3,533	2,352	3,784	186	9,855
Total	21	6,474	3,528	4,536	511	15,049

Assessment of profitability demonstrated a total net income of US$ 0.85 million for 17 VBSEs in 2004/05 and US$ 2.3 million for the 21 VBSEs in 2005/06 through production and marketing of quality seed. The marginal rate of return (%) for wheat, potato, rice and mung bean was 239, 193, 163 and 190, respectively (Table 4).

Table 4. Area cultivated, seed production and revenues by VBSEs in 2005/06 under RAMP in Afghanistan

Item	Wheat	Potato	Rice	Mung bean
Number of active VBSEs	17	14	9	7
Total area (ha)	542	45	139	264
Total production (t)	2,188	752	651	325
Average production (t/ha)	4.04	16.7	4.7	1.23
Average price (farm gate Afs/t)	17,000	8,946	17,460	21,300
Gross revenues (Afs/ha)	68,680	149398	82062	26,199
Production cost (average Afs /ha)	20,205	51,000	31,190	9,025
Net average marginal income (Afs/ha)	48,475	98,398	50,872	17,174
% Marginal income	239	193	163	190

Under ALP/E project, 17 VBSEs (including 5 retained from RAMP project in Nangarhar) were established in three provinces in eastern Afghanistan. They collectively produced about 3,856 tons of quality seed over the three year period (Table 5). In terms of technical performance, from total area planted an average of 85% was approved for wheat, rice, mung bean and potato during field inspection. The average cleaned seed recovery was 95% for all crops. For example, in 2007/8, the average purity and germination of VBSE seed samples were 98.1 and 91%, respectively, showing that VBSEs are capable of producing high quality seed for marketing.

Table 5. Amount of seed produced and marketed by VBSEs (t) under ALP/E project in Afghanistan

Crop year	Active VBSEs	Wheat	Rice	Mung bean	Potato	Total
2005/06	6	626	-	-	-	626
2006/07	15	955	94	11	-	1,060
2007/08	17	1,445	593	91	41	2,170
Total	17	3,026	687	102	41	3,856

The profitability analysis showed that the net profit margin was US$315,531 for 15 VBSEs in 2006/07 and averaged US$ 21,035.4 per VBSE. In 2007/8, the net margin for 17 VBSEs was US$1,311,060 from seed business and services with an average of $77, 121 per VBSE. The marginal rate of return (%) for wheat (QDS), Wheat (CS), potato, rice and mung bean was 504, 259, 269, 278 and 251, respectively (Table 6).

Table 6. Area cultivated, seed production and revenues by VBSEs in 2007/08 under ALP/E in Afghanistan

Item	Wheat (QDS)	Wheat (CS)	Potato	Rice	Mung bean
Number of active VBSEs	15	6	6	12	15
Total area (ha)	261	59.6	3.7	102.2	48.3
Total production (t)	1224	220.7	41.5	593.1	91.1
Average production (t/ha)	4.7	3.7	11.4	5.8	1.9
Average price (farm gate $/t)	800	850	230	446	714
Gross revenues (US $ /ha)	4107	3692	2610	2893	1570
Production cost (US $ /ha)	680	1029	707	766	447
Net marginal income (US $ /ha)	3427	2663	1903	2127	1123
% marginal income	504	259	269	278	251

Note: QDS=quality declared seed; CS=Certified seed

7. Elements for VBSE success

The number of VBSEs and the quantity of seed produced increased over time during the project period. Some VBSEs established by the two projects developed into small- to medium-scale seed enterprises on their own right through follow-up projects. Some VBSEs organized under the umbrella of provincial seed association and joined the Afghanistan National Seed Organization and continue to operate as seed producers and suppliers.

There are a number of prerequisites for the establishment and successful operation of VBSEs:

- Regular seed demand: from farmers within the community, neighboring villages or districts;
- Reasonable seed price: the margin should be affordable by farmers and profitable for producers;
- Appropriate seed quality: Farmers produced consistently higher quality seed than farm-saved or locally exchanged seed;
- Enterprise ownership: farmers should take the responsibility in managing and operating the enterprises;
- Business plans: developing tailor-made business plans based on demand survey and analysis;
- Crop and enterprise diversification: Enterprises with more crops minimized risks and earned better returns from the seed business;
- Sustainability: Farmers make a profit which enabled them to continue with seed business without external support

8. Creating linkages and supporting VBSEs

The strategy of involving stakeholders and encouraging them to work towards an annual business plan based on demand-led production is critical to develop sustainable, financially profitable seed production and marketing enterprises. Key aspects of partner support are described below and shown in Figure 2:

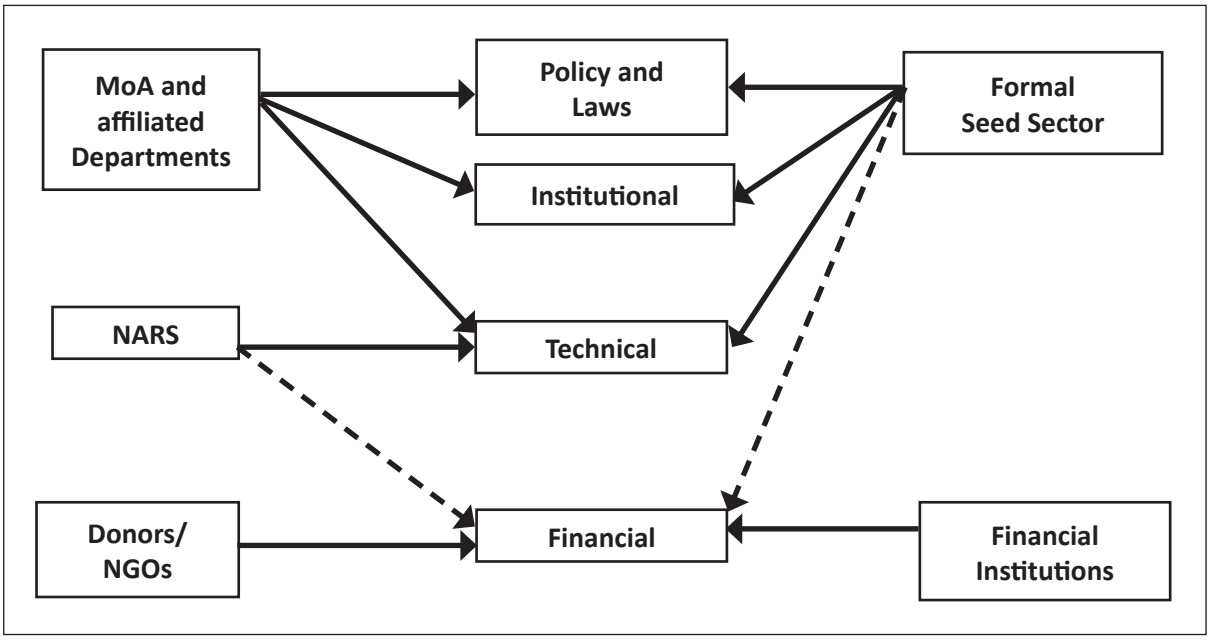

Figure 2. Key stakeholders supporting village-based seed enterprises (modified from Bishaw and van Gastel, 2008)

- Sourcing seed and other inputs:
- Partners help VBSEs to source early generation seed of the varieties most adapted to their areas from NARS, the formal sector or participatory breeding programs. Similarly, partners assist VBSEs to source the inputs (such as fertilizers and pesticides) required for quality seed production.
- Producing seed: Partners provide training, guidance and assistance to ensure that VBSE members have the skills and knowledge necessary to produce seed that meets quality standards.
- Processing and storing seed: VBSEs assisted to ensure that they are able to acquire simple low-cost mobile cleaner and treater prototypes which can then be easily copied and modified locally. Partners will also help VBSEs to build appropriate central seed storage facilities.
- Ensuring seed quality: Partners will train VBSE members to carry out field inspections and simple seed quality tests or through provision of services by the formal sector.
- Marketing seed: The marketing strategy includes promotional activities through on-farm demonstrations of new varieties, organizing field days for neighboring farmers, branding and market information provided through ministries, extensions services, and NGOs.
- Accessing credit: VBSEs need access to credit for purchasing field equipment, inputs (e.g. source seed, fertilizers and pesticides) and seed-handling equipment (e.g. cleaning, treatment, and packaging).
- Building capacity: Training will be implemented to build, step-by-step, farmers' technical (planting, harvesting, cleaning, treatment, testing and storage), financial and enterprise management skills (day-to-day operation of seed enterprises, record keeping, developing business plans).
- Establishing network of VBSEs: VBSEs are assisted to establish a network to link with input providers, facilitate information exchange and sharing experiences.
- Linking with local agro-industries: Linkages between grain producers and local agro-processing industries stimulates the use of better technology, creating demand for the use of quality seed.
- VBSEs continue to operate the seed business on their own right and some of them have been transformed into the private seed enterprises and are functioning as members of the national seed association (Samadi and Aziz, 2014).

A detailed work plan and timetable should be developed for the implementation of VBSEs. The commitment of all partners to the work plan and timetable will ensure timely and successful execution.

9. Conclusion

The following conclusions can be drawn from the establishment and operation of VBSEs in Afghanistan:

- The provision of adequate facilities, training and linkage to key stakeholders are prerequisites for the formation of business-oriented small-scale VBSEs which ensure long-term sustainability.
- The concept of organizing village based low-cost production and marketing seed enterprises to optimize seed delivery and diffusion of new varieties as an alternative, yet complementary to formal seed systems has proven feasible and effective for reaching poor farmers in marginal areas where the formal public and private sectors are not supplying quality seed.
- VBSEs should be flexible and have the freedom to operate informally, without the need to comply strictly with the stringent requirements of the regulatory and quality assurance agencies of the formal sector.
- VBSEs produced consistently higher quality seed than farm-saved or locally exchanged seed and provided seed at reasonable price creating continuous demand from the farming communities.
- VBSEs take the responsibility in managing and operating the enterprises by developing tailor-made business plans and diversifying crops to minimize risks and made profit to ensure sustainability.

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Legumes Seed System in Asia: A Case in India

M.G. Mula, K.B. Saxena, P. Gaur and H. Upadhyaya
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, Andhra Pradesh, India

Abstract

The legume (*Leguminosae* family) seed system in India consists of the informal, formal and the integrated seed sector. However, the informal seed sector dominates the seed production system. The majority of farmers who grow legumes particularly as dry seeds (in short pulses), save a part of their produce (about 80–90%) as seed requirement. Although, the private sector is increasing its share of the market, it is the farmers' sector (farmer-saved seed and exchange systems) that produces 70% of the quality seed. Quality seeds are labeled as 'truthful' seeds when farmers follow the recommended package of practices in order to maintain the level of genetic purity of legumes. In the formal seed sector, private companies respond to commercial incentives on hybrids of high-value seeds. However, the existence of the developed formal seed sector at the national level cannot guarantee small-farmer seed security at the community and household levels. The integrated approach that takes into cognizance the formal and informal seed sector in breeding, seed production and distribution has shown to have promising potential for improving seed supply to smallholder farmers. Moreover, any seed system, for that matter, requires a regulatory framework as well as a seed policy that considers regulations of an expanding and diversifying seed sector for the benefit of the farmers engaged in the seed production system.

Key words: legumes, seed system, pulses, informal seed sector, formal seed sector and integrated seed sector.

1. Introduction

Legumes, such as pigeonpea, chickpea, and groundnut, play an important role for sustainable agriculture in rainfed areas of India. The increasing population growth and the poor productivity (635 kg/ha) have resulted in the reduction of per capita availability of pulses (dry seeds), which together with undue price hike has distorted the consumption pattern of households. Production growth has not been able to keep pace with the population growth and, as a consequence, India's per capita net availability of legumes has fallen from 27.3 kg/year in the 50s to 16 kg/year in 2001 and fallen further at 10 kg/year in 2010 (Gupta 2008, www.commodityonline.com 2009, www.rediff.com 2009, Srivastava *et al*., 2010). The country's increasing demand for legumes has resulted in increase in imports to around 2.8 million tons in 2011–2012 (www.rediff.com 2012).

Pigeonpea and chickpea are primarily cultivated in western, central, eastern, and peninsular regions, whereas groundnut is a dominant crop of western and peninsular India. The contribution of chickpea to the country's pulse production is about 40%, whereas groundnut contributes about 30% to the edible oil basket of the country. In spite of the considerable production of these commodities (Table 1), reasonable quantities of these legumes are imported to meet domestic requirements

Table 1. Production statistics of pigeonpea, chickpea, and groundnut in India (2011).

	Crops		
Particulars	Pigeonpea	Chickpea	Groundnut
Average area (ha)	3,580,000	7,310,000	4,190,000
Average production (tons)	3,190,000	5,890,000	6,933,000
Average yield (current, kg/ha)	750	762	1,655
Projected yield (2015, kg/ha)	1,000	960	1,800
Expected growth of production (%)	5	5	5
Proportion of production sold (%)	60-75	50-90	85

(www.rediff.com 2012). The development of new short-duration varieties of chickpea and pigeonpea at ICRISAT has brought a major change in the cropping systems and adaptation patterns. The short-duration pigeonpea are now grown on a fairly large scale in the north (i.e., Uttarakhan) in rotation with winter wheat. Similarly, short-duration and drought-tolerant groundnut varieties are becoming popular with farmers in India whereas short-duration chickpea varieties have made a tremendous impact in peninsular India.

2. Pulse Seed Systems in India

Seed is the lifeblood and foundation of agriculture for smallholder farmers. Good quality seeds, which have genetic and physical purity, health standards, high germination and moisture percentage can increase farmers productivity by 20–30% (Mula 2012). In India, 70% of the country's seed system is managed by farmers' traditional practices, which involves saving seed from own harvest, and using seed for re-sowing, sharing, exchanging/bartering and selling. The formal seed sector has made some progress in certain crops but very little in others (i.e., legumes) where the traditional (informal) system remains dominant. Approximately 80–90% of all planting material used is largely sourced from farmers' own-saved seed or the informal seed sector. Farmers save seed of local varieties and use this continuously for about 3–4 years (Figure 1, i.e., pigeonpea) with low seed replacement ratio of 2–3% because the proportion of quality seed available each year is only 10–12% (Ravinder Reddy *et al.* 2007).

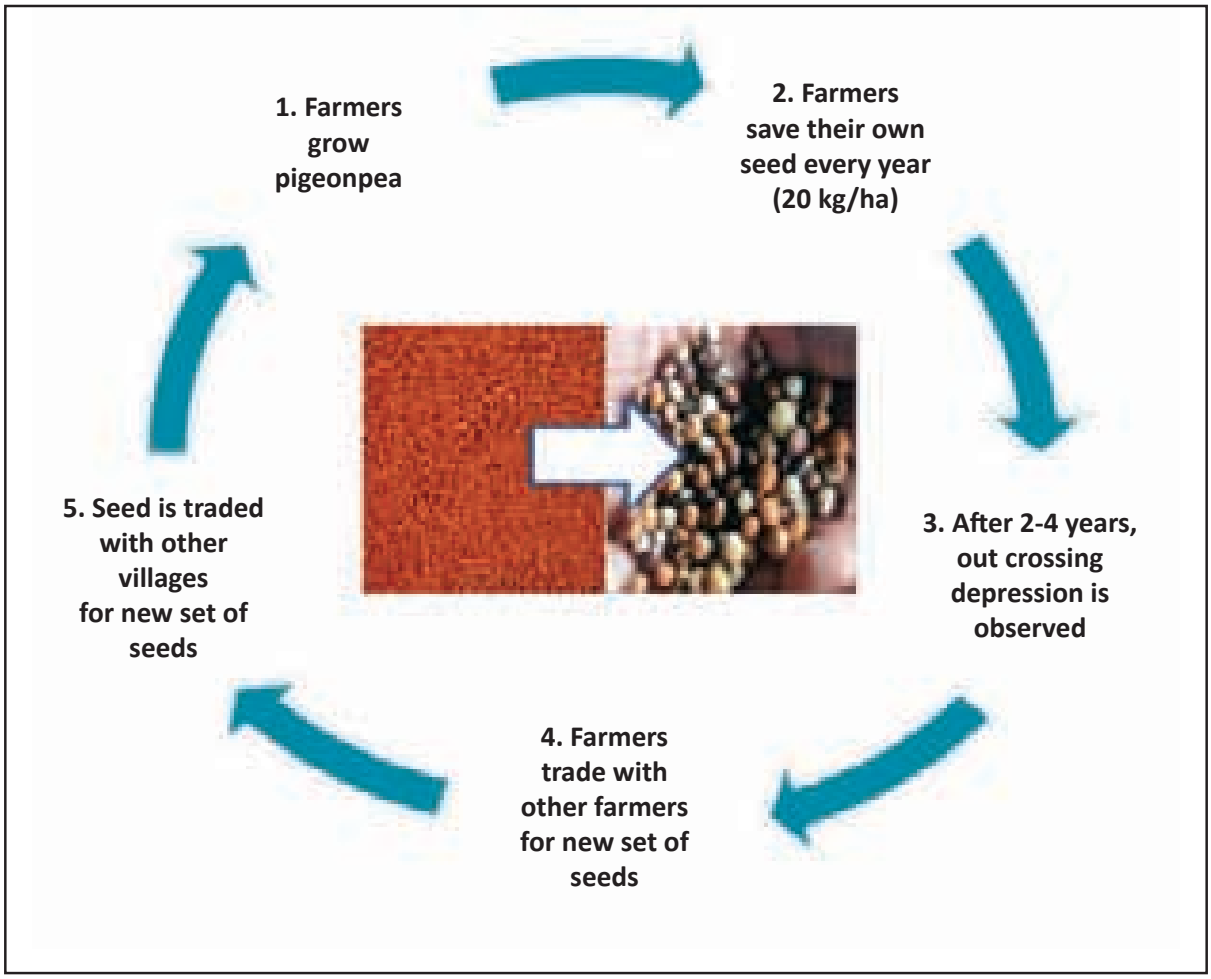

Figure 1. Existing pigeonpea smallholder farmers seed system model.

The cultivars used are invariably local landraces, and awareness about improved varieties, seed availability and seed access is poor. Seed is procured off-farm only when necessary as when own seed is not available due to drought, poverty or seed pests and diseases. The main sources of off-farm seed are local markets, relatives, other farmers and government relief agencies. However, these statements about the predominance of the informal seed sector cover significant differences between crops, villages, farmer groups and their socioeconomic conditions. Traditional seed systems are location-specific and vary greatly within farmer communities.

3. ICRISAT's Intervention

At present, ICRISAT has been involved in developmental projects aside from continuously breeding new high yielding cultivars of chickpea, groundnut and pigeonpea that complemented the seed delivery system of public and private sector partners and projects such as: Tropical Legumes II and the Odisha Pigeonpea project.

1. **Tropical Legumes II (TL II).** This project is funded by the Bill & Melinda Gates Foundation and has the objective of improving livelihoods of smallholder farmers through improved productivity and production of tropical legumes in South Asia. The incorporation of a seed system component in the project has provided avenue for smallholder farmers to be seed entrepreneurs. ICRISAT, in collaboration with state universities of the five states in India (ANGRAU – Andhra Pradesh; UAS –F Dharwad and UAS – Raichur in Karnataka; BAU – Bihar; OUAT – Odisha; and TNAU – Tamil Nadu), has developed the seed system models for chickpea, pigeonpea and groundnut (Figures 2, 3, 4 and 5) that resulted in total production of 61,783.78 tons of chickpea (50,801.93 tons), pigeonpea (1,202.59 tons), and groundnut (9,779.26 tons) of various seed class in 2012–2013 cropping season (Table 2). In pigeonpea, the concept of 'one village one variety' was institutionalized to guarantee isolation to avoid seed contamination whereas in groundnut, the Panjabrao Deshmukh Krishi Vidyapeeth (PDKV) model was promoted in the informal seed sector (Abate 2012).

Table 2. Seed production of various seed class of chickpea, pigeonpea, and groundnut under TL II project during 2012–2013 cropping season.

	Seed class (tons)					Total
Crop	Nucleus	Breeder	Foundation	Certified	Truthful label	(tons)
Chickpea	8.23	261.00	2,811.70	44,103.20	3,617.80	50,801.93
Pigeonpea	-	28.09	160.35	1,006.05	8.10	1,202.59
Groundnut	16.35	650.91	1,399.60	7,607.40	105.00	9,779.26
Total	24.58	940.00	4,371.65	52,716.65	3,730.90	61,783.78

In Andhra Pradesh, to facilitate efficient seed production and marketing, ANGRAU has established linkages with Andhra Pradesh State Seeds Development Cooperation (APSSDC), National Seed Corporation (NSC), State Farms Corporation of India (SFCI), and *Adarsh Rythu* for efficient production and seed diffusion. The involvement of Andhra Pradesh State Seed Certifying Agency (APSSCA) in roguing, inspection and selection, and certification of farmers' seed production fields has ensured purity and quality of seeds (Holmesheoran *et al*., 2012).

2. **Introduction and Expansion of Improved Pigeonpea (Arhar) Production Technology in Rainfed Upland Ecosystems of Odisha, India**. This project is funded by the Department of Agriculture of Odisha under the *Rashtriya Krishi Vikas Yojana* (RKVY) sub-scheme. The partnering of ICRISAT with the Department of Agriculture, Non-Government Organizations (NGOs), Odisha State Seed and Organic Product Certification Agency (OSSOPCA), and the Odisha Agro Industry Corporation (OAIC) established the seed delivery system (Figure 5) that resulted in the production of 589.84 tons of farmer preferred varieties and hybrids of various seed class in 2012–2013

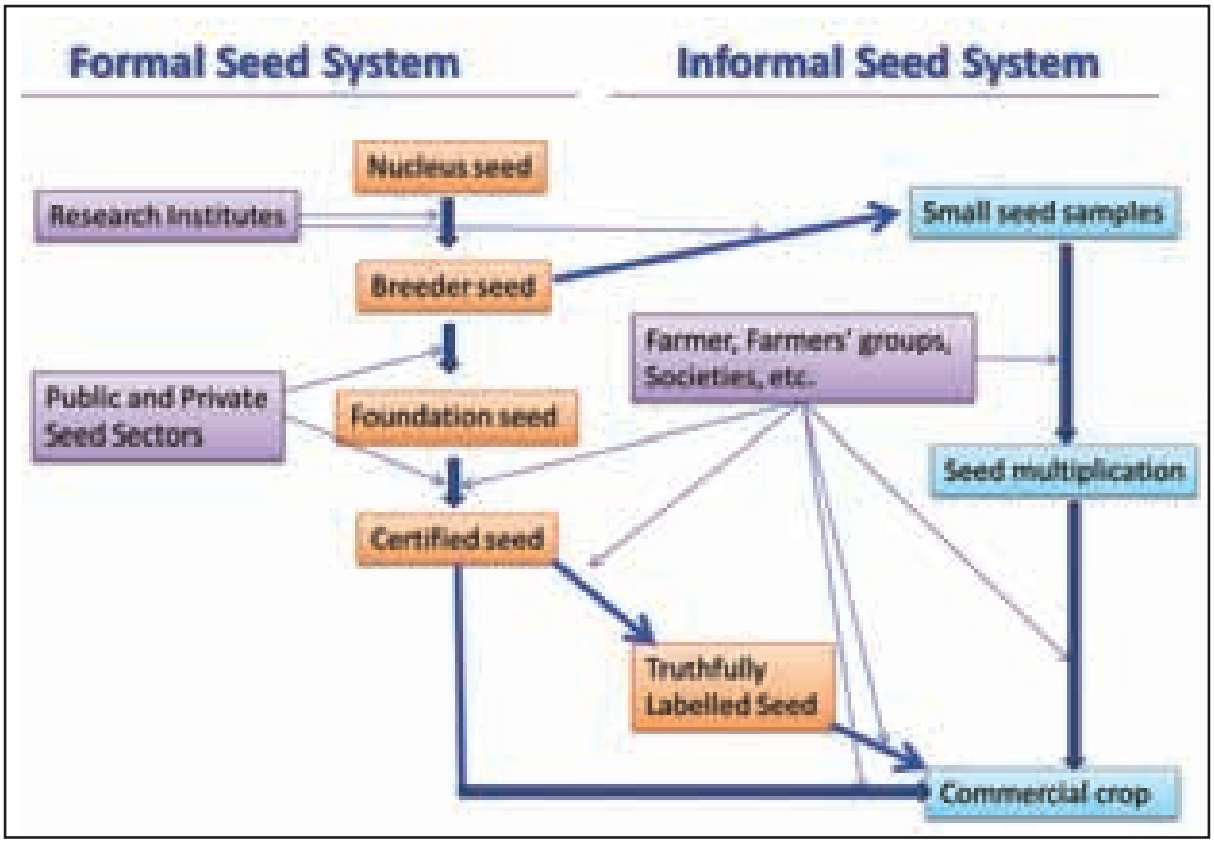

Figure 2. The linkages of farmer, farmer groups and societies.

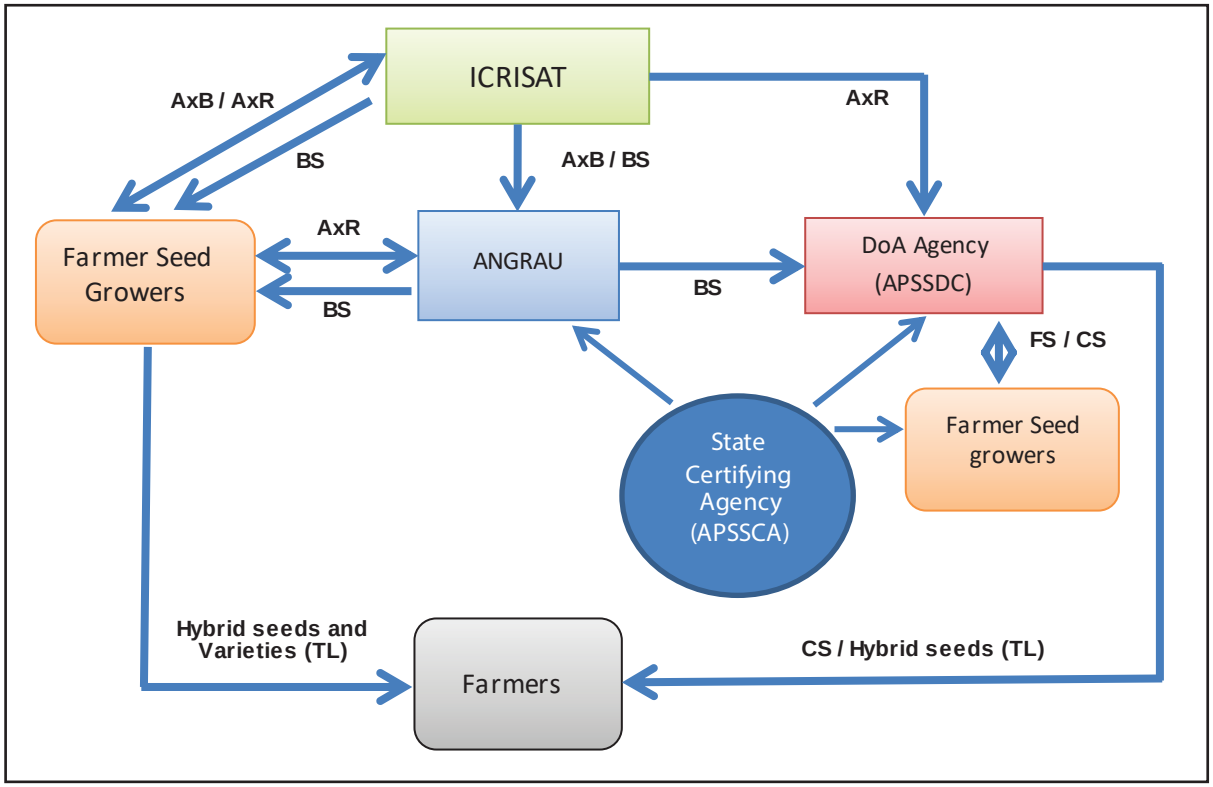

Figure 3. Pigeonpea seed system model in Andhra Pradesh, India

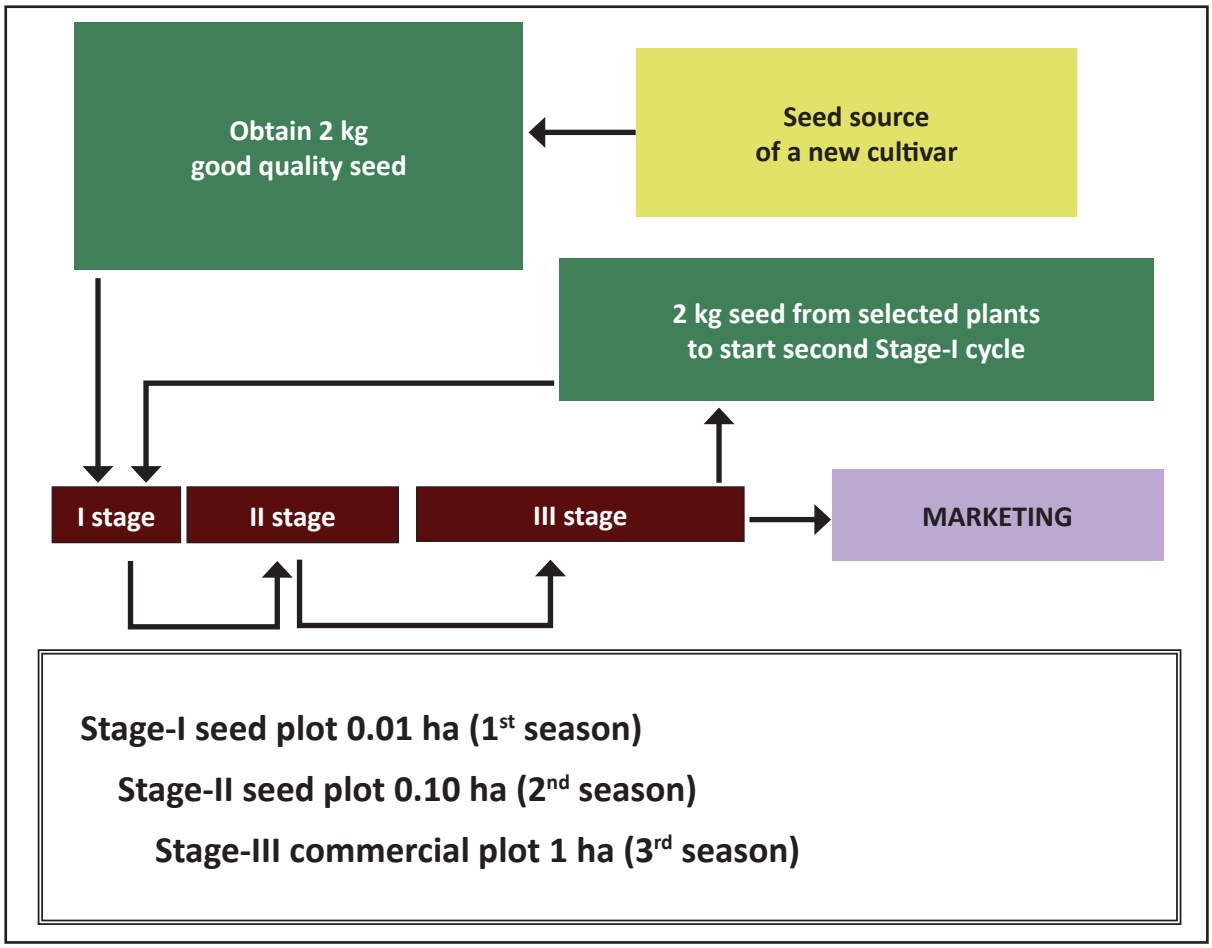

Figure 4. Community based groundnut seed production model (PDKV model)

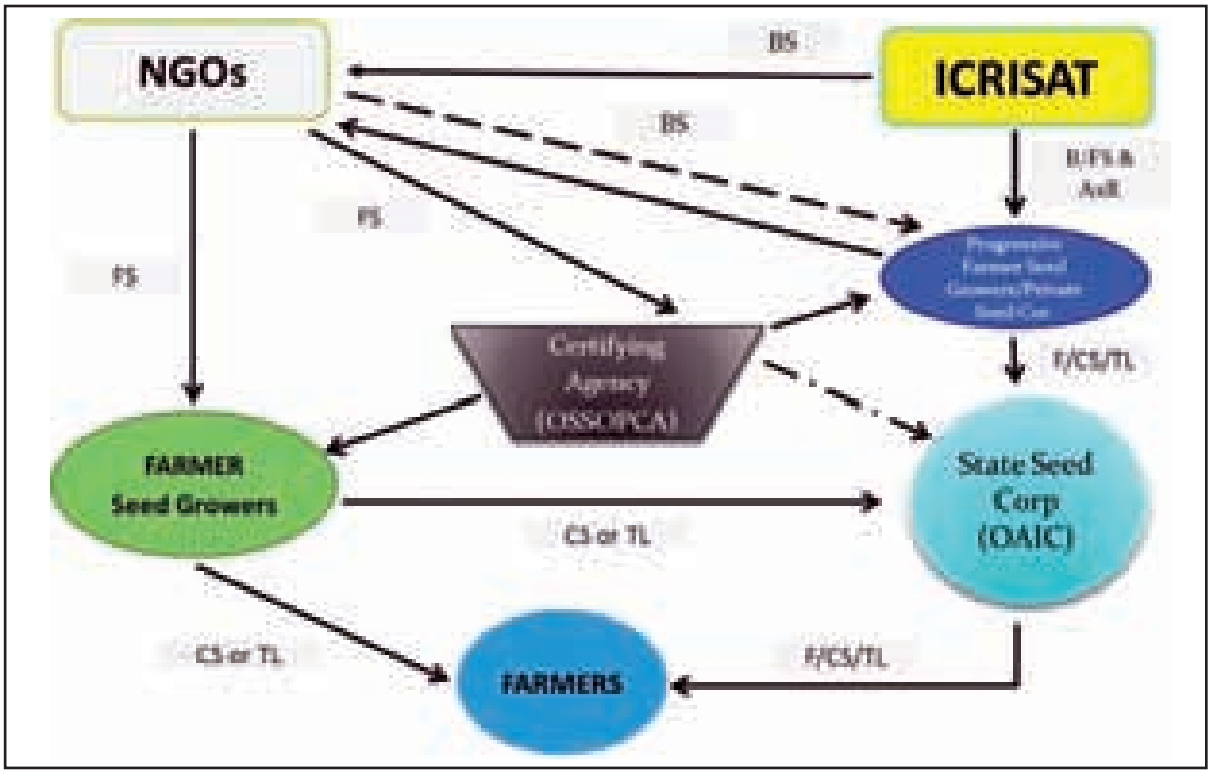

Figure 5. Pigeonpea seed system model in Odisha, India

cropping season, making seed production system viable and remunerative to smallholder farmer seed growers. To maintain the seed production chain and purity of seeds, the project adopted the model of 'one village one variety' concept. The benefit of partnering with OSSOPCA has necessitated the strengthening and institutionalization of the formal and informal seed production system in the districts of Kalahandi, Nauparha and Rayagada. ICRISAT will continuously supply the Breeder seeds of farmer preferred varieties and parental lines of hybrids whereas the OAIC was tasked to procure all various seed class produced by smallholder farmers to be used by the Department of Agriculture in expanding area of pigeonpea in the entire state of Odisha (Mula and Saxena 2013).

4. The Way Forward

Seed system for legumes in South Asia has a long way to go. However, in developing and strengthening formal and informal seed production and delivery systems to ensure quality seed of improved farmer preferred varieties and hybrids, we should do the following:

- Improving access to seed for smallholder farmers that focus on subsistence production through the enhancement of local village seed systems by testing a range of seed production and delivery options and searching for options to scale-out and scale-up alternative seed production and delivery schemes;
- Knowledge empowerment of farmers/rural entrepreneurs in seed production, post-harvest and processing, and marketing;
- Exploiting market niches commercial (large scale) production by developing seed markets and identifying seed supply constraints and recommending options to improve its efficiency; and
- Developing and/or strengthening seed regulatory framework as well as a seed policy that considers regulations of an expanding and diversifying seed sector for the benefit of the farmers engaged in the seed production system.

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Farmer-Led Seed Enterprises as a Strategy for Improving Smallholder Income through Private Contracting and Community Seed Production of Traditional Vegetables in Tanzania

Victor Afari-Sefa*[1], Daniel Kimani Karanja[2], Srinivasulu Rajendran[1], Takemore Chagomoka[3], Silivesta Samali[4], Alphonce Katunzi[5], Hamis Mtwaenzi[6], Lydia Kimenye[7] and Radegunda Kessy[1]

[1]AVRDC – The World Vegetable Center (AVRDC), Regional Office for Eastern and Southern Africa, PO Box 10 Duluti, Arusha, TANZANIA

[2]CABI PO Box 633-00621 Nairobi, KENYA

[3]AVRDC – The World Vegetable Center (AVRDC), Liaison Office Cameroon, C/o IITA - Cameroon PO Box 2008, Messa, Yaoundé, CAMEROON

[4]Horticultural Research and Training Institute (HORTI)-Tengeru, PO Box 1253, Arusha, TANZANIA

[5]INADES Formation Tanzania, PO Box 203, Dodoma, TANZANIA

[6]Tanzania Official Seed Certification Institute (TOSCI), PO Box 1056, Morogoro, TANZANIA

[7]Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), Plot 5, Mpigi Road, PO Box 765, Entebbe, UGANDA

Correspondence: victor.afari-sefa@worldveg.org; Tel: +255-27-2553093 / Fax: +255-27-2553125

Abstract

The growing scourge of malnutrition due to unhealthy and imbalanced diets has led to increased public health awareness and advocacy for diversifying diets with highly nutritious traditional vegetables and fruits. Several studies have shown that traditional vegetables are rich in micronutrients, vitamins, antioxidants, and other health-related phytochemicals and can play a key role in addressing human nutrition and development. However, a major reason for the low adoption of traditional vegetables from Africa is the inability of formal, centralized seed production systems to meet their complex and diverse seed requirements. Drawing on experiences in Tanzania with amaranth, African nightshade and African eggplant, this study provides a preliminary assessment of the viability of seed production under two farmer-led seed enterprise models, namely, contract seed production with seed companies, and the community-led Quality Declared Seed (QDS) production systems. Both models are examined as strategies for economically viable and sustainable distribution and promotion of traditional vegetable crops. In addition, the study examines the determinants of traditional African vegetable seed producers' participation in farmer-led enterprises and seeks to identify the impact of farmer-led enterprises on the crop income of seed producers. The assessment is based on participatory learning, action research and outcome mapping tools. Preliminary analysis shows that, on average, community seed producers have a lower input cost and higher returns than contract seed growers. While seed companies operate in a dynamic business environment and have profit-oriented motives that might contravene development objectives envisaged under the proposed seed contract model, the community seed production system may also encounter challenges in identifying and establishing viable market linkages. The two farmer-led seed enterprise models investigated have potential for higher income earning opportunities at both the farmer and community levels. Inaccessibility of traditional vegetable germplasm, lack of technical know-how, institutional bottlenecks, lack of strong collaborative links between seed sector stakeholders, and the need for an enabling national seed policy and regulatory environment must be addressed to successfully implement and scale up this approach.

Keywords: community seed systems, quality-declared seed systems, African traditional vegetables, technology dissemination, agricultural knowledge and information systems, agro-enterprise development, Tanzania

1. Introduction

The growing scourge of malnutrition due to unhealthy and imbalanced diets in most parts of sub-Saharan Africa has led to increased public health awareness and advocacy for diversifying diets with highly nutritious vegetables and fruits as essential complements to staple-based diets for the attainment of several Millennium Development Goals (MDGs). To this end, re-igniting an interest in, and a taste for, traditional foods can help not only improve nutrition but also increase incomes, restore agricultural biodiversity, and preserve local cultures (Stone *et al*., 2011). In comparison with globally important vegetables such as cabbage and tomato, traditional vegetables from Africa including amaranth (*Amaranthus* spp.*)*, African nightshade (*Solanum scabrum* and *S. villosum*), African eggplant (*S. aethiopicum, S. anguivi* and *S. macrocarpon*)*,* jute mallow *(Corchorus* spp.) and spider plant *(Cleome* spp.) have been shown to be richer in micronutrients such as iron, zinc, vitamin A, (Weinberger and Msuya 2004) and phytochemicals that help protect people against non-communicable diseases (Yang and Keding 2009, Uusiku *et al*., 2010). African eggplant, an easily cultivated vegetable, has recently been found to possess protective properties against ulcers induced experimentally, making it a cheap natural anti-ulcer remedy (Chioma *et al*., 2011). Besides their nutritional and medicinal importance, traditional vegetables are considered valuable because of their ability to fit into year-round production systems (Weinberger and Msuya 2004). Most traditional vegetables typically require little space, and can thus maximize scarce water supplies and soil nutrients better than crops such as maize, which need a lot of water and fertilizer (Tenkouano 2011). As the impacts of climate change become more evident, the hardiness and drought tolerance of traditional vegetables becomes increasingly important. Interest in traditional vegetables is surging due to increased awareness, education on their nutritional and overall health benefits, and the availability of improved recipes. A number of ongoing efforts by practitioners are underway to promote production and consumption of traditional vegetables across sub-Saharan Africa. Such developments have contributed immensely to a rise in demand for traditional vegetables, especially in major urban and peri-urban centers.

Production and marketing of traditional vegetables from Tanzania and other countries in sub-Saharan Africa are constrained by many factors: poor quality of the seeds used for production; spatial and time gaps in seed distribution systems; lack of structured seed markets; high postharvest losses of marketable produce due to lack of appropriate market infrastructure; high transaction costs along the supply chain due to weak linkages between supply chain actors (input suppliers, producers and markets); lack of appropriate market information systems; low bargaining power of farmers; and ineffective institutions and policies to enhance trade within and between countries (Ellis-Jones *et al.* 2008, Lenné and Ward 2008). It must be emphasized that government, private, and commercial seed companies in developing countries typically supply no more than 20% of seeds of even major food crops (Grossman *et al.* 1991, Almekinders *et al*., 1994, Rohrbach *et al.* 2003). The situation for the traditional vegetable sector of Tanzania is not that much different, with estimates of 70–75% of seeds coming from informal sources and 25–30% coming from semi-formal and formal sources (Ellis-Jones *et al.* 2008). Given that the increased demand for traditional vegetables has raised the demand for high-quality seeds and improved lines and cultivars, this study focuses on issues related to seed production and marketing systems.

Formal seed supply and distribution systems for traditional vegetables are underdeveloped, partly stemming from the fact that most of these vegetables had, until recently, not gone through official variety release and hence could not be legally commercialized by parastatal and private seed companies. In response, the long-term effort of The World Vegetable Center (AVRDC) has resulted in the release of seven new varieties of traditional vegetables in Tanzania in 2011. Despite this new development in Tanzania, the provision of clean foundation seeds for commercialization by private seed firms remains a major constraint in the supply chain as the Tanzanian Agricultural Seed Agency, the public institution responsible for provision of foundation seeds to the private sector, does not have resources to provide adequate amounts as required (Afari-Sefa *et al.*, 2011).

Private seed companies may, under sole profit maximization objectives, possibly perceive traditional vegetables seed production as less profitable compared to staple crops such as maize or exotic vegetables due to several reasons: uncertain and fluctuating demand caused by competition from farmer-saved seeds; seed dormancy and storage difficulties; lack of strong regional preferences, among others. Given that the majority of farmers mainly get their seeds from informal channels, which include farm-saved seeds, seed exchanges among farmers and/or local seed markets, strengthening the informal seed production systems must therefore be an urgent priority if the supply-side bottleneck is to be addressed. Farmer-led seed enterprise (FLSE) offers an opportunity to address these constraints by bridging the gap between the formal and informal sectors. Yet, several FLSEs developed over the years have had challenges with sustainability, partly due to the fact that they are mostly project driven with hardly any sound exit strategy. Major reasons for failure include poor project design (unclear objectives, failure to build in sustainability), lack of technical expertise and institutional linkages to research and seed agencies, and lack of attention to marketing (Wiggins and Cromwell 1995; Tripp 2001).

This paper, which draws on the experiences in describing the process used, successes achieved and lessons learnt in Tanzania, was part of a pilot project aimed at evaluating two FLSE models for sustainable supply of quality traditional vegetable seeds in Kenya and Tanzania. This component of evaluating strategies for economically viable and sustainable distribution of FLSE and promotion of traditional crop varieties is an exploratory study to evaluate two farmer-led seed enterprise models, namely, contract seed production with formal seed companies, and the community-led Quality Declared Seed (QDS) production systems. Lessons learned provide context for further research in other countries and a basis for best-bet model validation and scaling up.

2. Overview of seed systems and policies in Tanzania

Tanzania has introduced several policies and regulation for improving seed varieties, production and marketing. These policies and regulations include the Seed Act of 2003 and its regulations 2007; Plant Protection Act of 1997; Protection of New Plant Varieties Act of 2002 (plant breeder varieties) and its regulations (2008). To improve seed quality and develop a more secure seed supply system, the government has introduced the QDS program, which has been developed by FAO. The program provides training to farmers and also increases the availability of quality seeds for the agricultural community. It works where seed markets are not functional and government resources too limited. Under the QDS system, seed producers are responsible for quality control whereas government agents check only a very limited portion of seeds lots and seed multiplication field (FAO 2006, GRAIN 2005). Apart from the QDS program, the government has established an independent institute called the Tanzania Official Seed Certification Institute (TOSCI) to regulate seed businesses in accordance with the Seed Act of 2003. The government has further established an independent body called the Agricultural Seed Agency (ASA) with the key mandates of promoting the use of improved seeds as well as promoting private sector participation in seed production, processing and marketing. Despite several challenges, these policies and regulations have changed the face of seed production and marketing system in Tanzania, particularly after the trade liberalization regime of including the seed industry in several sub-Saharan African countries in 1990s.

3. Experiments with two FLSE models

3.1. Overview of FLSE models investigated

To address the issue of unavailability of quality seeds of traditional vegetables in Tanzania and Kenya, the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) in collaboration with CABI and other partners in Tanzania initiated the project, "*Scaling up farmer-led seed enterprises for sustained productivity and livelihoods in Eastern and Central Africa*" from December 2009 to June 2012. The partners in Tanzania included AVRDC, HORTI-Tengeru, TOSCI and

INADES-Formation (an NGO), Tanzania. The key objective of the project was to evaluate FLSE models on traditional vegetable to generate evidence-based and rigorously analyzed conceptual models for economically sustainable enterprises to improve seed production. The viability of two FLSE models, contract farming and QDS were investigated.

Production of traditional vegetable seeds takes place both under the auspices of seed companies in Northern Tanzania (Arusha region), as well as under the QDS program in the Central zone of Tanzania (Dodoma region). A major challenge faced with the contract seed model was the difficulty in securing contracts for new farmer entrants as most seed companies preferred to deal with their own experienced farmers, the majority of whom did not reside in the project focus communities. Complementary inputs (seeds, fertilizers and agrochemicals) under the seed contract model are provided by participating seed companies against deduction from sale of proceeds at harvest; the INADES Formation Tanzania (an NGO) provides farmer beneficiaries under the QDS model with a similar service. Seed companies also provide technical advice to their contracted farmers. AVRDC was responsible for providing training oversight to both agricultural extension officers and farmers in the two study regions for this project. Following supply of foundation seed by AVRDC to participating seed companies and HORTI-Tengeru, both contracted and QDS farmers are supplied with improved commercial traditional vegetable seeds for cultivation.

3.2. Characteristics of study sites and identification of farmer beneficiaries

The Arusha region study site, where the contract farming seed model is being investigated, falls under the Northern highlands agroclimatic zone and experiences a bimodal rainfall of 760–1200 mm per annum (usually from October-December and March-May). The Dodoma region study site located in central Tanzania, where the QDS model is being validated, has a semi-arid (savanna) type of climate with a unimodal regime of 500–700 mm per annum, usually starting as early as mid-November in some places and ends around mid-May followed by a long dry season (Stigter *et al*., 2005). Four villages (Kikwe, Maweni, Mlangarini and Nduruma) in the Arumeru district of the Arusha region were selected for validating the contract farming model. Five QDS model villages – Nghumbi, Tubugwe and Manghweta (located in Kongwa district) and Mbori and Tambi (located in the Mpwapwa districts) – were selected in the Dodoma region. Amaranth, African nightshade, and African eggplant were selected as the focus crops for the study based on a needs assessment in the identified communities.

3.3. Study design and approach

Farmer beneficiaries for both FLSE models were based on a purposive selection criterion to meet project goals and aspirations. Using a multistage random sampling procedure, a baseline survey was conducted at the beginning of the project to establish the pre-adoption socioeconomic situation and production practices of the participating farmers. Since the project emphasized training farmers in seed production and evaluating the two FLSE models, the assessment of the two models was based on participatory learning, action research, and outcome mapping tools through community sensitization. A training curriculum was developed based on identified information and capacity building needs of project beneficiaries in seed production and extraction. Subsequently, training of trainers (ToT) workshops were conducted in each of the two regions, as a result of which 10 agricultural extension officers and more than 100 farmer facilitators in the project focus districts were trained in seed regulation, certification, production and marketing. ToT graduates have subsequently been conducting season-long training of interested seed growers in all nine selected communities of the two study sites. Training focuses on the technical aspects of quality seed production as a business. Data collection protocols were developed to collect farm-level agronomic and economic data for evaluating the two FLSE models. Monitoring visits to the various communities is undertaken on a regular basis to track progress of the intervention.

4. Comparison of experiences from contract seed and community seed system (QDS) models

4.1. Agronomic performance

African nightshade was the most popular crop in the contract seed farming model while amaranth was the most popular crop under the QDS model. The preferences of seed companies and ultimately consumers in the two distinct agroclimatic zones might have accounted for the observed differences. From the 10 contracted farmers for the 2010/11 season in the Arusha region, eight produced a total of 340 kg of African nightshade seeds from 3.85 ha. Two other farmers produced 379 kg of African eggplant from a total of 0.80 ha, while one other farmer who received a contract for producing both African eggplant and amaranth produced 278 kg of amaranth seeds from 0.40 ha of land.

Under the QDS model, 17 farmer trainees (31.3% women) with access to water for irrigation produced seeds of African eggplant (4.0 kg; 0.02 ha), amaranth (755.0 kg; 0.93 ha), and African nightshade (6.3 kg; 0.13 ha) in the 2010/11 cropping season. Furthermore, 21 kg seed of amaranth was produced from a group plot (0.05 ha) in one of the villages. While average production figures for the Arusha region might be slightly higher than for the Dodoma region, possibly because of favorable climatic and soil conditions, a critical review and comparison of production and cost figures provides an indication of the enormous benefits of skill acquisition and access to the requisite inputs over time as farmers go through various learning curves following training. Ultimately, farmers encountered a number of production challenges that could explain the yield variations in the two regions. Infestation of crops, particularly amaranth and African eggplant fields by red spider mites and termites during dry spells, was a major constraint observed in the two study regions. Access to water was an equally important challenge in locations where fields were not located close to a reliable water source or where farmers did not have a means to pump water to their fields. There were also instances where some farmers experienced unforeseen delays in receipt of complementary farm inputs such as seeds and agrochemicals from the contracting seed companies.

4.2. Seed certification

The two FLSE models require different certification requirements as per the Tanzanian Seed Act of 2003. Under the QDS model extension officers who have undergone ToT and are collaborating on the project have been trained by TOSCI staff to collect samples from fields of beneficiary farmers for testing in their labs. The results of the test are then relayed to farmers. In the 2010/11 season, for example, all the seeds produced from the 17 trained QDS farmers in the Dodoma region had mean germination rate and purity above 90.0% (Karanja *et al*., 2011). The seeds successfully went through all stages of mandatory field inspection and quality tests, and were certified by TOSCI as QDS 1 and allocated lot numbers. Seeds produced under seed company contract models, however, require a much more stringent inspection and quality test given that they could be sold nationwide or even in neighboring countries. A typical dilemma farmers face is the delay in field inspection and receipt of inspection reports/results due to lack of sufficient personnel at TOSCI. As farmers can sell only certified seeds, this sometimes delays seed marketing; seed may go dormant during the delay. Without a steady and reliable seed supply, farmers lose opportunities to meet seasonal demand for specific vegetables.

4.3. Economic and market performance

Preliminary data for the private sector model shows that smallholders can confidently and profitably produce traditional vegetables under both FLSE models. Results on an estimation of the determinants of farmer participation in FLSEs showed that younger farmers preferred to be part of farmer-led enterprises, and they also participated more in contract farming than in QDS. Smallholders also preferred to engage in contract farming, whereas large farm holders preferred to participate in QDS. Table 1 gives a comparative overview of the costs and revenues accrued from

Table 1. Cost-benefit analysis of amaranth seed production under two FLSE models per two-fifths of a hectare representative farm*

		Contract seed model		QDS model	
Variable cost item	Description of cost item	Cost (TZS)**	Revenues (TZS)**	Costs (TZS)**	Revenues TZS**
Cost of seeds	0.5 kg	2,000		1,500	
Land rent per season	3–4 months	10,000		10,000	
Cost of land preparation (ox plough/manual	1–2 times	40,000		15,000	
Labor for sowing seeds	1–2 persons/day	3,000		6,500	
Labor for preparation of water harvesting ridges	70–100 ridges	10,000		10,000	
Watering and seed sowing at nursery (pre-emergence)	2–3 persons over a 2-day period	5,000		5,000	
Watering on main field (post emergence)	7 person days over 2.5 months	50,000		15,000	
Cost of manure and application		NA		15,000	
Cost of chemical fertilizer	per season	55,000		NA	
Labor for chemical fertilizer	2 times/ season	15,000		NA	
Cost of insecticide/fungicide	per season	40,000		3,000	
Labor for insecticide/ fungicide	per season	12,000		12,000	
Labor for weeding (twice per season)	about 1–2 person days	25,000		10,000	
Labor for bird scaring	1 month	60,000		5,000	
Labor for thinning out	3 person days	10,000		10,000	
Sales from thinned seeds (by-product) 200–250 bunches	@TZS 100 per bunch		70,000		5,0000
Cost of harvesting bags		15,000		7,000	
Labour for harvesting	2–3 persons	30,000		8,000	
Cost of seed transport to storage	per season	15,000		3,000	
Labor for seed threshing	for 1 week	30,000		6,000	
Plastic material for threshing	per season	60,000		30,000	
Labor for seed winnowing	3 days	30,000		NA	
Wire mesh for seed sorting	2 meter length	4,000		3,000	
Plastic storage containers		NA		26,000	
Sale of seeds (200–278 kg)	@2,500–4,000/kg		1,112,000		500,000
TOTAL		521,000	1,182,000	201,000	550,000
Gross margins per two-fifths ha		661,000		349,000	
Benefit-cost ratio		**2.27**		**2.74**	

* Given that the traditional vegetable fields investigated are relatively smaller, our unit of analysis is based on a pragmatic farm size of 0.40 ha as opposed to the standard comparative unit of 1 ha

** 1 $USD = TZS 1550 (Tanzanian shilling);

NA = Not applicable

amaranth seed production under the two FLSEs investigated on two-fifth of a hectare (1 acre) based on the representative farm approach. On average, production of amaranth seed was higher in the Arusha region (278 kg per 0.40 ha) than the Dodoma region (200 kg per 0.40 ha) partly because of the relatively humid and high precipitation (rainfall) amounts at the former as compared to the drier conditions in the Dodoma region. However, the cost of production was higher for the Arusha study site [TZS 521,000 (USD 336) per two-fifths ha] due to higher use of inputs as per requirements of contracting seed companies than for the QDS seed growers at the Dodoma study site [TZS 201,000 (USD 130) per 0.40 ha) as well as observed marked differences in factor costs in the two study sites. There were also marked differences in producer prices in both regions. A preliminary analysis of the benefit-cost ratio from the data collected however seems to suggest that QDS farmers have higher returns per input as noted by a benefit-cost ratio of 2.74 compared to 2.27 from contract seed growers. Given that the FLSE models are still in the process of evaluation, the results presented are based on survey data representing average farmers and thus may not truly reflect ideal or potential economic performance of skilled farmers under the two FLSE models in the two study regions.

Several of the seed growers had the opportunity to sell traditional vegetable seeds as well as their by-products. These tend to serve as an additional source of income and also as an important component of household nutritional needs. This was particularly the case during thinning of direct seeded plants such as amaranth, where leaves of thinned plants were sold or consumed at home. Contracted seed growers typically had guaranteed prices for their produce that were set at the beginning of the season. Evidence from our study indicated that there were different prices offered by different seed companies for the same crop to the beneficiary farmers as per their negotiated contracts. For example, African nightshade seed growers in the Arusha region received between TZS 16,000/kg (USD 9.68/kg) to TZS 25,000/kg (USD 16.13/kg) from the different participating seed companies during the period of this study. There were instances where farmers felt that they were guaranteed lower prices than the prevailing farm-gate seed producer price by participating seed companies. By the 2012/13 production season, one seed company had received sufficient stocks of traditional vegetable seeds and therefore to stop contracting farmers for their seeds and rather decided to offer farmers contracts for production of tomato seeds instead of traditional vegetables as a compromise to the dynamic profit making objectives of private enterprises vis-à-vis the development goals of the project.

While several of the QDS farmers were able to sell their seeds in their own and nearby communities, others had difficulty exploring viable markets. Typically, there was strong competition between QDS and non-certified farmer-produced seeds sold at the same market. This partly stems from the lack of differentiation between the enhanced quality traits of QDS certified seeds and non-certified farmer-produced seeds, as QDS producers store produce in non-branded containers. QDS farmers need branded packaging material to identify their produce and possibly attract premium prices. The issue of market differentiation for seed is a major bottleneck to success and scaling up of the two FLSE models.

5. Summary and conclusions

Results from our preliminary assessment demonstrate the complementarity of the two FLSE models in contributing to farm household livelihoods in the two study regions. The contract seed and community seed system models are contributing to food and nutrition security through crop diversification and improving livelihoods through income earned from seed businesses. While seed companies operate in a dynamic business environment and have profit-oriented motives that might contravene the capacity building and development objectives envisaged under the contract seed production model, the community seed production system also may encounter challenges in identifying and establishing viable market linkages. Nevertheless, the two seed enterprise models offer higher potential and capacity for increased seed harvesting, processing and storage and higher income at both the farmer and community level. Inaccessibility of traditional vegetable germplasm, lack of adequate technical know-how, insufficient attention given to traditional vegetables by

the formal seed sector, and other institutional bottlenecks need to be addressed to successfully implement and scale up this approach. Besides technical support, access to complementary inputs such as improved quality foundation seeds, agrochemicals, water pumps and water harvesting/ storage devices are major determinants of success of FLSEs.

Strong collaborative links need to be fostered between farmers, researchers, nongovernmental organizations, seed regulating agencies, and the formal seed industry. This requires a coordinated effort and commitment of all partners, growers as well as local, regional, and international research and development agencies. Continuous support of farmer-led seed enterprises through capacity building of seed growers, particularly in seed production and marketing, is necessary to ensure they will become more efficient and profitable. Successful public-private partnerships aimed at empowering farm households require a thorough prior assessment of trade-offs of participating partners to ensure a win-win situation for all. An enabling seed policy and regulatory environment is critical for the successful uptake of improved traditional vegetable seed production under FLSEs. To help build effective and sustainable seed systems, governments need to focus on educating and training participants in the public and private sectors to increase their understanding of the technical aspects of varietal development, seed production, and seed marketing, as well as policies and regulations related to seed development.

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Community Seed Production of Chickpea (*Cicer arietinum* L.) and Lentil (*Lens culinaris* Medic) in Ethiopia

Million Eshete[1], Sherif Aliye[1], Asnake Fikre[1] and Chris O. Ojiewo[2]

[1]Ethiopian Institute of Agricultural Research (EIAR), Debre Zeit Agricultural Research Centre, P.O. Box 32, Debre Zeit, Ethiopia

[2]International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), ILRI Campus, Addis Ababa, Ethiopia

Abstract

Chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medic) are the most important grain legumes covering 21.3% of the total acreage (1.6 million ha) and 24.1% of production (23.2 millon tons) of all pulse crops in Ethiopia (CSA 2012). They are grown by more than 1.7 million farmers; are major staple food legumes and are a good source of dietary protein (17 %, 23%). These crops require low input for production and can maintain and restore soil fertility (can fix up to 60 kg N /ha/year). Moreover, they are high potential crops for domestic and export markets and considered to be strategic crops for national food security and agricultural development in the country. Two different types of seed supply systems, formal and informal (community seed production) are known in Ethiopia. To date the majority chickpea and lentil producers obtain their seed for planting informally from own saved seed or through local exchange. The informal seed system for chickpea and lentil currently operates at the individual farmer or community level and depends on local knowledge of plant and seed selection, sourcing, retaining and management, as well as local diffusion mechanisms. It is, therefore, important to continually search for solutions to improve the availability of, access to and use of quality seed required by farmers. In this paper, we provide an overview of community seed production and delivery systems of chickpea and lentil operating in the country; review the initiatives and document best approaches to improve the availability of improved quality seeds to farmers in order to maximize productivity of these crops in Ethiopia.

1. Introduction

Chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medic) are among the most important pulse crops predominantly grown in the crop-livestock based farming systems of the central, north and northwest highlands of Ethiopia where Vertisols are dominant. The total area under chickpea and lentil amounts to 231,000 ha and 110,000 ha and the corresponding production was 400,200 tons and 128,000 tons respectively (CSA, 2011/2012). The crops are known to be an important source of dietary protein for those who cannot produce or cannot afford costly livestock products. Chickpea and lentil contribute a significant portion of the total value of pulse exports (Shiferaw *et al.* 2007).

Despite the importance of chickpea and lentils, the national average seed yield of these crops are very low, 1.73 ton/ha for chickpea and 1.13 ton/ha for lentil (CSA 2011/12). On the other hand, the national chickpea and lentil programs have undertaken considerable research to improve the productivity of the crop in the country. Since 1974, the national crop improvement program has developed and released several varieties of chickpea (24) and lentil (11) with their full production packages. The yield advantage of improved varieties is two to three folds more than farmers' local varieties. Some of these improved varieties were also identified to meet local and export market standards owing to their important quality. However, the productivity of these crops remained very low in farmers' fields, compared to released improved varieties with potential yield of 4 t/ha for chickpea and 2 t/ha for lentil in large-scale production.

One of the major causes of low crop yields is the limited awareness and access of farmers to seeds of new crop varieties. Two different types of chickpea and lentil seed systems, i.e., formal and informal are known in Ethiopia. Key actors in the formal sector include public institutions such as the Ethiopian Institute of Agricultural Research (EIAR), the Ethiopian Seed Enterprise (ESE), Ministry of Agriculture, and the newly emerging private agricultural enterprises whereas farmers and NGOs are key actors in informal sector.

In community seed production, the informal seed system offers many opportunities for improving the seed security of small-scale farmers for it is built on farmers' knowledge and capacities. Hence, in community seed production, the majority of seed demand in Ethiopia is fulfilled by the informal sector, which is estimated to be 80–90% (Bishaw *et al.*, 2008). On the other hand, the informal seed system has gone largely unrecognized, unappreciated and undocumented while the formal seed sector has been unsuccessful in meeting farmers' needs in less favorable and marginal areas where production conditions are often complex and more risk prone. It is important to continually search for solutions to improve the availability, access and quality of the seed farmers need.

This paper, is therefore, aimed at providing an overview of the current community seed multiplication and delivery systems of chickpea and lentil operating in the country and reviewing initiatives in the area and documenting best approaches to improve the availability of improved quality seeds to farmers in order to maximize productivity.

2. Seed delivery systems

The seed multiplication and delivery systems for chickpea and lentil in Ethiopia involve variety development and release, seed production and distribution. The key actors in this process are researchers, farmers' extension workers, traders, etc. Generation and transfer of new technologies are critical prerequisites for agricultural development, particularly for an agrarian-based economy such as Ethiopia. Thus, seeds of improved varieties of chickpea and lentil are an essential input for increasing crop production and productivity. In Ethiopia, two distinctive but interacting seed delivery systems are now recognized for chickpea and lentil: the formal and informal sectors.

3. Performance of formal seed system

The formal seed system of chickpea and lentil is composed of institutional and organizational arrangements consisting of all enterprises and organizations that are involved in the flow of modern varieties from agricultural research to the farming communities. These include several interrelated components such as variety development, release and registration, seed multiplication and processing, seed quality control and certification, and seed marketing and distribution. The formal seed multiplication system was and still is used as a major source of Breeder and Foundation seed of new varieties (technology transfer channel) obtained from the national research system (EIAR, regional research institiutions and higher learning institutes). However, when it comes to meeting the commercial seed demand (certified and quality declared seed) this sector supplies less than 10% of the country's potential seed demand per year (CSA 2012). The contribution and efforts made by the Debre Zeit Agricultural Research Center (DZARC) toward the production of Breeder and Pre-Basic seed has been remarkable (Tebkew *et al*., 2009). Amounts of chickpea Breeder and Basic seeds produced by DZARC are summarized in Table 1. The commercial seed multiplication is mainly done by ESE and other regional seed enterprises such as Oromia Seed Enterprises, Amhara Seed Enterprises etc.

Table 1. Amount of breeder and foundation seed of chickpea produced at DZARC from 2008–2014 (MT)

Year	Arerti	Shasho	Mariye	Habru	Ejere	Natoli	Kutaye	Teji	Chefe	Acos D.	Minjar	Total
2008	1000	285	2	20	10			10				1327
2009	1950	300	3	30	20			20	25			2348
2010	2400	256		100	25			25	30			2836
2011	2434	300	4	200	36	4	10	35	40	13		3076
2012	2500	200		200	30	5	15	31		15		2996
2013	3000	170		149	43	3	13	43	25	20	5	3471
2014	3000	487		300	35	15	10	35		30	15	3927
Totals	16284	1998	9	999	199	27	48	199	120	78	20	19981

Formal systems are externally regulated through the application of rules and regulations governing both the production and distribution of seed, which is largely controlled by Ethiopian and Regional Seed enterprises but is increasingly being undertaken by specialized companies operating along commercial lines (Jones *et al.* 2006). These companies tend to market seed through appointed distribution and retail channels. The ESE produces, processes, distributes, and markets improved seed including chickpea and lentil based on the official demand projection of the regional bureaus of agriculture. The enterprise produces seeds of chickpea and lentil on its own farms and through contracts with public and private farms, cooperative unions, and smallholder farmers and distributes it to the ultimate users. Chickpea and lentil breeder seeds are supplied to ESE from the national agricultural research centers to produce Pre-Basic and Basic on its own farms located in different regions of the country. The Basic seed is distributed to individual farmers and cooperatives for multiplication of certified seed that is sold to the agricultural office and cooperatives for distribution to different regions. The Ethiopian seed system reforms show limitations of focusing on supply or regulation in isolation, and ignoring the social actors in local seed systems. The participation of the private sector in the chickpea and lentil seed business is negligible. As a business institution, the ESE works in more than 90% of the cases with cereals (hybrid maize, wheat, sorghum). Hence, legumes in general and chickpea in particular are served in less than 7% of its seed demand (Fikre *et al.*, 2014). Therefore, the major actors in the seed system of chickpea are the informal seed sector (seed grower associations, unions, individual farmers etc.).

4. Informal community based seed production and delivery system

The informal seed system comprises individual private farmers who select and save their own seed or exchange seed with others through traditional means such as gifts, bartering, labor exchange, cash transactions or social obligations. It may also include a diversity of local level seed production initiatives organized by farmers' groups or NGOs working under no legal norms and certification schemes (Cromwell 1992, Bishaw 2004). In Ethiopia, the informal seed system accounts for 90% of the seed used by smallholder farmers (Bishaw 2008). Community seed production of chickpea and lentil currently operates at the individual farmer or community level and also depends on indigenous knowledge of plant and seed selection, sourcing, retaining and management, as well as local diffusion mechanisms. Informal systems are short, simple and less externally regulated and are particularly important in serving the needs of smallholder farmers who use own-saved seed from the previous harvest and/or seed accessed from friends, relatives and local markets.

The shortage of varieties is a serious technical constraint. Seed of many chickpea and lentil varieties are not produced by the informal seed system. Many improved varieties are not known by the farmers and seed production in the formal seed sector is limited to a very few varieties. Additional constraints relate to low seed extension and popularization and seed promotion by various organizations compared to the vast number of farming communities in the country. Community seed production seeks to augment supply through more decentralized on-farm seed multiplication, but decisions on what to multiply remain largely top-down, and not responsive to demand with the exclusion of small-scale seed merchants who possess great potential to meet seed demand in rural areas (Mcguire 2005).

Cognizant of the forgoing gaps in the formal seed system, efforts have been made in seed multiplication and delivery coupled with pre-scaling up of improved lentil and chickpea technologies. Currently there are six Community Seed Producer associations at Ada, Lume and Gimbichu who are major suppliers of chickpea and lentil seeds in the country. Farmers also realized that producing improved seeds is a very lucrative business. In this regard, the contribution of the pre-scaling activities so far undertaken at research center (DZARC) and the national (EIAR) level to strengthen the informal seed sector to be the major supplier of chickpea and lentil seed in the country has been remarkable (Tebkew *et al.*, 2009).

5. Approaches on strengthening informal community seed production

5.1. Pre-scaling of technologies

The agricultural technology generation and transfer process as a system has many actors (researchers extension workers, traders, etc.) playing key roles in maintaining its holistic nature (Eshete *et al.*, 2006). Each player has their role in strengthening the informal seed sector, which, in turn, improves the agricultural productivity, production and farmers' livelihoods. For example, the DZARC has developed many chickpea and lentil varieties but their adoption in the production domain was low or non-existent (Tebkew *et al.*, 2009).

In order to reverse this situation, the DZARC and EIAR in collaboration with different partners initiated pre-scaling of chickpea and lentil technologies in selected woredas and nationwide, respectively. The partners include Regional Research Extensions Advisory Council (REAC), researchers, farmers, administrative officials, extension workers, local NGOs, and traders. They made successful progress in testing, adapting and promoting different chickpea and lentil technologies suitable for small-scale farming systems. So far efforts and progress made by DZARC at the zonal level and by EAIR at national level are summarized as follows.

5.2. Pre-scaling in target districts by DZARC

A pioneering work on lentil pre-scaling out was started by the DZARC in 2005/06 using the high yielding, rust resistant lentil variety 'Alemaya', with early planting (late July/early August), use of ridge and furrow practices to drain the excess water, and one to two hand weeding. The pre-scaling activities were implemented in major lentil producing areas in Gimbichu and Berehe – Aleltu weredas of East Shewa Zone of Oromiya Region (Eshete *et al.*, 2006).

The activities include identification and evaluation of main stakeholders, organizing formal stakeholder meetings, sharing of experiences and setting common vision and objectives, defining functions and identifying roles, task sharing with clear responsibilities and signing memoranda of understanding with detailed action plans by the center. Moreover, trainings on quality seed production and agronomic practices were also given to the participants.

Some of the outstanding results of chickpea and lentil pre-scaling activities (at the center level) which have considerable contribution towards strengthening the seed multiplication and delivery system of chickpea and lentils to the present level and changing the farmers' livelihoods to the present level in the country are presented in Tables 2 and 3.

The scaling up was very successful because the improved lentil variety Alemaya is now widely grown by farmers and brought great impact in changing the livelihoods of the farmers. Joint work of all stakeholders in the value chain (researchers, managements of the research center and EIAR, woreda administrators of Gimbichu and Bereh- Aleltu technical group of woreda administration); and the high demand for lentil and chickpea in the local market also made a great contribution to

Table 2. Lentil technology pre-scaling by DZAR in East Shewa

Year	Participating farmers	Area covered in hectare	Average yield in t/ha	Total yield obtained in tons
1998/1999	700	350	2	700
1999/2000	700	400	2	800
2000/2001	468	117	2.4	280.8
2001/2002	142	35.5	2.2	78.1
2002/2003	200	50	2.1	105
Total	2210	952.5		1963.9

the successful acceptance of lentil and chickpea scaling up by farmers (Eshete *et al*., 2006). Indeed, such technology adoption process has become a model by which almost all farmers incorporate technology into their farming systems. Likewise, similar efforts and progress on chickpea crop have been made at the center level, as presented in Table 3.

Table 3. Chickpea technology pre-scaling by DZARC in East Shoa and Gurage zone

Year	Participating farmers	Area covered (ha)	Average yield (t/ha)	Total yield (t/ha)
1998/1999	1200	600	3	1800
1999/2000	2120	800	3.5	2800
2000/2001	1500	700	3.5	2450
2001/2002	734	183.55	3.8	697.5
2002/2003	1733	741	3.6	2667.6
Total	7287	3024.55	-	10415.1

5.3. Pre-scaling at national level by EIAR

EIAR initiated the pre-scaling of chickpea and lentil technologies in four major regional states which include Amhara, Oromia, South and Tigray. Encouraging results have been recorded through the scaling up of two improved chickpea varieties (Arerti and Habru) and one lentil variety (Alemaya) in four pilot intervention regions (Tables 4 and 5). In general, the results of the nationwide pre-scale up activities in chickpea and lentil have further demonstrated the possibility of bringing about significant changes in the productivity of Ethiopian agriculture.

Table 4. Chickpea technology scaling up at national level, 2009/2010 and 2010/2011

	2009/2010				2010/2011			
Region	Seed distribution in tons	Area covered in ha	Participant farmers	Variety	Seed distribution in tons	Area covered in ha	Participant farmers	Variety
Tigray	9.25	71.15	285	Habru & Arerti	17.5	125	500	Shasho & Arerti
Amhara	42.6	328	100	Habru & Arerti	22.5	61	642	Shasho & Arerti
Oromia	19.2	148	592	Habru & Arerti	24.4	174	697	Arerti
SNNP	4.25	32.7	131	Habru & Arerti	8	57	228	Arerti
Total	75.3	579.85	1108		72.4	417	2067	

Source: Kebebew *et al.* 2011

Table 5. Lentil technology scaling up at national level, 2008/09 – 2009/10

Region	Seed distribution in tons	Area covered in ha	Participant farmers	Variety
Tigray	5.6	70	285	Alemaya
Amhara	26.2	237	950	Alemaya
Oromia	7.6	92.75	380	Alemaya
SNNP	7	205	80	Alemaya
Total	46.4	604.75	1695	

Source: Kebebew *et al.* 2011

5.4. Seed Roadmap Approach for Chickpea Seed Availability

One strategy that has helped chickpea seed production to increase significantly is the Seed Road Map approach initiated by the ICRISAT-led Tropical Legumes Project. With all functional key stakeholders in place, the informal seed system dominated chickpea commercial seed production by partners is summarized in Table 6.

Table 6. Commercial Seed (Certified and QDS) of chickpea produced with partners in Ethiopia disaggregated by variety and year (MT)

Year	Arerti	Shasho	Mariye	Habru	Ejere	Natoli	Kutaye	Teji	Chefe	Acos D.	Minjar	Total
2008	4000	600	0	360	5	10	10	5	5	5		7008
2009	6640	996		664								10309
2010	9520	952		560								13042
2011	10400	1560	26	910	26	13	26	26		13		15011
2012	14640	2196	18.3	1281	36.6	18.3	36.6	18.3		18.3		20275.4
2013	16000	2000	12.5	1800	50	25	25	25	25	25	12.5	22013
2014	23200	3480	29	2030	29	29	58	29		58	29	30985
Total	84400	11784	85.8	7605	146.6	95.3	155.6	103.3	30	119.3	41.5	118643.4

5.5. Training of key stakeholders in the seed value chain

Another method through which chickpea seed production has spread out is through capacity building of various seed stakeholders. Farmers in particular have moved forward to form farmer's groups, some of which have even evolved into more formal private seed companies. Table 7 below summarizes some of the trainings conducted since 2006.

Table 7. Number of farmers and other stakeholders trained on chickpea technology and production since 2006

	Number of trained personnel								
Type of trainee	2006	2007	2008	2009	2010	2011	2012	2013	Total
Researchers	8	15	12	17	22	27	33	42	176
Research technicians	22	35	45	55	63	73	45	39	377
Farmers	250	470	603	934	1785	2175	2000	3024	11241
Agricultural experts	35	41	33	63	88	83	121	117	581
Development Agents	120	169	210	336	375	480	354	285	2329
Farmers Cooperative unions	5	10	15	28	20	13	12	13	116
Community Seed producers		2	6	10	12	13	14	12	69
Others	35	63	79	153	263	200	185	215	1193
Total	475	805	1003	1596	2628	3064	2764	3747	16082

6. Some outcomes of community based seed promotion

So far progress made in improving the chickpea and lentil seed multiplication and delivery system showed that using improved technologies has changed farmer's livelihoods. Thus, improving the seed multiplication, delivery system and thereby scaling up/scaling out of improved production technologies will have an impact on the livelihoods of the farmers as well as to other actors in the

value chain. The value chain approach will help to transfer technologies that are needed by the market and help to change farmers' behavior in applying what they have known in one value chain to others.

7. Lessons Learnt

Institutional linkage and intensive communication between all stakeholders are important for technology scaling up to promote easy access of farmers to improved seeds. Although complementarities between the formal and informal, the informal community based seed sector is more essential for adequate quality seed multiplication of improved chickpea and lentil technologies dissemination under Ethiopian conditions.

8. The way forward

The following issues need attention for strengthening the community based seed multiplication and delivery system of chickpea and lentil in the country.

- Organizing more farmers into seed out-growers and linking them with markets and distribution system needs attention.
- Implementing formal seed certification system in the country is essential to maintain the seed legalization for seed out-grower farmers and farmers' groups/associations
- Scale up the success stories to other parts of the country needs great emphasis in the future.

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Integrated Seed Sector Development in Ethiopia: Local seed business development as an entrepreneurial model for community-based seed production in Ethiopia

Amsalu Ayana*[1], Gareth Borman[2], Abishkar Subedi[2], Fetien Abay[3], Hussein Mohammed[4], Kedir Nefo[5], Nigussie Dechassa[6], and Tadesse Dessalegn[7]

[1]Programme Management Unit, ISSD Ethiopia Programme, Addis Ababa, Ethiopia
[2]WUR/CDI, Wageningen, The Netherlands
[3]Mekelle University, Mekelle, Ethiopia
[4]Hawassa University, Hawassa, Ethiopia
[5]Oromia Seed Enterprise, Addis Ababa, Ethiopia
[6]Haramaya University, Haramaya, Ethiopia
[7]Bahir Dar University, Bahir Dar, Ethiopia

*** Correspondence:** aga.amsaluayana@gmail.com

Abstract

Local seed business (LSB) development is one of the components of the Integrated Seed Sector Development (ISSD) programme in Ethiopia, focusing on organizing and supporting groups of farmers to produce and market quality seed of local preferences. These farmer organizations target the seed markets that are neither attractive for private companies, nor cost effective for public enterprises. The programme component started in 2009 and continues to operate until the end of 2015 in four regional states (Tigray, Amhara, Oromia and SNNPR) of Ethiopia, implemented by a consortium of five universities and one public seed enterprise. The Integrated Seed Sector Development and partner interventions have supported a number of LSBs to competently produce and market quality seeds of more than 22 crops and 85 varieties. Thirty four first generation local seed businesses currently contribute more than 5% to the formal supply of legumes, cereals and oilseeds through the national public distribution system. Since commencement of the second phase of the ISSD Ethiopia programme in January 2012, the total number of LSBs across the four regional states has reached more than 200 and continues to increase. Local Seed Businesses produce many crops not included in the national distribution system for which significant local demand within the farming community exists. Potato is one such crop for which LSBs are a dominant supplier of quality seed. These LSBs make a significant contribution to local food security by providing options for farmers to select those varieties better suited to their local agro-ecologies and cultural preferences. In this paper, opportunities for and challenges to LSB development are discussed.

Introduction

It is widely accepted that supply and use of good quality seed of adapted crop varieties can make an immense contribution to agricultural productivity. This is clearly emphasized in the Agricultural Growth Programme of the Agricultural Growth and Transformation Plan (MOFED 2010) of the Federal Democratic Republic of Ethiopia. A key issue for the farmer is his/her access to quality seed of the right variety at an affordable price. Accessibility is defined in part by the availability of seed. Seed availability is determined by the quantity, proximity and timely physical presence of seed within a given location, but not its quality, variety and affordability. Those three are the remaining dimensions for defining accessibility. In Ethiopia, as in elsewhere in the world, the diversity of these demands for seed variety, quality, availability and affordability makes for a great challenge to ensuring farmers' access to quality seed.

Integrated Seed Sector Development (ISSD) is a concept that acknowledges and appreciates the unique challenges faced by a sector characterized by diversity and complexity, which it advocates should be addressed in a pluralistic approach to development (Louwaars and de Boef 2012). Such

an approach should strengthen individual seed systems, while actively seeking opportunities for integrating the activities of, and complementarities between, these multiple systems in the sector. Foremost, this approach guides the identification and characterization of multiple systems in the seed sector, which include, in Ethiopia: the farmer seed system, where farmers produce, save and exchange seed among themselves (Almekinders *et al.*, 1994); local seed business system, in which farmer groups produce a seed with a local market orientation; and a range of formal systems for certified seed production and dissemination involving public, private, regional, national and international producers and companies (see Tesfaye *et al.*, 2012). All of these systems exist to satisfy the diverse demands of the market and its specific segments.

Local Seed Business (LSB) development is one component of the ISSD Ethiopia Programme, focusing on organizing and supporting groups of farmers (often legally registered as seed producer cooperatives) to produce and market quality seed that has great local demand. Local Seed Businesses target the segment of the seed market that is neither attractive for private companies (MacRobert 2008), nor cost effective for public enterprises; hence, the niche remains untapped. These farmer organizations strive to deliver quality seed of a diverse range of local (e.g. potato, barley, sorghum, field pea) and improved varieties of important local and traditional food and cash crops that are adapted to the local agro-ecologies and affordable for smallholder farmers (Alemu *et al.*, 2013). Herein lays two key assumptions and/or conditions for LSBs to be successful in their business: seed demand is regular for sustainable production; and production is cost effective at attractive prices to the consumer.

This paper aims to share the opportunities for and challenges to LSB development in Ethiopia with regards to their realization of meeting the demands of farmers within this specific market niche. Therefore, the paper discusses the socio-economic and institutional factors responsible for these opportunities and challenges. The LSB development programme component of ISSD Ethiopia has been operating since 2009 and will continue to operate until the end of 2015 in four regional states (Tigray, Amhara, Oromia and SNNPR) of Ethiopia. It is implemented by a consortium of four universities (Bahir Dar, Haramaya, Hawassa and Mekelle) and Oromia Seed Enterprise. In addition to these key implementing institutions, ISSD is closely collaborating with regional Bureaus of Agriculture, regional research institutes of the four regions, the Ethiopian Seed Growers and Processors Association, the Ethiopian Agricultural Transformation Agency, the Ethiopian Institute of Agriculture and the Federal Ministry of Agriculture. The four implementing universities have attracted a number of other universities in the LSB scaling up strategy. The Centre for Development Innovation of Wageningen UR in the Netherlands provides technical and institutional support. The ISSD Ethiopia programme is supported by the Kingdom of the Netherlands, through the Embassy in Addis Ababa. Other partners include a number of federal, regional state and local government organizations, development organizations and the Ethiopian Seed Producers and Growers Association.

1. Development objective

The objective of LSB development programme component is to contribute to sustainable seed supply at village and district level by organizing and supporting seed producer cooperatives to become technically well-equipped, professional (i.e., technically capable in seed production and processing), market oriented and autonomous in their seed business. Thereby, the ISSD Ethiopia programme contributes to food security and economic development through agriculture.

2. The LSB approach

Hosted at each of the five coordinating units, a multidisciplinary team of experts (also innovators) were recruited to support the development of LSBs in their mandate areas. In all cases, the team consists of at least one seed, farmer organization and agribusiness expert, trained on the principles and objectives of the ISSD and LSB development approaches and monitoring and evaluating the

performance of seed producer organisations. This includes identifying the specific capacity needs of the LSBs and targeting interventions based upon those evidences. Such an evidence-based approach is integrated into the planning, monitoring and evaluation framework. The team brings specific expertise to the programme, but also has a prominent role in facilitating more concerted and coordinated efforts of local partners in ensuring LSBs have the right access to inputs and services.

The innovators in collaboration with local and regional partners conducted baseline studies during the last quarter of 2009 to identify potential groups of farmers who can be organized and supported in their development into LSBs. Further, the general approach to supporting LSBs is described as follows, adapted from the manual for Supporting Local Seed Business Development (Abdo *et al.*, 2012):

1. Identifying potential partners: developing a checklist for identifying which local governmental and non-governmental organisations (NGOs) are directly and indirectly involved in the relevant seed value chain, profiling important details such as their respective organization type, past and present activities in the seed value chain, professional staff availability and their available operational budget.
2. Creating awareness: on the objectives, planned activities and service provision of the LSB project and its partners, and also the relative importance of the use of quality seed for agriculture in Ethiopia.
3. Innovation site identification: innovation sites to be developed as LSBs are selected based upon the following guiding, but not limiting, factors:
   - Presence of local GO/NGO partners;
   - Potential of local agro-ecology for quality seed production;
   - Experience of farmers and organization in quality seed production;
   - Access to important infrastructure for marketing.
4. Innovation site selection: confirming the interest of farmers and partners to engage in LSB development through actual organisation of the farmers into seed producer cooperatives (if not already legally registered) and through signing MoUs with local GO and/or NGO partners.
5. Conducting baseline survey: collecting basic primary and secondary data on the LSBs seed production and marketing, and other organizational, financial, technical and agribusiness performance aspects, according to a predefined checklist of the most relevant information needed, and also by conducting the LSB key performance indicators assessment (Subedi A. and Borman, 2013).
6. Identifying specific capacity needs: evaluating the LSB assessment results and other information gathered during the baseline survey, generating conclusions on the Strengths, Weaknesses, Opportunities and Threats (SWOT) of the organisation, identifying key bottlenecks or gaps in the seed value chain and relevant partnerships, including those that facilitate access to inputs and the security of markets, and specific capacity needs.
7. Prioritizing and planning interventions: through local and regional workshops with LSBs and partners, priority areas are validated and addressed, interventions are designed, and action plans are set into motion.
8. Generating evidence: assigning innovators, researchers, students, woreda experts (of district offices of agriculture), development agents of the public extension system and LSB partners to study, monitor and evaluate the performance of LSBs and interventions.

Through collaboration with local and regional stakeholders, and LSB members themselves, the organizations are supported in their seed entrepreneurship through targeted joint action plans addressing organisational and financial management, quality seed production and internal control, and marketing and market development. Intervention actions addressing these topics include

a diversity of capacity strengthening activities, such as training, awareness raising, facilitating important institutional linkages, and strategic coaching and competence based consultancy. In all cases, LSBs were supported in the development of diverse variety of portfolios and strategic business plans. The LSBs are also beneficiaries of modest investment grants, whereby proposals for business investments, matched in cash and/or in kind by the organisation themselves through their own investment of resources, are critically reviewed, revised and conditionally rewarded. The program tries to make strategic investments in their business, without creating unnecessary dependency in successful business operation.

4. Results and discussion

4.1 Diversity in LSB in Ethiopia

The map in Figure 1 displays the distribution of 34 first generation LSBs across four agriculturally important regions of Ethiopia, namely: Amhara (red dots), Oromia east (yellow) and south and west (green), Southern Nations, Nationalities, and Peoples' Region (SNNPR) (blue) and Tigray (purple). Since commencement of the second phase of the programme in 2012, the number of LSBs has been steadily increased through partnerships with GOs and NGOs, higher education and learning institutes and with both federal and regional agricultural research centres. Currently there are more than 230 farmer organizations supported in LSB development in the same four regions where first generations LSBs are distributed. Close to 40 partners are involved in the scaling up of the number of LSBs in the regions. These include universities, cooperative unions, cooperative promotion offices, research centers (both regional and federal), regional bureaus of agriculture and NGOs. It is also interesting to note that the LSBs are organized in Agricultural Growth Programme districts (potential districts), Productive safety-net Programme districts (food insecure) and other districts, covering a wide range of districts in terms of food security and surplus production. Applying the legend of the map, it is observed that LSBs are located in both high and low potential agro-ecologies of (relatively) highlands of both the north-western and south-eastern plateaus. For the realization of the development

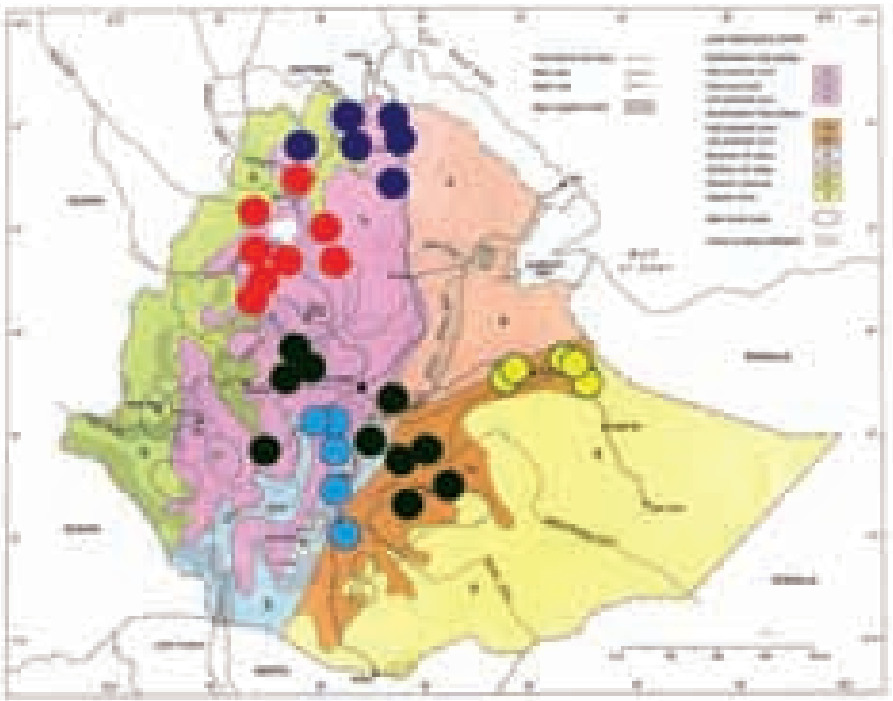

Figure 1. Geographic distribution of first generation LSBs in Ethiopia.
Note: Red, yellow, green, blue and purple dots denote LSBs located in the regions of Amhara; Oromia east; Oromia south and west; SNNPR and Tigray, respectively.

objectives of the LSB development component of the ISSD programme in Ethiopia, distribution is strategic for both the coverage of agro-ecological zones and total portfolio of crops and varieties. On a socio-economic gradient, the sites are also diverse.

4.2. Membership size of LSBs

Figure 2 shows the member size (aggregated by gender) for three years (2010–2012) in the four regions where ISSD is implemented. LSBs in Amhara have a large member size with a total average of 209 members/LSB, whereas LSBs in Tigray have relatively low member size with average total of 44 members/LSB. Women membership is also relatively more in Amhara than that of the other regions. ISSD observation is in favor of small member size per LSB for quality seed production. As membership size increases quality control becomes difficult.

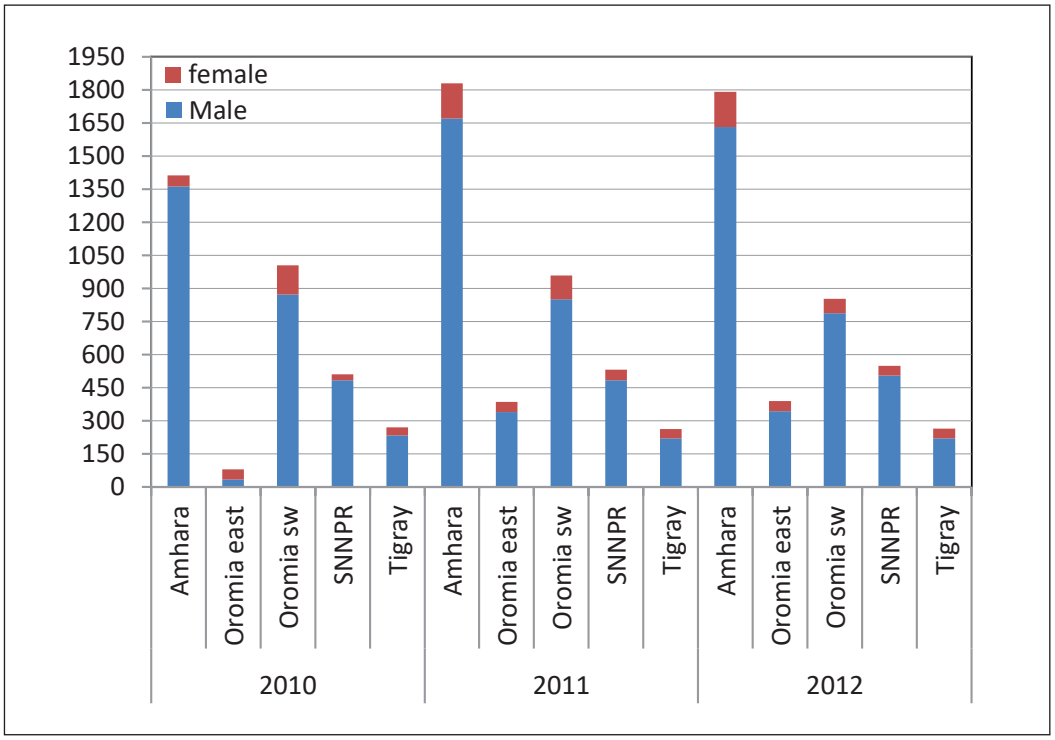

Figure 2. Membership size by year and regional ISSD units.

4.3 Crops and varieties addressed by LSBs

In 2012 the LSBs supplied improved seeds of 15 crops and 38 varieties (Figure 3), including seed potato, onion, groundnut, sorghum, lentil, field pea and chickpea for which the seed supply from the formal system is minimal. Thus, LSBs make a significant contribution to ensuring local food security by providing options to farmers to select those varieties better suited to their local agro-ecologies and market preferences.

4.4. Realizing the LSB development objectives

The total amount of seed produced by LSBs has been increasing from year to year (Table 1a) and the substantial increment in 2012 is attributed to increased number of LSBs through a scaling up strategy. Similar trends hold for seed potato production for the same period (Table 1b). The public seed enterprises in Ethiopia do not supply seed potato so far. The LSBs, research centers, and some individual farmers with linkages to research centers and a few private seed companies such as Solagrow and Crogrow are supplying seed potato in the country.

As a result of focused capacity development efforts, self-reliance in decision making and task division as well as quality seed production within all first generation LSBs has been greatly improved

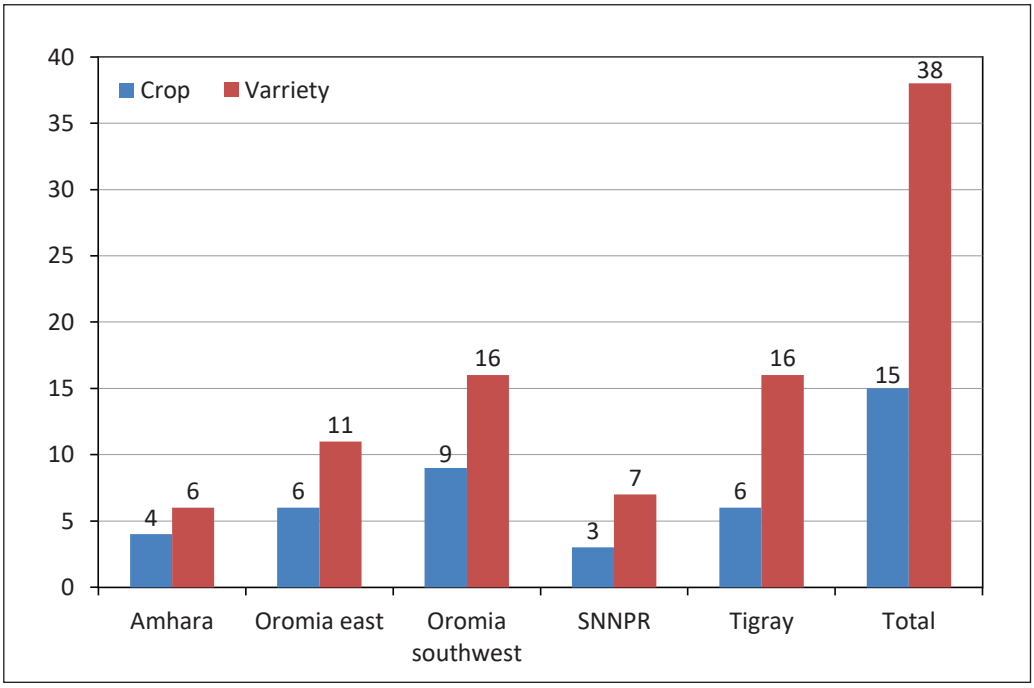

Figure 3. Number of crops and varieties for which LSBs produced seeds in 2012.

Table 1a. Amount of seed produced (quintal = 100 kg) by LSB in four regions from 2010–2012.

	Amount of crop seed produced		
ISSD regional unit	2010	2011	2012
Amhara	15,435.10	7,538.00	44,871.00
Oromia east	108.00	118.00	915.10
Oromia southwest	4,919.00	9,098.00	58,101.80
SNNPR	2,591.70	3,463.26	5,484.73
Tigray	8,045.00	15,035.00	11,993.13
Total	31,098.80	35,252.26	121,365.76

Table 1b. Amount of seed potato produced (quintal=100kg) by LSBs in four regions from 2010–2012.

	Amount of seed potato produced		
Region	2010	2011	2012
Amhara	3,900.00	2,070.00	310.00
Oromia east	445.00	1,292.00	3,858.00
Oromia sw	3,067.00	10,330.00	24,933.00
SNNPR	-	-	2,360.00
Tigray	1,013.00	2,157.00	4,995.00
Total	8,425.00	15,849.00	36,456.00

over the past four years, consolidated for the vast majority (Subedi and Borman, 2013). Towards the objectives of the programme component, LSBs are becoming truly autonomous in their seed business. However, concerted effort still needs to be made in strengthening their self-reliance in post-harvest value creation and marketing of seed. Those two are the main areas of weakness that have been identified during mid-term assessment of the program component, as will be highlighted later in this paper.

The provision of modest innovation grants has helped the LSBs purchase inputs such as basic seed and to invest in required facilities such as seed stores (including diffused light seed potato store), offices, office equipment and administrative materials, seed packaging materials and sewing machines. All these facilities contribute to making the LSBs more competitive in the market (Alemu *et al.*, 2013). The LSBs have been linked to a number of key partners, such as district offices of the Bureau of Agriculture for extension and seed quality regulatory services, Cooperative Promotion Agency offices for licensing their seed producer cooperatives and legal advisory services (including cooperative by-law amendment), proximity to agricultural research centers for access to basic seed and newly released varieties, and to NGOs for technical and financial support (Alemu *et al.*, 2013). These relationships with important input and service providers are key to improving the production cost efficiency of the business, which in turn is crucial for maintaining profitable margins for seed sales at a price still attractive for the market (MacRobert 2008; Alemu *et al.*, 2013). With guidance from MacRobert (2009) and knowledgeable resource persons, preparation of each LSB's business plan has also made a meaningful effort in defining the shared collective vision and objectives of the organization, and in preparing a strategic plan of action for all operations of the seed business, including market assessment, product development and marketing. However, these strategic plans of action need to be revisited continuously and revised for more appropriate and contemporary agenda setting.

Participatory Varietal Selection (PVS) has been an extremely promising innovation for seed producer portfolio development and variety adaptation (Abay and Bjornstad 2008). All LSBs have increased the number of crops and varieties in their portfolios through acquiring the required knowledge and skills to produce such a wide range of products for the market, often maintaining sufficient materials on-farm for responding to dynamic farmer demands for seed in response to changing environments and climate uncertainty. As many as 85 different varieties of 22 crops are presently within the collective portfolio of LSBs in Ethiopia. This includes seed potato, onion, groundnut, sorghum, lentil, field pea and chickpea for which the seed supply from the formal system is minimal. These LSBs make a significant contribution to improving local food security by providing farmers with the option to select those varieties better suited to their local agro-ecologies and cultural preferences.

Under the individual subheadings below, specific opportunities for and challenges to LSBs in fulfilling the demands of farmers within this market segment are discussed.

4.5 Opportunities for and challenges to development

Quality seed production

Clustering adjacent farmlands serves as a best practice for adequately responding to the complexities arising from small landholdings and fragmentation in the production of quality seed (see Figure 4). More than 200 individual farming plots of less than a quarter of a hectare each have been clustered in such a way to create a total of 36 hectares for the production of seed at Marwold site in Amhara regional state. In such an example, the real added value of the cooperative model is revealed. The clustered farming plots contribute to far greater economies of scale in seed production and are easier for inspection, field management and maintenance of isolation distances, and for technical supervision by organized sub-committees for internal seed quality control. Clustering also facilitates the demonstrations of seed quality during organized field days, which in turn promote the demand for LSB products.

The institutionalization of internal quality standards and control procedures has been a widespread success among the first generation in LSB development. The innovation itself has been supported by a number of interventions, ranging from training and awareness raising to the establishment of a specialized committee for internal quality control and documented procedures for quality seed production, inspection, and quality-oriented member rewards or penalties, with recognition in the cooperative's by-laws. By-law amendment for appropriation within the LSB context has been a successful, but also challenging institutional innovation, requiring the participation and endorsement of the responsible Government authority.

Figure 4. Hybrid maize (background) and wheat (foreground) seed production on clustered land holdings at Marwold site, Amhara Region, Ethiopia.

Seed promotion

As a part of promoting their seed, LSBs make efficient use of field days. The field days contribute to creating a better image of the LSBs in the presence of potential customers and authorities, such as the Bureau of Agriculture and Cooperative Promotion Agency. With the support of the ISSD programme, mass media such as radio, television and newspapers, and also magazine, brochure and pamphlet production, and the organization of large seed exhibitions are cost-effective opportunities for LSBs to promote their products to the market. Due to limited resources for active marketing, constraints in seed value addition including the use of distinctive seed packaging and branding, and the distance created between the end users and producers of seed through Government coordinated collection and distribution of seed without mechanisms for traceability and feedback make such opportunities for LSBs to promote themselves as a source for quality seed so important. ISSD is further supporting the LSBs to add value to their seeds through cleaning, packaging, labeling and marketing directly to other farmers. Support also includes linking the LSBs with other partners and service providers such as finance institutions. The ISSD initiated direct seed marketing (seed enterprises started to directly sell their seeds to farmers in certain pilot districts) gives confidence for the LSBs to add value and market their seeds directly

Seed price setting

For LSBs that serve as contract out-growers for public seed enterprises, seed price is set by a committee consisting of representatives from the LSB executive committee, the Bureau of Agriculture and the contracting party. However, it is to be noted that such LSBs can continue their seed business by producing locally demand crop seed even when the contract public seed enterprise is not there, which makes the LSBs different from other group of farmers who serve as out-growers. The seed price is typically set at 15–20% above the grain price, which is often established at the time of harvesting when demand is not yet been fully realized. Hence, the price for seed is arguably sub-optimal, putting seed growers at a disadvantage. For LSBs that sell their seeds directly to farmers the LSB executive committee, in consultation with its members, sets the seed price based on real market demand. In another case, LSBs may sell their seed in bulk to other bulk buyers like NGOs who negotiate a price that is deemed fair by both parties. Those LSBs that manage to sell seed directly to farmers and NGOs often obtain higher prices than those who are out-growers, but lack this security of the market. ISSD encourages LSBs to practice direct selling of their seeds so as to develop marketing skills as NGO-based bulk seed selling is not sustainable.

Seed marketing strategies

Often it is exclusively through contract agreements that LSBs enter the formal system, whereby the seed produced is subject to processing, certification and grading. Independently, LSBs have neither the facilities for processing their seed, nor the access to external quality assurance services, and as a result are limited in their opportunities for marketing their seed. In the aforementioned cases it is revealed that LSBs face either local economic or institutional constraints in adding value to and directly marketing their seed for a premium price. There is also considerable resistance towards establishing such marketing autonomy within the LSB organizations as they act as important out-growers and outlets for the public seed distribution system. Facilities for value addition need to develop through LSBs' internal investment, credit, grant and donation, all of which ISSD is currently facilitating. For those LSBs that elect to focus on the crops and varieties that public distribution neglects, fewer obstacles are experienced in providing to a local market. ISSD supports and coaches the LSBs to focus on such niche markets that both public and private seed enterprises are not addressing.

The programme on ISSD in Ethiopia actually advocates for a mixed model of production, whereby LSBs securing a market for seed of the major cereal crops through contract schemes can benefit from supplying to another bulk purchaser of, for example, potato seed tubers, like an NGO, while continuing to focus on creating and satisfying demand within an immediate geographic orientation for more local and traditional food crops. It is also to be noted that in certain LSB sites, such as in those in the highland areas of Tigray region, bartering is a commonly used strategy for seed marketing, whereby, for example, a single kilogram of improved barley seed can be exchanged for 2 kg teff grain, or 3 kg of wheat grain.

5. Conclusions

Results of ISSD interventions for local seed business development show that LSBs have strongly improved their professionalism in the management and decision making of their organizations. Evidently, most LSBs have improved the division of responsibilities among LSB members, enhanced business planning and associated organizational leadership skills; therefore justifying their progress towards becoming truly autonomous in their seed business. However, capacities for post-harvest seed value addition and marketing are the two main weaknesses of LSBs that persist nationally.

The majority of the LSBs are now technically well equipped to produce quality seed. Key performance indicators include an increased capacity for quality seed production, internal seed quality control mechanisms and the enhanced implementation of cooperative bylaws pertaining to seed quality control. Awareness raising and training, as well as continuous follow-up by the ISSD innovators, contributed to the establishment of cross-functional teams and committees within the LSBs' organizations with a clear differentiation of roles and responsibilities.

Local Seed Businesses have increased their financial capacities for purchasing inputs such as basic seed and fertilizers. Consequently, LSBs have increased the availability of affordable quality seed of improved and local varieties at village level. Some LSBs have made available quality seed of varieties that are not addressed by public and private enterprises, such as potato, groundnut and onions. In addition, the crop variety portfolio of most LSBs has increased through collaboration with research in PVS trials and in planning for early generation seed production.

The diversity and local adaptability of seed products in the LSBs' portfolios is regarded as a major strength in realizing their market niche. As some preliminary ISSD studies show, another is their cost effectiveness in being able to market their products at a price attractive to that particular market segment, where smallholder farmers are the main customers. This is achieved through the facilitated linkage to subsidized inputs and services provided by (non-) governmental organizations. With regards to their capacities for greater value addition, product promotion and marketing, as revealed above as the key prevailing constraints in their development, improved access to credit is observed as an important bilateral relationship to improve upon.

The LSB component of the ISSD focuses on transforming local initiatives in seed supply into local seed businesses. Given the diversity of the farming system, poor rural infrastructure and a wide range of food security crops in Ethiopia, LSBs are filling the wide gap between the informal and formal seed systems. This paper argues that LSBs contribute to both the availability and accessibility of quality seeds of superior varieties in Ethiopia.

6. Acknowledgements

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Local seed businesses in Uganda: a market-oriented approach towards community seed production

Astrid Mastenbroek
Centre for Development Innovation, Wageningen UR, P.O. Box 88, 6700 AB Wageningen, the Netherlands; tel. +256 (0)787 007 615; e-mail: astrid.mastenbroek@wur.nl

Abstract

The integrated seed sector development (ISSD) programme aims to improve food security and economic development by providing smallholder farmers with sustainable access to quality seed of superior varieties. The specific objective of the programme is to create a vibrant, pluralistic and market-oriented seed sector in Uganda.

The ISSD programme in Uganda focuses on establishing functional, commercially sustainable local seed businesses (LSBs), and on helping public sector organizations provide efficient and effective services to seed sector operators at national and local level. The programme works with 30 LSBs in three geographical areas in Uganda. The first year of intervention, 2013, concentrated on markets, marketing, quality seed production and access to inputs and services (mainly foundation seed). In the first season of 2013 (2013A), 16 local seed businesses were able to procure input[9] seed for 196 hectares. In the second season, 2013B, the planted area increased to 287 hectares, and the number of groups that purchased input seed increased to 23 groups. The shortage and high cost of foundation seed at the national agricultural research institutes are hampering the expansion of acreage planted. However, institutional buyers, such as the National Agricultural Advisory Development Services (NAADS), as well as farmers, have shown interest in buying seed from the LSBs.

The fact that LSBs have closer ties to farmers than commercial companies, and are recognized by local authorities and the NAADS, motivates farmers to buy seed from LSBs. Nonetheless, rumours of fake and poor quality commercial seed have made some farmers reluctant to buy seed in general. LSBs could build on social relationships to strengthen trust amongst their customers, and show that they are reliable sources of good quality seed.

The most profitable seed is that which has a high commercial value, such as hybrid maize, and is produced by commercial seed companies. LSBs serve a much more local market. The added value for LSBs to produce seed with lower commercial value is their proximity to farmers and the opportunity to serve niche markets (low volumes of seed, or seed that is too bulky for seed companies to be profitable).

The concept of community seed production as a market-oriented LSB supports the sustainable production of quality seed and enhances food security. However, in order to be successful the concept needs a favourable national policy environment, access to inputs for quality seed production, and consumer confidence in the seed produced by LSBs.

1. Introduction

In Uganda, the following four seed systems have been identified: farmer-saved seed systems; community-based seed systems; seed produced by private seed companies; and closed value chains, in which processors obtain seed, loan it to farmers, and then buy the produce back from the farmers after the growing season. Examples of closed value chains are coffee and sunflower. Figure 1 provides an overview of the characteristics of each of these seed systems.

In Uganda, 13% of the cultivated area is planted with seed from commercial seed companies (Gareeba-Gaso and Gisselquist 2012), 70% of which is planted with maize seed. The remaining 87%

9 Input seed is defined as either foundation seed obtained from a national agricultural research institute, or certified seed that is obtained from seed companies and used to produce seed for selling on to farmers.

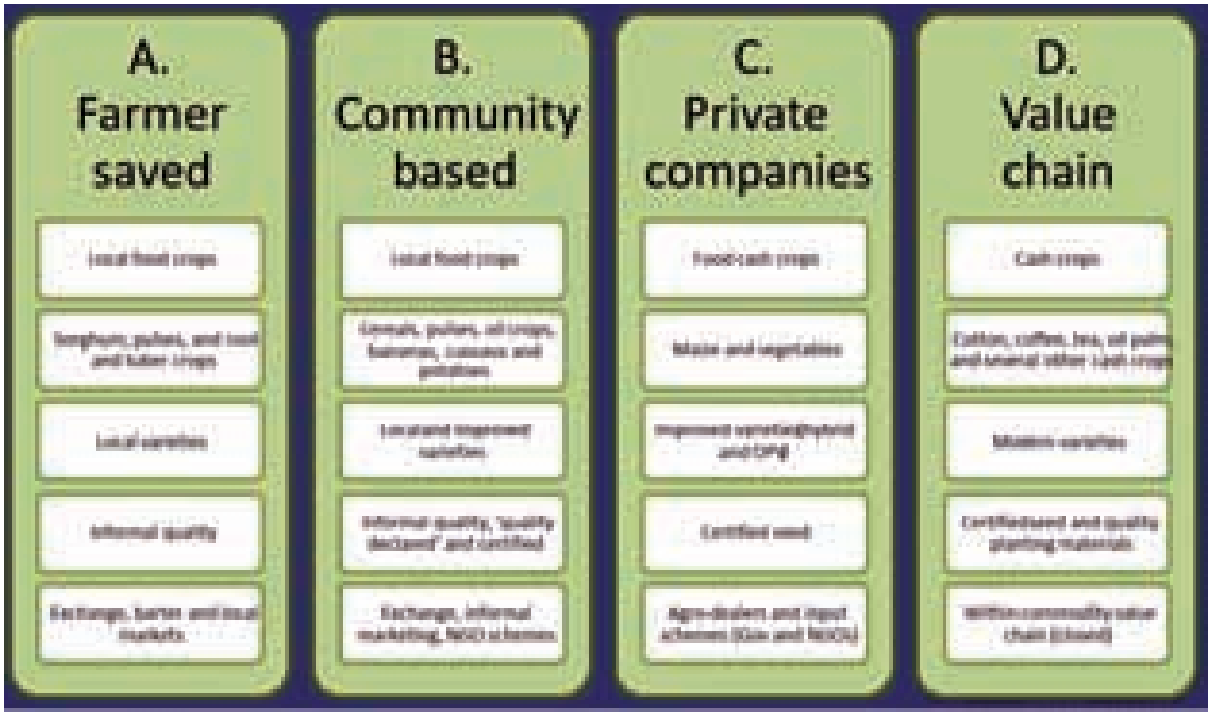

Figure 1. Overview of seed systems in Uganda.
Source: ISSD Uganda, 2012

of cultivated land is served by the informal seed system, which includes farmer-saved seed and community seed production schemes. Most commonly, seed that is produced by seed companies includes hybrid maize and rice seed, while farmer-saved seed and community-based seed production include pulses, tubers, oil crops and cereals. Figure 2 provides an overview of the crops grown in the three agro-ecological zones in which the programme is active (Northern Uganda, Southwestern Uganda and Northwestern Uganda). The major crops that farmers grow include beans, maize, groundnut and cassava. The diversity of cropping patterns in the zones generates a demand for good quality seed in relatively small quantities.

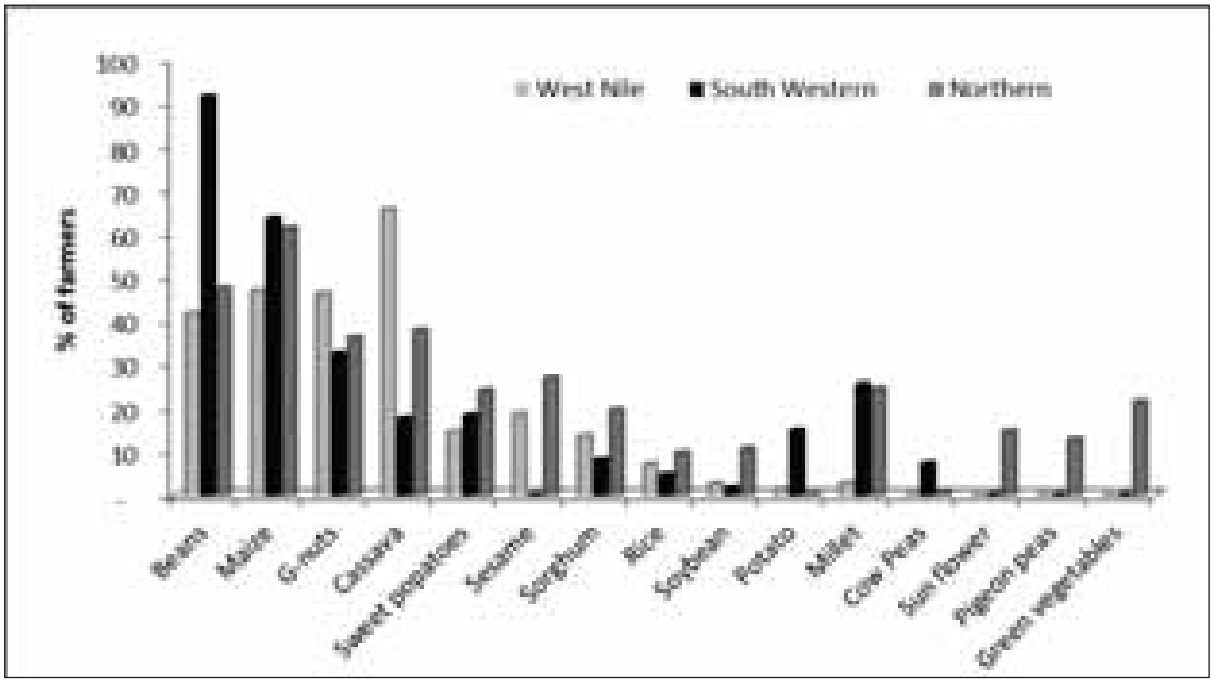

Figure 2. Crops grown in three agro-ecological zones in Uganda.
Source: ISSD, 2013

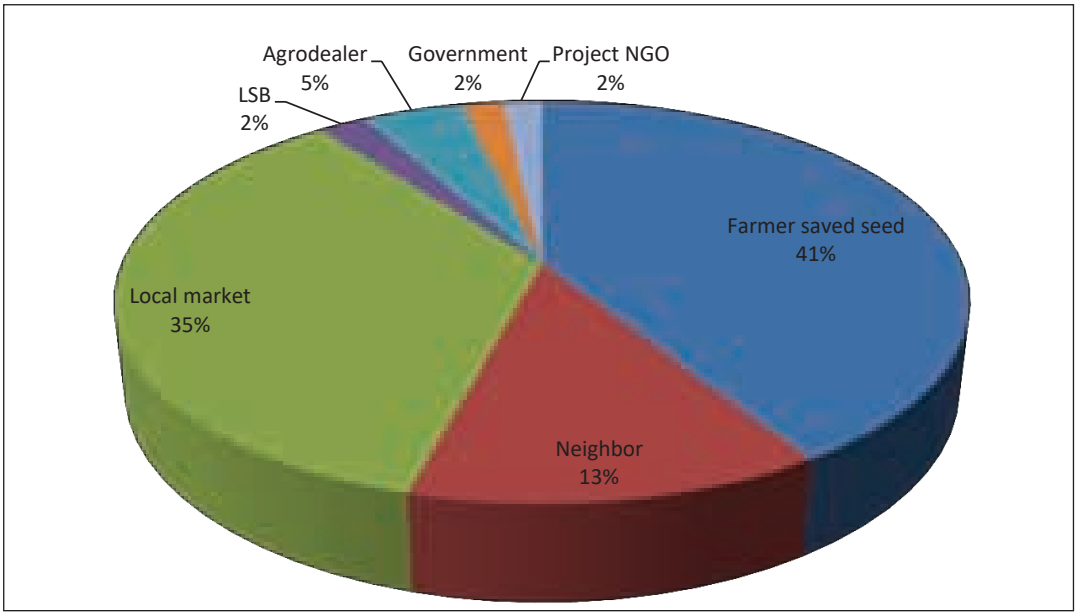

Figure 3. Farmers' seed sources in Northern Uganda, Southwestern Uganda and West Nile
Source: ISSD, 2013

Figure 3 shows how farmers access seed for planting; the figure is based on interviews with 905 farmers in the three areas in which the programme is active. Farmer-saved seed constitutes the largest proportion of seed used by farmers. Farmer-saved seed, in addition to seed obtained in local markets or from neighbours, covers about 89% percent of the quantity of seed planted. These three sources together represent the informal seed system, while seed obtained from agrodealers, or provided by non-governmental organizations (NGOs) or government programmes, is considered to be within the formal sector. The LSBs are at the interface between the formal and informal seed systems, comprising features of both systems.

2. Project objectives

The Government of Uganda (GoU) prioritizes agricultural development as playing a key role in the country's economic growth and in poverty reduction. The GoU aims to increase production and productivity levels in agriculture. Many stakeholders in the agricultural sector mention the limited availability of, and access to, high quality seed as being one of the main obstacles to increasing production and productivity levels. To address this issue, the Centre for Development Innovation at Wageningen University and Research centre (Wageningen UR) designed the integrated seed sector development concept and program.

The overall objective of this four-year program is to improve food security and economic development through integrated seed sector development (ISSD), providing smallholder farmers with access to quality seed. More specifically, ISSD aims to create a vibrant, pluralistic and market-oriented seed sector in Uganda. To achieve this, the program works towards establishing functional local seed businesses, and fosters the development of an enabling environment for seed sector operators at national and local level. This second component of the program focuses on a number of key issues at national and local level that hamper the development of the seed sector, including the quality assurance of seed produced; access to foundation seed; and the integration of the informal seed systems in seed policies and bills. These issues are addressed through multi-stakeholder processes, dialogue and innovation projects.

3. Methods and approaches

ISSD works with 30 LSBs in three agro-ecological zones in Uganda: West Nile (Northwestern Uganda), Northern Uganda and Southwestern Uganda. During the first year, the program focused on markets, marketing, quality seed production and access to inputs and services (mainly basic seed).

The first phase (September 2012–December 2014) is currently focusing on 30 LSBs; the second phase of the program (January 2015–June 2016) aims to increase the number of LSBs to 130 through partners adopting the LSB approach. By the end of the program these farmers' groups will be producing and marketing quality seed of locally preferred crops and varieties in local markets, and will be operating as local businesses. They will be technically better equipped, commercially sustainable and able to create linkages with service providers. The ISSD programme focuses on crops that enhance food security and on varieties that are locally adapted and preferred by farmers.

A diagnostic study was carried out in 2012 for each of the farmers' groups; the groups were scored according to factors critical for LSBs to function successfully as commercially sustainable enterprises. These factors, which were defined at the start of the program, are as follows: market, marketing, unique product, consumer feedback mechanisms, access to finance, access to inputs and services, quality seed production, governance and land. In 2013, the program focused on market, marketing, quality seed production and access to inputs and services, with an emphasis on basic seed. A seed expert and an agribusiness expert based at the Zonal Agricultural Research and Development Institute (ZARDI), in collaboration with ZARDI staff, are providing training and mentoring support to the groups in these areas. The programme does not supply free hand-outs and/or start-up material as most of the marketing activities that are implemented by development projects in Uganda stop functioning as soon as the project ends, because the farmers' groups are not required to invest in their own businesses. However, in the ISSD program, once a group has shown serious interest in cultivating seed and has produced seed on a minimum of eight hectares (annually) they can apply for a small infrastructural grant. The group needs to contribute 25% of the requested amount.

4. Progress and results to date

Initially, most groups expected the program to purchase inputs for them, even after extensive awareness raising on the concept of local seed business. This delayed the process of mobilizing resources in the first season (2013A). However, the limited availability of foundation seed for certain varieties from the agricultural research centres was also a limiting factor that contributed to the low acreage planted (Table 1).

Table 2 provides an overview of the area planted and the volume of seed produced and sold. Almost all the seed harvested was sold either to farmers in the neighborhood, seed companies, or National Agricultural Advisory Development Services programs. A number of LSBs save a proportion of seed for planting grain in the next season, for their own home consumption.

Table 1. Number of LSBs and area planted for seed production

	Southwestern Uganda		Northern Uganda		West Nile		Total	
	2013A	2013B	2013A	2013B	2013A	2013B	2013A	2013B
No. of LSBs producing seed	6	7	7	6	3	10	16	23
Area planted with seed (in hectares)	64	81	118	155	15	51	196	287

Source: ISSD, 2013

Table 2. Amount of seed produced and sold by LSBs in the 2013A season

Crop	Acreage planted (in hectares)	Quantity of seed produced (in metric tons)	Quantity of seed sold (in metric tons)	Remarks
Cassava	105	152	143.5	
Beans	37	21.3	17.3	harvest not fully recorded
Rice	32	2.6	64.7	harvest not fully recorded
Soybean	13	5.6	5.6	
Sesame	6	3.8	3.8	
Groundnut	2	2.0	0	
Potato	1	5	2.5	

Source: ISSD, 2013

Farmers, the National Agricultural Advisory Development Services (NAADS) and government extension services are interested in procuring quality seed produced by LSBs. Some LSBs have already sold seed to neighboring farmers. The distance to agro-input dealers and the fact that farmers find it difficult to identify quality seed are major factors impacting the sale of seed produced by LSBs.

5. Key factors influencing the success and commercial sustainability of LSBs

5.1. Access to inputs and services

The program began late 2012, with the selection of group members and the implementation of diagnostic surveys. Although ISSD made it very clear from the onset of the program that groups would not receive foundation seed to start up their enterprise, the groups still expected to receive such materials. This, together with the lack of funds provided by the groups, resulted in the low acreage of seed planted and, consequently, low productivity in the first season, 2013A. The groups also recognized the lack of availability of foundation seed, and the distance between the source of foundation seed and their fields.

5.2. Quality seed production

Preliminary seed testing results showed that the quality of seed produced in Southwestern Uganda meets the germination, purity and moisture content required to be registered as certified seed in Uganda. Field inspections, conducted by breeders from the National Agricultural Research Organization (NARO), were also able to confirm the quality of seed being produced by local seed businesses. Internal quality control is guaranteed by a quality control committee, consisting of group members. The ZARDI agronomist and seed expert also play a role in making sure that quality seed is produced. The ISSD programme is in the process of holding discussions with the government about recognizing seed produced by LSBs as standard seed, and developing a quality assurance mechanism that meets the requirements of quality seed production, while taking into consideration the nature of the LSB.

5.3. Markets

Lack of information concerning markets, farmer demand and released varieties makes it difficult for seed producer groups to define what their market is. Currently, they simply produce seed and then market what they have produced, creating a risk of unsold seed when the supply does not meet the demand criteria of farmers.

5.4. Marketing

The main advantage of LSBs is their proximity to the farmers they serve. A cost-benefit analysis of seed production shows that it is a more profitable enterprise than grain production for the same crops. For example, farmers who produce bean seed can take home 2.4 million Ugandan Shillings (UGX) per hectare, after valuing all labor, whereas for bean production they would make a loss if they took into consideration all their (home) labor costs. Local seed stakeholder meetings show that farmers and government extension services are interested in quality seed produced by LSBs. Seed produced in the first season of 2013 was sold to neighboring farmers and there is evidence that the LSBs have been reinvesting the profits in their seed enterprise. The distance to agro-input dealers and the fact that farmers find it difficult to identify quality seed are the major factors affecting the sale of quality seed produced by LSBs.

6. Discussion

Sustainability of this form of community seed production depends on access to required inputs, recognition of the informal seed system under the Seed Act, and being able to understand and act upon the market demand. The presence of counterfeit seed in the market has deterred farmers from buying quality seed and reduced consumer confidence in commercial seed. The fact that LSBs have closer links to the farmers than commercial companies, and that they are recognized by the sub-county governments and NAADS, motivates farmers to buy from LSBs. At the same time, rumours concerning fake and poor quality commercial seed have made farmers generally reluctant to buy seed.

There is a discord between the food security aim of the program and its business perspective, as the most profitable seed is that which has a high commercial value, such as hybrid maize, which is produced by seed companies. However, the added value for LSBs to produce seed with lower commercial value is their proximity to farmers and the possibility of entering niche markets (low volumes of seed, or seed that is too bulky for seed companies to be profitable).

In summary, for the LSB approach to be a successful way of increasing farmers' access to quality seed, it does not only depend on the entrepreneurial spirit of the farmers' groups, their ability to control the quality of the seed they produce, and their ability to address market needs. An enabling environment for LSBs is essential for success and includes:

- a conducive policy environment and the enforcement of policies and seed regulations;
- access to good quality foundation seed to guarantee the genetic purity of seed produced by LSBs;
- external quality assurance mechanisms to increase consumer confidence in the institutional parties that will distribute the seed to those farmers based further away from the LSBs;
- farmer confidence in quality seed, and in the benefits of their farming systems, to promote an increase in the uptake of quality seed in the country;
- access to credit and inputs, foundation seed or class-1 certified seed, which are needed to operationalize the LSBs;
- proximity to agro-input dealers and other seed company outlets, ensuring LSBs can get a market share; in the long run, agrodealers may play an important role in providing complementary agricultural inputs, such as pesticides and fertilizers, to farmers.

7. Conclusions

The concept of community seed production as a market-oriented LSB provides potential for sustainable quality seed production and enhanced food security. However, in order to be successful, the concept requires a favorable national policy environment, access to inputs for quality seed production, and consumer confidence in the seed produced by LSBs.

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Sustainable Seed Systems for Family Farming: Promoting More Inclusive Public Institutions – Lessons Learned from Mesoamerica

Allan Hruska
Food and Agriculture Organization; Sub-regional Office for Mesoamerica

Summary

The "formal" seed systems in Mesoamerica function only for a limited portion of farmers. The systems were designed to respond to large commercial farmers and the businesses that attend them, providing a very limited number of varieties (sometimes hybrids) of a limited number of crops through a limited number of businesses. Over the last fifteen years the "informal" seed sector, that attending to family farmers and local interests, has grown in experience and results, in many cases highlighting the divisions between the two systems and the lack of services and support from the "formal" system to the "informal" system. FAO's Seeds for Development project worked for three years to bridge the gap between the two systems, through a series of discussions and analysis of the national seed systems. The project supported twenty-nine small, local seed businesses attending family farmers, as well as the public seed systems, so that they could better appreciate and respond to the needs of the "informal" sector. As a result, most countries in Mesoamerica are moving towards inclusive public seed institutions, making adjustments in their administrative procedures to better serve local seed businesses, increasing seed security for family farmers. While progress is evident, several key challenges remain for the creation of truly inclusive public seed systems and to achieve sustainable seed systems for family farmers in Mesoamerica.

1. Introduction

Fundamental Role of Seed Security for Food Security

Three crops (maize, beans and rice) play a fundamental role in food and nutrition security in Mesoamerica. The foods of these crops form the basis of the daily diet of the majority of the resource-poor and food-insecure population of Mesoamerica. The vast majority of the production of maize and beans in Mesoamerica comes from family farmers.

There are a number of important constraints to increasing the stable consumption of basic grains and securing food security for the majority of Mesoamerica's food insecure families, but one of the most important is the low productivity of basic grains. This is especially true for common bean (*Phaeseolus vulgaris*), which is almost entirely produced by family farmers, is an essential source of protein in the diets of most resource-poor families, and for which the access to quality seed has been very limited due to the lack of commercial channels of distribution. Most family farmers in Mesoamerica continue to use bean seed that is nothing more than a small stash of the previous year's harvest or what is easily obtainable from family or friends, if no household left-over seed is available at the next planting time. While local provision of this "seed" may provide varieties that are locally desirable, there are often serious problems with the quality of the "seed" planted, due to poor germination as a consequence of inadequate storage conditions (insect-infested, high moisture leading to pathogen growth and lack of viability due to exposure to excessive temperatures) and the potential of seed-borne diseases due to the lack of quality-control procedures. The poorly functioning local seed systems, especially for local beans, are a major impediment to securing food security for many resource-poor families in Mesoamerica. The use of high quality bean seed versus saved grain can produce a large increase in productivity. The increase in productivity can be measured in the increased viability of the seed, the increased ability of seedlings to finally establish and produce a good productive plant, and the increased access to appropriate moisture and temperatures through the correct sowing time.

Some governments in Mesoamerica have sought to overcome the lack of access to quality seed by giving free seed to resource-poor farmers. A number of the governmental programs are large and have continued for years, giving bean and corn seed away to large numbers of resource-poor family farmers. While there may be short-term benefits of such give-away programs, their impact and sustainability have been often questioned and there is no evidence that any such program has led to a sustainable seed sector.

In order to achieve food and nutritional security, resource-poor farmers need to have seed security. That is, they need to have access (physical and economic) to the quantity of seed of the varieties they desire at the right moment for planting to cover their necessities. The sustainable supply of seeds depends on a sustainable seed system, which must: respond to the demand of farmers, prosper over time and be resilient to shocks, and be innovative and able to improve over time.

2. Seed Systems in Mesoamerica

Most countries in Mesoamerica do have well established and functioning seed systems, but they do not function well for small, local seed businesses or resource-poor family farmers as they were designed for and largely continue to function for larger commercial seed businesses. But other seed systems often exist alongside the official systems. The established official systems are often referred to as the "formal" systems, while the other seed systems, not recognized or normally supported by the official system are referred to as "informal."

The "formal" seed systems in Mesoamerica typically have a legal foundation (usually a national seed law), a registration system (for varieties and producers) and an institutional and administrative structure, typically divided between the Ministry of Agriculture and the National Agricultural Research Institute (NARI). This structure oversees the normative aspects of seeds, including the official recognition of crop varieties, authorizes the legal recognition of quality categories, and operates the administrative and technical components of the process leading to the commercial category, called "certified seed."

In Mesoamerica, "certified" seed is seed that has been determined by the competent national authority to have met or exceeded all quality standards of both the final product and the production processes.

This system is in contrast to that used in many other countries, where the responsibility of labelling the seed falls to the producers and quality assurance is made via "truth in labelling" legislation. The perceived quality from the farmer's perspective is largely based on the apparent trustworthiness of the company in the eyes of the consumer. The certified seed systems used in Mesoamerica results in a large technical and administrative burden on the national seed authority.

Some aspects of the formal system are typically managed by NARI and generally include managing germplasm collections, breeding programs, and international germplasm exchange of priority crops. Often these priority crops are those for which large commercial markets do not exist for varietal development or seed sales. These are crops which are either not attractive to larger commercial farmers, or their germplasm is largely in the public domain and are usually self or open pollinating, making intellectual property rights of the germplasm or process difficult. The NARIs also typically maintain the basic seed of registered varieties and produce the registered seed used to produce certified seed. In some cases the NARIs produce the certified seed that is used in government social programs.

The formal systems function well for their original purpose and traditional clients: large seed companies (national or transnational) that produce a limited number of varieties of a limited number of crops. Unfortunately, they function much less well, or not at all, for small, local seed businesses or family farmers.

The barriers faced by smaller seed enterprises are several: the inexperience of the businesses in registering themselves with the national seed authorities, access to Basic or registered seed of the

varieties they would like to produce, the lack of field inspectors to get to the remote fields and supervise the production, the lack of adequate and timely laboratory testing, and the inability of the official system to recognize local landraces, due to over-stringent requirements on genetic uniformity. As the entire technological/administrative structure for quality seed is built around the certification process, any group or business that attempts to produce quality seed outside of the certification scheme is left without access to quality-control infrastructure or technical support.

Finally, small, local seed enterprises typically have no role in the national public seed governance structure. Some countries do have private sector participation in seed policy discussions via representation on national seed committees, but that representation invariably comes from the large private companies, not small, local seed enterprises, leaving them without an effective voice in shaping seed policy and procedures.

Over the last ten years a number of initiatives in Mesoamerica have grown to support the development of "informal" seed producers. A number of these initiatives have focused on promoting the conservation and use of local varieties and on participatory breeding methods to continue to improve the local varieties. Other initiatives have focused on local seed banks and territorial development. In both cases the official national systems have been ill-prepared or without adequate legal, political or administrative support to engage positively with these initiatives.

The initiatives have often been supported by civil society organizations that do not have a strong linkage with the national seed system. The lack of communication or shared vision has led to the development, almost in isolation from the official system, of alternative seed systems. Without much interaction between the two sectors, and in some cases mistrust, the two systems have often appeared to be content with the further development of parallel systems.

3. Seeds for Development Project

In March 2010 the FAO office for Mesoamerica (SLM) began the implementation of the Spanish-funded "Seeds for Development" project with the objective of improving family farmers' access to and use of high quality seed of the priority family agriculture food crops (maize, bean and rice). The project sought to promote sustainable seed systems for family farmers in Mesoamerica by creating or strengthening local seed businesses, while simultaneously working with the official national seed systems to engage with the local seed businesses, to begin a dialogue that could lead to a better understanding of the constraints of the current system and barriers to their incorporation into the "formal" system, ultimately creating more inclusive national seed organizations.

At project inception a series of workshops were held to discuss the national goals of food security and the role of seed security and family farming in that goal. Dialogue was facilitated between the national "formal" seed sector officials and members of the "informal" sector to discuss common goals and the barriers faced by those outside the "formal" sector. A number of key points arose from these discussions:

1. The national legislation and administrative procedures define the criteria necessary for the recognition of varieties using the DUS (Distinctiveness, Uniformity, Stability) criteria, based on international systems, such as that of the International Union for the Protection of New Varieties (UPOV). The DUS system, when strictly interpreted, is an impediment to the recognition of local bean landraces, mainly because of the genetic diversity inherent in these landraces. The DUS system could be adjusted to recognize local landraces by changing the percentage of plants that correspond to a particular description.
2. Most national seed systems do not have the technical or administrative capacity to attend to small, local seed businesses, many of which are situated far from the capital cities. Many countries have only a few trained seed technicians, who often do not have access to the necessary transport and resources to visit and verify compliance of the field standards under which certified seed production should be carried out. Most countries of Mesoamerica have

only one official seed laboratory in which all seeds must be tested against phytosanitary and germination standards before they can be certified. Often the time required to send samples to the laboratory and receive back the results in remote areas is a serious impediment to marketing seeds.

3. The certification procedure and label is synonymous with "quality" seed in most Central American countries, leaving little room for discussion of "non-certified, quality seed". Recent high-profile corruption scandals involving the official certification of seed that did not meet the requirements and its export to a neighboring country led to a re-examination of the assumption that "only certified seed is high quality and all certified seed is of high quality." In South America there are examples of countries that allow labeling of seed by the seller and its commercialization. This system works well where there is a legal framework that allows the user to legally challenge misrepresented bags of seed. This system converts the national seed authority's role from that of inspector and pre-sale enforcer to that of auditor and post-sale adjudicator.
4. The lack of supply of the registered seed by NARI to local seed companies can be a serious roadblock to the production of quality seed by small businesses. The lack of fluid communication between small businesses and NARI and the lack of capacity to plan for and produce registered seed of the varieties required at the moment it is needed result in many lost opportunities for small seed companies. The necessity of having a public institute with the mandate of doing basic seed production was questioned, being an activity that can be produced by a company under the supervision and responsibility of the institute, eliminating the need for a public institute to handle complex operations that it may be ill-equipped or staffed to handle.
5. Even in countries with explicit laws and policies promoting food security and family farming, seed offices do not have a clear mandate to promote family farming seed systems through support of local seed businesses or view the small businesses as important clients.

4. Two Seed Systems? Or One Inclusive Seed System?

Dialogue among government seed officials, local seed business leaders and FAO experts resulted in some shared perceptions and recognition of the benefits of creating a unified, inclusive system, incorporating and supporting the "formal" and "informal" seed sectors. There was also recognition that the "informal" sector brought to the table valuable experiences and perspectives from which the formal sector could learn, and that the formal sector needed to fully appreciate and plan to change the legal and administrative impediments that kept the "informal" sector isolated.

Discussions converged on common recognition that:

1. National seed policies and systems should support the national goals of food and nutrition security and rural poverty reduction. The services and goods provided by the national seed system are public goods. An inclusive formal system should provide benefits to all clients.
2. Local seed enterprises and groups could and should benefit from the technological skills and infrastructure maintained by the official system, including training on seed production, processing, packaging, sales, market opportunities and the knowledge of seed health and the laboratories to test that health.
3. Local land races and varieties offer an excellent opportunity to conserve and utilize plant genetic resources. Instead of a narrow focus on DUS system and the exclusion of genetically-diverse varieties, varietal improvement programs should seek to integrate the goals of plant genetic conservation along with varietal development and use.
4. The public seed systems need to work more closely with the small local seed enterprises to better determine demand for registered seed of the required varieties at the required time.
5. Quality bean seed can be produced by non-traditional seed businesses given the appropriate training, supervision and quality control.

6. The lack of certification does not mean that seed is of low quality. Sometimes the seed simply has not had the benefit of the oversight or administrative processes required for certification. Similarly, certification is not always a guarantee of quality, as demonstrated by notorious corruption scandals.
7. To further the discussions and develop the agendas for action, it is important to include the small, local seed enterprises into the national seed governance structure.

5. Moving Towards an Inclusive Official Seed System

The facilitated dialogue created a number of proposals to make the public seed systems more inclusive. Some of the recommendations and actions taken originated with the public sector, others from the emerging private sector, and yet others came from the FAO-facilitated exchange of experiences with other countries.

Access to Official Recognition of Seed Quality

One of the first and most polemical discussions regarded the shared assumption among official seed regulators that only certified seed was quality seed. The discussions started with an examination of that assumption, including the fact that many countries outside the region do not certify seed, depending instead on the legal implications of truth-in-labelling laws. It is also believed that having a seed production system with optional certification will reduce the work needed by the National Seed Authority. On the contrary, it provides more demand for work since post-control of non-certified seed needs to be carried out and auditing of enterprises accredited for self certification needs to be permanently done.

Second, the many comments about the lack of resources of the official seed system to attend to the demands of many small, remote seed producers led to the conclusion that alternatives needed to be sought to provide services to small businesses so that they could receive official recognition of the quality of their seed.

The solutions offered to overcome the problem of lack of resources (inspectors, vehicles, travel funds and laboratories) were several. Costa Rica has worked at developing an alternative recognition process, which would grant an official label to seed that had been locally produced and its quality assured through a self-certification process. This process recognized that services should be provided to the remote seed producers, while also recognizing the unlikely probability that the government could directly attend the remote enterprises. This process and the resultant label would be different from the official certification process, and recognized as such.

Other countries (Panama, Nicaragua and Honduras) took a different path, stating that all seed should be certified under the same procedures and receive the same recognition (label). This decision was made in part to provide family farmers with the same level of quality as larger farmers, and in part to maintain a direct role in the quality assurance. These countries have worked closely with the new local enterprises to attempt to guarantee the supply of registered seed in a timely manner, field inspectors who could verify the quality conditions of the field production, and timely response from the seed laboratories that test the seed against standards. It should be noted here that for a country with one million ha of bean production that it is necessary to have 40,000 ha of seed production. If that came from small areas of production (i.e. 1 to 2 has each), 20,000 inspections would be needed during the two weeks of flowering time, meaning that 1,500 inspections would have to be done per day, as an inspector will rarely do more than 4 ha in one day.

Both Costa Rica and Nicaragua recognized that they would have a hard time providing field inspection service if the number of seed production fields continued to increase in remote areas and have begun internal discussions about the possibility of accrediting local inspectors, who would be trained and authorized to provide the same services as the official inspectors. Nicaragua has

also announced that it will build, equip and staff two regional seed laboratories in the bean seed-producing zones, so that small enterprises would have timely results from requests for testing of seed quality.

The dialogue and reflection regarding national seed services in Honduras led to a complete reversal of public policy and support for the seed sector. During the late 1990s Honduras had completely privatized their national seed services, eliminating its basic and registered seed banks and selling or renting its seed processing plants and storage capacities. As a result of their participation in the Seeds for Development project, Honduran authorities decided that a functioning public seed system is a fundamental national strategic asset that produces important public goods and requested that the FAO assist it in re-establishing their capacities to coordinate and protect the public interest, via re-building their capacity and re-stocking their germplasm bank.

Honduras and Nicaragua have moved forward on the issue of registering local varieties, supported by the efforts of the Collaborative Program for Participatory Crop Breeding in Mesoamerica. In both countries a number of bean varieties are close to receiving local recognition as registered varieties.

Finally, the discussions regarding the role of seed systems in promoting national food security led a number of countries to re-examine their national seed legislation and policies. Guatemala held a national workshop to begin the process of defining the key elements of a national seed policy and identify principle actors who should be involved in the process.

The Seeds for Development project was very successful in helping support the establishment or strengthening of twenty-nine small seed enterprises, which began to supply high-quality bean seed to family farmers across Mesoamerica. The project also supported the strengthening of the official seed systems, through infrastructure, training and learning through interchange with neighboring countries. But probably the most important impact that the project has had was in facilitating the dialogue between the nascent private sector with the public sector, that examined fundamental questions such as the role of the public seed sector in national priorities to administrative details of how make adjustments so that local, often remote small seed enterprises could enjoy the same level of services that received larger, more established seed companies.

6. Challenges for the seed systems

Great progress has been made and most countries are clearly on the path of creating more inclusive public seed institutions that support local seed enterprises in their business of supporting family farming and achieving food and nutritional security. But several important challenges remain.

6.1. Give-away seed social programs

Several countries in the subregion have very substantial and long-term public programs that provide seed and fertilizer for free to large number of family farmers. Figure 1 shows an estimate of some of these national programs, totalling over US$ 140 million spent by national governments in the purchase and give-away of seed through such programs. These figures include only the direct fiscal cost, and do not include the costs of distributing the seed.

While these programs may have a role in helping to pave a transition from an emergency situation (all seeds lost in a region due to extreme climatic events or pest damage, or in helping extremely poor farmers build working capital), some governments have become trapped into giving away large amounts of seed year after year to the same farmers, with no motivation for the farmers to transition to anything else. In fact, political and economic pressure from numerous interests groups have now made these programs so entrenched that they are difficult to shift away from, despite the stated interest of several recent governments. While the benefits of the programs have not been determined, their costs are quite obvious: beyond the yearly government budget outlay, the programs have effectively destroyed any local markets for small-scale seed purchases. In addition, the job of distributing the seeds and fertilizer was handed over to the NARIs, which meant that

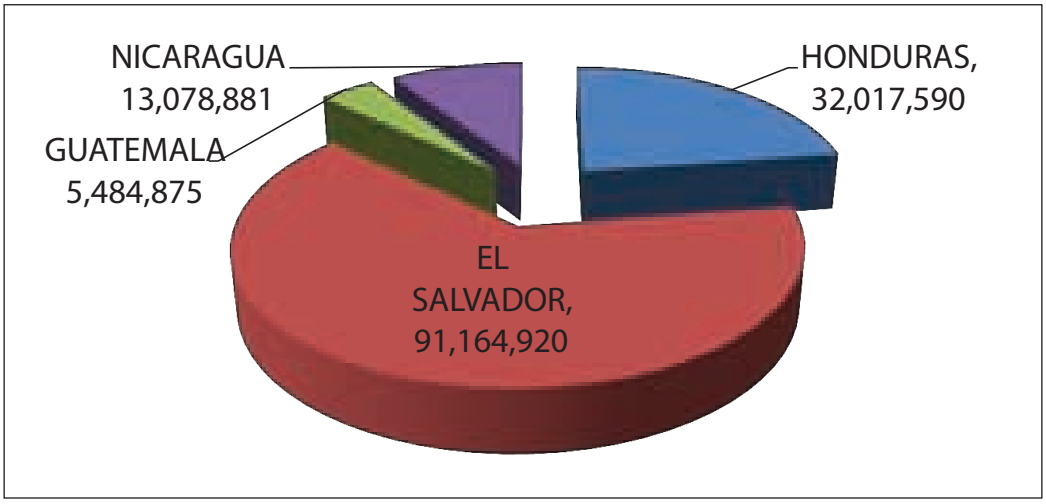

Figure 1. Direct public expenditures (US$) for seed give-away programs 2006–2012 (El Salvador, 2006–2013, Guatemala 2009–2013, Honduras 2006–2011, Nicaragua 2007–2010). Seed value estimated at US$2.42/kg).

instead of developing and testing new varieties and engaging in international research collaborations, the NARI researchers have been converted into logistic operators. Their spreadsheets have changed from lists of varieties and their field performance to lists of citizens who should receive some of the latest giveaway – and then having to travel to the communities to oversee the distribution.

In these situations farmers will not claim their rights if the seed received is of poor quality because it was a gift, so the most fundamental discussion between farmers and salesmen that a customer "will not purchase seed again" from that company if the quality does not improve, does not happen. That scenario is the basic incentive for a company to improve the quality of its seed.

6.2. Strengthening small seed enterprises

The twenty-nine small seed enterprises that were created or strengthened by the Seeds for Development project are all producing high-quality bean seed and all face serious challenges. Most are incipient businesses, and as such still have to improve the quality of their product, improve marketing and sales, and strengthen their internal governance, administration and finance situations. Obtaining and managing credit is one of their biggest challenges. But in some countries, so are the governments, via their seed give-away programs. Ironically, some small seed enterprises have benefited in the short-run from these programs, as they have purchased seed from the small businesses. In the longer-run, however, the programs damage the businesses, as the give-aways effectively destroy any real or future demand via direct purchase by the producers. Receiving the seed for nothing also does not create the sense that the seed is a good investment in their crop production and thus worth making.

The nascent companies are currently very limited in their offer of products and services, typically producing just one variety (albeit the most sought-after locally) of common bean. There is great potential to expand the varieties and crops that they offer and to begin simple comparison trials where testing of different varieties can be carried out and the results observed. There is great potential for these local businesses to be incorporated into national and region multi-varietal trials.

The Seeds for Development project held a conference and trade-fair to allow the new businesses to share their experiences and ideas that was enthusiastically attended and praised. Honduras has created a network, a nascent trade association or federation, of small seed businesses. They have developed a joint labelling scheme and are finding success in marketing well beyond what any one small company could achieve.

6.3. National seed policy

There is a need to engage in a process to define and approve national seed policy. A seed policy is understood as a document that directs seed law and regulations. It is a declaration of intent of the government on which direction to take in a complex seed sector, in areas such as public-private relationships, private sector development, regulations of foreign trade, taxes, subsidies, public and private breeding, compulsory or optional certification, etc.

The process of policy development should be accompanied by a thorough revision of national laws, decrees, institutional and administrative arrangements and adjustments to the governance structure. It is important that all actors participate actively in this discussion and the construction of the National Seed Policy.

6.4. Seed production, varietal development and plant genetic resources

An important pending issue is how to successfully merge the goals of varietal development and seed production with that of plant genetic conservation and utilization. This needs to be done conceptually, institutionally, via common policies and operationally.

Although inter-related, the two topics live in different universes. Plant breeding and seed production lie in the Ministries of Agriculture with their NARI at a national level and a set of international organizations and treaties (CGIAR, UPOV, etc.) and is driven by demands for increasing production, productivity, food security and exports. Typically it has a shorter time-horizon. The conservation and utilization of plant genetic resources are covered by different international treaties and governance mechanisms, often linking with the Ministries of the Environment, and not the Ministries of Agriculture, creating institutional divisions and rivalries that are often difficult to overcome. In practice, no country in Mesoamerica has a clearly articulated, coherent vision of how the two agendas could move forward jointly.

Beyond potential synergies and efficiencies, this division creates concrete difficulties. For example, local land races of common beans, which may have unique qualities and whose continued use could promote the conservation of local plant genetic resources, but are not permitted to be registered as varieties due to genetic diversity is one example of the contradictions of the current systems.

7. Conclusions

FAO's Seeds for Development project has clearly shown that the creation of inclusive national public seed institutions is desirable and achievable. The process requires structured dialogue that identifies and reaches agreement on the role of the public seed institutions and national seed objectives in the framework of larger national goals. The dialogue is important in both creating trust among the "formal" and "informal" sectors and for the formal sector to appreciate and seek solutions to the impediments that the "informal" sector faces under laws and administrative procedures that were created to support larger commercial farmers and the businesses that attend them. Once identified, the impediments have been directly addressed in some cases (building additional seed laboratories, hiring more field inspectors or accrediting local inspectors, improving planning mechanisms to ensure the timely availability of registered seed), whereas other issues require continued dialogue and action (modifying the rules for varietal recognition to permit more genetically-diverse landraces, opening the public governance structure to give voice to small, local seed businesses and their associations, creating a comprehensive national seed policy). The promotion of local markets and the transition out of on-going national seed giveaway programs are also key factors that must be addressed in order to achieve sustainable seed systems for family farmers in Mesoamerica.

Experience on Certified Seed Production with Associated Family Farmers in the Highlands of Bolivia, Ecuador and Peru

Gonzalo Tejada[1], Tania Santivañez[1], Javier Aguilera[2], Nicola Mastrocola[3] and Rember Pinedo[4]
[1]FAO-RLC; [2]FAO Bolivia, [3]FAO Ecuador, [4]FAO Peru.

Correspondence: gonzalo.tejada@fao.org

Abstract

In Bolivia, Ecuador and Peru, Andean agriculture is practiced in extreme climate conditions; high altitudes of more than 2,000 meters above sea level (highlands) and with irregular topography. At present, one of the main problems that face the Andean region is the shortage and lack of use of quality seed in crops such as potatoes, flour corn, quinoa, fava beans and common beans, causing low yields and products with low commercial quality, resulting in low prices and small family incomes, generating food insecurity. Andean Seeds Project (GCP/RLA/183/SPA) of FAO, funded by the Spanish Cooperation Agency, aims to change this situation by producing high-quality, certified seeds, with a sustainable crop production intensification (SCPI) approach. The project works by building the capacity of associations of Andean family farmers to produce certified seed with an internal quality control system through the farmer field schools (FFS) methodology, and to develop and execute a solid business and marketing plan. To date, the project has organized and strengthened 87 seed producer organizations which bring together 1445 families, who in the 2012/2013 growing season produced 1740 tons of certified seed of potatoes, flour corn, quinoa, fava beans and common beans, which has enabled to plant approximately 5500 hectares, representing a 20% of the demanded area of the project working area. Field evaluations have demonstrated a 20% and 23% increase of the average crops yield, by country and crop respectively, due to use of certified seed. Furthermore, the project has strengthened institutional capabilities and seed legal frameworks in the three countries. Important lessons were learned from the project's experiences. First, the main motivation of the producers is the visible outcomes of using seed of high quality. Second, the use of quality seed must be accompanied by good and appropriate agricultural practices to ensure increases in productivity. Third, participatory, holistic and multidisciplinary approaches to capacity building are effective in achieving results for community organizations. Importantly, respect for local knowledge and traditions creates a good working environment and inclusiveness that promotes the achievement of expected results. Family farming can contribute significantly to formal seed production. To do this they need an appropriate environment, its means promoting policies, good regulations and efficient services. Sustainability of seed producer organizations mainly depends on local demand.

1. Introduction

Andean agriculture in Bolivia, Ecuador and Peru is conducted in extreme weather conditions such as drought, flooding, frost and hailstorms. Furthermore, it is done at high altitudes between 2000 and 4800 meters above sea level (Meyer 1979). The croplands are located on an irregular topography of the Andes, presenting a diversity of microenvironments in relatively small spaces.

The Andean farmers understood the adverse conditions of their environment and have developed as a response a series of technologies that allow them to progressively modify the inconvenient aspects (Blanco 1995). One such adaptive mechanism has been the domestication of a wide range of cultivated species, resulting in the Central Andes of South America being one of the main five centers of domestication of food plants, with 45 economically useful native species (Tapia and Fries 2007). In the Andes region, since time immemorial, there is an active exchange of seeds and genetic material (Tapia 1992). However, following the Spanish conquest of the 14th century, there was a shift into other economic activities such as mining and construction at the expense of agriculture,

resulting in loss of knowledge of centuries, aggravated by the inexistence of a written culture in the pre-Hispanic societies.

At the present time, the highland agriculture is predominantly family farming (FAO 2011), which includes agricultural production, livestock, forestry, fisheries and aquaculture. Despite the fact that there are considerable differences among countries and within each country, the term has the following features (FAO 2012):

- Limited access to land and capital resources
- Predominant use of family labour, with the head of the family directly involved in the production process, i.e., even though there may be some division of labor, the head of family does not assume as manager, but as one more worker of the family
- The farming/forestry/fisheries/aquaculture is the main source of household income, which can be supplemented with other non-agricultural activities that take place inside or outside the family unit (services related to rural tourism, environmental benefits, handicraft production, agro-industries, casual, etc.)

Generally, there are two systems that supply seed in Andean agriculture; the formal seed system which is regulated and is oriented to modern and commercial agriculture and the informal system which often predominates in family farming (Thiele 1997, Tejada 2003). Both systems are complementary, but the overdependence on the latter has been associated with low yields and products with low commercial quality, resulting in low prices meagre family incomes, food insecurity and poverty. There is an evident need for the use of high-quality seed of the main crops such as tubers and Andean grains, flour corn, quinoa, fava bean and common bean to improve productivity and livelihoods in the highlands of Bolivia, Ecuador and Peru. This was the rationale for the establishment of the Andean Seeds Project described in the subsequent sections of this report.

2. Actions taken by the Andean Seeds Project

The changes from the times of the republic to date, not only changed the farming model for the high Andean zones, but consolidated social exclusion processes, that according to Kay (2007), have three dimensions: economic exclusion (marginalization of production systems), political exclusion (access or rights inequality), and cultural exclusion (lack of acknowledgement and segregation of values and cultural practices). One such group that has been excluded is the family farmers; it is generally considered that they cannot produce or use quality certified seeds. It is against this background that the Andean Seeds Project, with support from the Spanish Agency of International Cooperation for the Development (AECID, acronym in Spanish), was set up to reach out to this excluded group. The project aims at improving the availability, access and use of the certified seed in the highlands zones of Bolivia, Ecuador and Peru.

Figure 1 presents outputs and outcomes for the Andean Seeds Project. We considered the following work strategies:

- Application of the approach of sustainable crop production intensification (SCPI), which is the first strategic goal of the FAO that, at the same time, uses the “eco systematic approach” in the agricultural management (FAO 2011).
- The promotion of the association between family farmers as a condition to work in the empowering and strengthening of the farmers’ capacities. That includes achieving legal status of the organizations and obtaining the registration with the seeds authority in the each country.
- The strengthening of the family farmers organized in three capacities: (i) producing quality seed, (ii) implementing an efficient internal quality control system and (iii) developing and implementing a solid business and marketing plan.
- The use of the farmer field schools (FFS) as the main tool for strengthening people’s capacities. This methodology has been successfully developed and spread by the FAO in several continents.

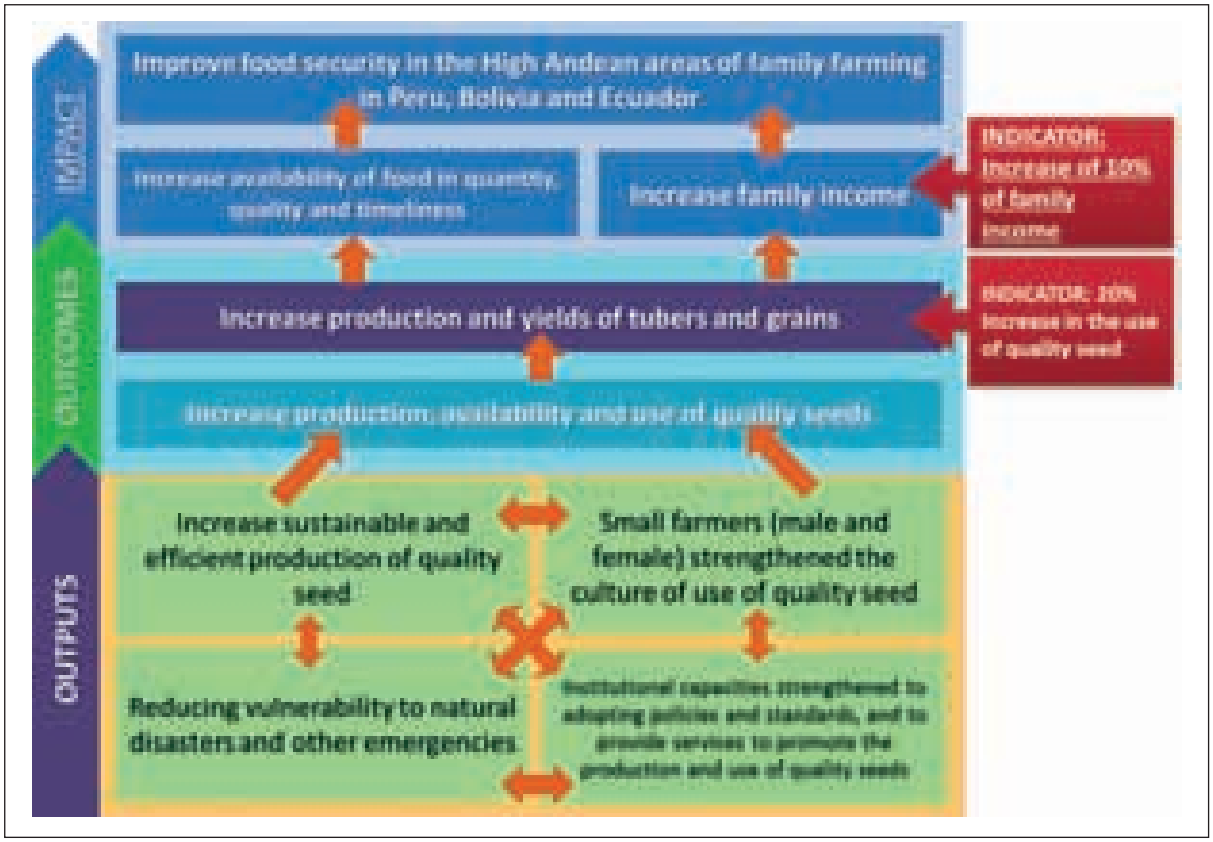

Figure 1. Conceptual framework of the Andean Seeds Project

3. Achieved results

To date the project has established and is currently strengthening 87 certified seeds producers organizations, representing 1445 families (Table 1).

Table 1. Number of established organizations undergoing capacity strengthening in Peru, Ecuador and Bolivia (members by gender).

Country	Goal operations	Established organizations	Members		
			Men	Women	Total
Peru	25	31	344	163	507
Ecuador	26	26	292	104	396
Bolivia	22	30	387	155	542
TOTAL	73	87	1,023	422	1,445
			70%	30%	100%

With these organizations, in the 2012/2013[10] growing season the project managed to produce and commercialize 1740 t of certified seed of potato, flour corn, quinoa, bean and fava bean, tripling the production of the previous cycle (557 t), (Table 2). The seed was produced from a total of 33 improved and native varieties (Table 3). To certify seeds of native varieties it was necessary to make some changes on seed legislations and include the native varieties in the variety registration.

This volume of seed produced enabled the planting of nearly 5500 hectares of commercial fields; it represents coverage of 20% of the seed local demand (Table 4).

10 The producers have had only two growing seasons.

Table 2. Produced certified seed, by country and crop (t)

Country	Potato	Flour corn	Quinoa	Bean	Fava bean	Total
Ecuador	331	38		34		402
Peru	894	4	16			914
Bolivia	380		7		36	424
Regional	1,605	41	23	34	36	1,740

Table 3. Number of varieties used by country and crop

Country	Potato	Flour corn	Quinoa	Bean	Fava bean	Total
Ecuador	4	2		1		7
Peru	8	2	5			15
Bolivia	1		6		4	11
REGIONAL	13	4	11	1	4	33

Table 4. Estimation of coverage with the produced certified seed, in relation to the potential crop area in the work zones of the project. (Hectares and percentages)

Country	Potato	Flour corn	Quinoa	Bean	Fava bean	Total
Crop area (hectares)						
Ecuador	276	1,253		375		1,904
Peru	230	64	2,010			2,304
Bolivia	254		893		145	1,291
Regional	759	1,317	2,903	375	145	5,499
Coverage of the seed demand (%)						Average
Ecuador	8%	21%		8%		13%
Peru	7%	4%	64%			29%
Bolivia	12%		53%		11%	25%
Regional	8%	17%	60%	8%	11%	20%

In field evaluations[11], we observe a big rise in the productivity only for the use of the certified seed; in crops this increase goes from 23% to 170% and by country from 20% to 83%. These data passes the planned goal of 20% (Table 5). Also, despite such an increase in production, the cost of production has not increased dramatically, indicating a good increase in family incomes.

Table 5. Behavior of the performance in the crops with quality seeds

Crop	Goal growth performance	Average growth (%)			Average per crop	Crops' average
		Peru	Ecuador	Bolivia		
Potato	20%	20%	128%	171%	107%	
Flour corn	20%	18%	39%		29%	
Quinoa	20%	21%		25%	23%	57%
Beans	20%		82%		82%	
Fava Bean	20%			46%	46%	
Country average		20%	83%	81%		
Regional average		61%				

11 The data was collected from commercial fields that used certified seeds in comparison with average local yield.

For the strengthening of the capacities of the seed's producer organizations and of the farmers using these, 144 FFS were developed with 2537 participants – 1597 (63%) men and 940 (37%) women. The 144 FFS are distributed as follows: in Peru 61 FFS (1075 participants), in Bolivia 60 (1123 participants) and Ecuador 23 (339 participants). According to the type of FFS, 66 are addressed to seed production and 78 are addressed to train the farmers in the use of quality seed. According to the type of crops, these were developed as follows: 94 FFS in potatoes, 26 in quinoa, 16 in fava beans, 7 in soft corn and 1 in beans. Also, 66 FFS facilitators were trained in the three countries.

Efforts were focused on strengthening institutional capacities through training and educational events, having organized more than 470 training activities (FFS sessions, workshops, courses, talks, field days, tours and gatherings) involving nearly 15,000 participations.

For the strengthening of the legal frameworks, a legal strategy was developed. This created an amendment proposal of the seeds regulation of Ecuador, in a participative way and in consensus with the main institutions from such country. The regulation was approved by the Ministerial Agreement Nº 494 dated 26/10/2012. In Peru it was contributed with the new General Seeds Regulation approved by Supreme Decree Nº 006-2012-AG dated 1/06/2012. Also, the approval of the regulation for the certification of quinoa seed was encouraged (Administrative Decree Nº014-2012-INIA dated 11/02-2012).

There are also other important collateral benefits:

- Empowered farmers, which has enabled the development and consolidation of leaders, both at an individual level (within the association) as associative (between organizations), setting the stage for the development of seed producers networks.
- Outstanding involvement of women, since a third part of the members from the associations is formed by women. In Peru there is an organization formed by only women, which was also awarded as keepers of quinoa diversity.
- Some associations are carrying out investments with their own resources, due to the fact that they have proved that the seed production is profitable.
- The level of organization and empowerment of some associations has allowed them to manage before government bodies and the cooperation organizations, some economic resources in order to inject them to the seed business.

4. Limitations

Among the main limitations found, the following can be mentioned:

- There are few local or native varieties registered in the farming records, which limits the production of certified seed for those varieties not registered but in demand. This determines, essentially, that the varieties that are not registered continue in the informal system.
- There was a limited supply of superior seed category and this limits the seeds producers organizations to increase their production volumes.
- It was found that there is limited workforce due to the process of migration from the fields to the city and the competitiveness of salaried jobs such as mining and construction with farming.
- There is limited development of technology for harvest and post-harvest aimed at family farmers, as a result of which some jobs have to be carried out manually or with very simple equipment, taking away efficiency of the process.

5. Lessons learned

The main lessons learned are:

1. The main motivation of the participants is the evident results of the use of quality seed for both the production of seed and its use.
2. The use of quality seeds alone does not guarantee the success of the productive process; it has to be accompanied by good and opportune cultural practices. The FFS have been very effective when showing such practices.
3. The strengthening of capacities must be comprehensive and multidisciplinary. It was noted that previous processes have only focused on productive aspects; on the other hand, in the project it was complemented with concepts of quality management, business management and risk management.
4. Multi-sectorial articulation is critical for the comprehensive strengthening of the participants. In the field it was possible to create awareness and involve an important number of the public and private entities, which have been supporting the work model of the project, both nationwide as sub-nationwide.
5. The FFS is a fundamental methodology for being able to implement and strengthen organizations. The use of this methodology was a good choice, which was accepted very well by the producers and has created expectation in the entities promoting development, public and private, of the work areas.
6. The selection of organizations has been key to the achievement of results, since criteria were combined such as the organizational and productive experience on farming with the disposition of productive fields.
7. The participative work in the decision making of the organizations is very important in order to promote that the producers work together as an organized group, with the project serving as a facilitator of such process. This contributed in an important way to the empowerment of the organizations.
8. The respect to knowledge and local habits creates a good work environment that favors the achievement of expected results. This generates an environment of confidence in the project and influences the producers to involve in the promoted activities.

6. Pending agenda of the project

There are some topics from the agenda that are being developed, such as:

1. The incidence in public policies, for which, it is being encouraged that the governments (national and subnational) may be able to take the work model or the experience developed by the project in order to incorporate it to their government programs.
2. The perfection of community risk management models to face the shortage of seeds due to climate disasters. There is some progress in the creation of situation diagnostics, mapping of actors and the implementation of pilots from such community systems at a local level.

7. Conclusions

The two most important are:

- Family farmers, through associations, contribute significantly to formal seed production, especially if their capacities are strengthened beforehand.
- For this they need an appropriate environment, which means promoting policies, good regulations and efficient services, especially public services.

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Sustainable seed systems, productivity of grains and resilience in family agriculture in Central America

Luis E. Alvarez Welchez[1], Allan Hruska[2], W. Hugo[2,] B. Moscoso[3,] C.M. Garcma,[3] R.Harrison[3], E. Navarro[3], F. Romero[3], R. Araya[3], L. Pinto[3], and M.Ruiz[3]

[1]Chief Technical Advisor of the Seeds for Development Project.

[2]Technical Officer and Agricultural Officer of the Seed for development project respectively.

[3]National Technical Coordinators of the seven countries of project: Seed for development.

Correspondence: lalvarezwelchez@gmail.com

Abstract

The experience presented here comes from the Seeds for Development Project and its public-private alliances with small farmers of family agriculture in Central America. The region has its challenges: high environmental vulnerability, weak institutions and governance, low transparency in the markets, and the low productivity of basic grains of (maize (*Zea mays*), bean (*Phaseolus vulgaris* L.) and rice (*Oriza sativa*)). Family farmers have little access to quality seed of these important crops. The strategies and methods of work on this experience have had an approach, of participative technological innovation, based on the development of sustainable systems of seeds from the production, commercialization, trade, market development and use of seed of high quality, until turning the seed in one input of productivity and market. Twenty-nine business and cooperatives were selected to be strengthened and to create rural companies that produce seeds of high quality of basic grains. Those who participated became qualified in all the line of process of the seeds, with special emphasis in the enterprise management, commercialization and trade. In 2013, there were nearly 11,000 familiar agriculturists producing seeds of high quality, of which 33% were women. From the 2010 to the 2013, 29 seed companies of small farmers sold 10,000, metric ton of seeds of high quality of beans and have produced more than 1,200 metric tons of seed of good quality of maize. The use of seed of good quality increased maize yields on average by 32% and bean yields by 43% in family agriculture. Nevertheless, the true measurement of the success is in the development of seed rural companies that will continue supplying in a sustainable way seeds to thousands of vulnerable families of Central America, and of the involvement of the public sector in this process. In this way, the work of the states for certification of seeds for the small farmers is sustainable and inclusive.

1. Central America

The Central American Isthmus is made up of seven countries: Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica and Panama, with a territorial extension of 522,760 km2 and has a population of nearly 45 million people. Forty-one percent of the population in Central America lives in rural areas, of which 63% live under the line of the poverty and 40% under the line of the destitution. The Central American sub-region has its own challenges: high exhibition to threats and environmental vulnerability, weak institutionalism and governance with low transparency in the markets, worsening the poverty and the hunger. No less important is the loss of the nutritional security of the population. Much of this can be attributed to low yields due to a great extent to the lack of access of the small producers to seeds of good quality and to the vulnerability of its production systems.

2. Introduction

The national programs of basic grain seed in the public sector of the Central American countries, after the green revolution, did not continue their process of development to a great extent, as a result of the processes of reconstruction of their economies and the globalization. Along with

the lack of renovation of the technical personnel and investments in the national institutes of investigation (NARIS) in the services of extension and the national commissions of seeds, resulting in a rise in the prices of the basic grains, that are the sustenance of the population. Thus, in 2009, the project Seeds for Development was born at the request of the Ministers of Agriculture of the sub-region in answer to the increase of the prices of foods. When the project initiated its field operations in 2010, the seed sector in all the countries was focused to satisfy the demand of the large-scale mechanized agriculture of the flat lands areas and not the family agriculture of the hillsides. For the case of maize, a market existed to provide mainly hybrid seed of high performance with high demand of inputs and in its majority for animal consumption. For beans, in some countries a formal market of seeds did not exist, in others this was marginal. This situation has made many producers use grain as seed contributing to the low yields.

The countries had their fundamental focus on the certification of seeds without participation of the small producers. The official organizations that certify seed, the formal sector of the seeds, were very separate from the informal sector. This is the reason why the project Seeds for Development initiated a strategy of fortification of the public sector and for the formation of groups of rural producers of seeds of good quality of basic grains. The development of sustainable systems for quality seed initiated an alliance between small producers and the public sector. At the moment the public sector is recovering their extension and research programs in seeds to satisfy the demand of the small producers and has initiated a process of developing of the seed sector that requires more time to contribute to the processes of fighting against poverty and hunger.

3. Objective

This experience has had as a main objective to improve the availability, access and use of seed of good quality of basic grains (rice, maize, and beans) of family farmers in a sustainable form, through the formation of groups and rural companies of small farmers for the production and commercialization of high quality seeds within the framework of family agriculture, supporting the development of sustainable systems of seeds.

4. Strategy

The strategy of the project Seeds for the Development was based on the establishment of sustainable systems of production, storage and care of seeds, commercialization and use of seed of good quality, which allows that the seed is recognized as an input of productivity and market. Towards this end, 160 groups of small seed producers were identified in the seven countries to receive training in production, post-harvest, and internal control of quality of all the productive chain of seeds. At the same time 29 associations and cooperatives were selected to form rural companies capable of producing seeds of good quality of basic grains, those that are enabled as well in all the line of process of the seeds with special emphasis in enterprise management, commercialization and trade. This benefitted nearly 12,000 family farmers who are producing quality seeds for family agriculture, of which 33% are women.

5. Methodology

The project simultaneously initiated the strengthening of the public sector in charge of the basic and registered provision of seed and has supported the certification processes. The participation of the governments is made through technical assistance and provision of basic and registered seeds to the groups and companies, so that these can as well multiply the seed, and to receive the supervision and control of quality of the state until certification and sale. The strategy involves working directly in the form of practices in the field with the agriculturists by means of a participative process of technological innovation, where the producer plays an important role of the process, taking into account its knowledge and actions in the taking of decisions.

6. Execution

The project was executed with the ministries of agriculture of the countries of Central America, Panama and Belize and with associations of producers of family agriculture in strategic regions of the rural territories of the countries. In Panama the project is executed under the Coordination of the National Committee of Seeds (CNS); in El Salvador with the National Center of Farming Technology and Forestall (CENTA); in Nicaragua with the Nicaraguan Institute of Technologic Agriculture (INTA); in Costa Rica with the National Committee of Seeds (CNS); in Belize with the Ministry of Agriculture and Fisheries (MRNA); in Honduras with the Direction of Science and Farming Technology (IT DICTA) and the National Service of Animal and Plant Health, (SENASA) and in Guatemala with the Ministry of Agriculture and Cattle (MAGIA) and support of the Institute of Science and Technology research (ICTA). At regional level the work is oriented to contribute to the fortification of sustainable systems of seeds that assure availability and sustainable access to seed of good quality of basic grains (maize, frijol, sorghum, and rice) for small farmers for the nourishing and nutritional security (SAN) in Central America, Panama and Belize. As a result of this project, it is considered that the countries' members determine which policies and mechanisms of institutional management are important for the supply of high quality seeds of basic grains to national and regional level, with special attention in the sector of family agriculture. The work of the project at the level of the companies and producing groups of interest of seeds in communities is done in coordination with the services of extension, the work in equipment with experts in handling of companies, commercialization and trade of seeds in family agriculture. The potential of the market in Central America is of two million families who produce basic grains and that with the development of the project have happened to increase the use of good quality seed from 8% to 21%. Several modalities exist to produce and store good seeds of quality of grains that go from a communal bank of seeds to an associative company that produces for its associations and the national market and of export at regional level.

7. Results

From 2010 to the 2012, twenty-nine rural companies of small producers supported by the project have produced more than 8,134 t of seed of good quality of beans and 1,195t of seed of good quality of maize. This seed was sufficient to grow 203,350 ha of beans and 95,600 ha of maize, guaranteeing the availability of beans to feed 762,562 families and sufficient maize to feed 265,555 families. The use of seed of good quality increased on average by 32% for maize yields and 43% of beans. The true measurement of the success is in the development of rural seed companies that will continue supplying seed of good quality to hundreds of thousands of vulnerable families of Central America in a sustainable way, and of the involvement of the public sector in this process. Simultaneously, the project has initiated the fortification of the public sector in charge of the basic and registered provision of seed and has supported the certification processes.

The participation of the governments is made through the provision of technical information and is registered to the groups and companies so that these can multiply the seed and receive the supervision and control of quality of the state until certification and sale. Also, the project stimulated the investigation, the participatory plant breeding improvement, liberation and validation of varieties through the National Institutes of Agricultural Research, which in participative form with the agriculturists, chose and released varieties of basic grains suited to the local agro-ecological systems that are mostly of difficult topography and fragile lands. In addition, these varieties were chosen in response to the demand of the local market, and for production systems that reduce the vulnerability to climatic variability. The seven countries in the short time of 34 months of operations in the field are executing the project from the 29 small seed companies, along with their national institutes of investigation (NARI) and their systems of extension. The appropriation of the public sector is made through different modalities and alliances, with significant contributions by the States in the payment of personnel, services of extension, production of basic and registered seeds for the rural companies that the project promotes. On a parallel, the Seeds for the Development project has collaborated with the public sector to rehabilitate their programs of basic and registered production

of seed. The case of Honduras and Costa Rica stands out in that the two countries had lost their basic seed of maize 18 years ago; through the project's intervention the countries have reinitiated seed production operations.

8. Seeds, productivity and resilience

The strategy of intensification of seed production is based on three elements: 1) Increase of the productivity of small producers in its production system through seeds of good quality, use of promising varieties, handling of crop residues and remainders, spacing of sowing, efficient handling of the nutrition of the plants, low external inputs, and handling of the moisture availability in the ground. Most of the producers of Central America are on dry land, thus do not have irrigation but hold the moisture (humidity) in the ground as much for periods of drought as of excess of rains. 2) Seeds of good quality: pure, genetically physiologically viable, without impurities physical, and healthy in general. For this, alliances with the national institutions of investigation of the agriculture ministries were created to develop rural companies with small producers of seeds to obtain sustainable systems of production of seeds that do not depend on external assistance. 3) Increase in the production of crops, through identification and control of plagues and diseases, efficient use of pesticides, control of weeds with handling of residues of crops and herbicides, not to burn, cover the ground, rotation of cultures, minimum tilling to the soil, integrated handling of crops, agro forestry and systems, good practices of postharvest, and insertion from the small producers to the market.

Simultaneous to the promotion of productive processes, the organizational processes of people have been promoted, through the formation of share capital that gives sustainability to the system, so that its implementation is not limited to the project time frame. For this, a policy on the use of incentives was applied oriented to the capitalization so that small producers are their own financial intermediaries, for example, through small farm loan banks that are promoted by the Central American countries, through which projects of production and projects of insertion to the market and financing in rural means finance. Also, the processes of environmental protection of their units of production must be promoted through average use of adapted seeds to climatic ends, control of the erosion, control of the loss of fertility of grounds, economic valuation of the ground, water and vegetation. Positive results can be seen where it has been implemented with good agricultural practices: in the fields of small producers (less than 3 ha) it has increased the productivity of the maize (from 1 MT/ha to 2.5 MT/ha), of beans (from 0.7 MT/ha to 1.5 MT/ha); there is an important improvement in the moisture of the ground in the driest months (from a 8% to a 29% of moisture retention capacity in the soil). These changes with good practice of use of good seeds and of sustainable soil cover management, mark important differences for the producers of Central America, when there are sometimes 20 days that are dry in a rainy month. The increase in the percentage of moisture allows the maize crops to endure better between 20 and 40 days without rain. From this, it is possible to conclude that a simple technique such as leaving the residues of crops on the surface of soils instead of burning them, brings positive effects in the erosion, the infiltration of the water, the decomposition of the organic matter, the microbiology of the ground, and mainly in the global heating of the Earth surface. By all means it is necessary to measure with greater intensity these impacts in each agro system at the local level.

9. References

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Organizational Performance and its Relation to Household Level Economic Indicators: Evidence from Community-Based Rice Seed Production in Nepal

Narayan P. Khanal and Keshav Lall Maharjan
Graduate School for International Development and Cooperation, Hiroshima University; Japan

Correspondence: narayankhanal36@gmail.com

Abstract

This paper measures organizational performance indicators: participation, business plan, incentive system and linkage; and analyzes their impact on household level economic indicators (technical efficiency and proportion of rice seed sold by household in the market). Data for the study were collected from the three Tarai districts: Siraha, Chitwan and Kailali of Nepal. Four community-based rice seed producer organizations with 15 households from each of these organizations were chosen for the study from each of the above-mentioned districts. The economic indicators were estimated using household data whereas organizations' performance indicators were gauged through group discussion and documentary study. Result shows that there is wide variability of economic and organizational performance indicators across the organizations and there is positive impact of organizational performance indicators on household level economic indicators. However, the degree of impact of these indicators on proportion of rice seed sold is higher as compared to that of technical efficiency. Moreover, organizations with higher educated leaders have better performance. It means facilitation of these organizations for selecting/developing higher educated leaders is important for enhancing their performance, which also contributes on economic benefits at household level.

1. Introduction

The concept of community-based seed production (CBSP) system evolved in 1990s as a response to the failure of private seed companies and government corporations' to supply diverse rice varieties in cheap price in the rural areas (Cromwell and Wiggs 1993, David 2004). In this system, farmers' organized in groups or cooperatives (synonymously referred to as community-based seed producer organizations – CBSPOs in this article) produce seed at household level, and accessed input and output marketing through CBSPOs. There are 128 registered CBSPOs involved in production and marketing of cereal seeds including and majority of them (>80% are operational in the Tarai (70–650m above mean sea level) region. It is expected these organizations could enhance the seed replacement rate (SRR) of these crops including rice. The SRR of rice in 2011 in Nepal was 8.7%, which is lower than the recommended SRR of 25% (SQCC 2012). In spite of the great potential of CBSPOs in supplying rice seed in rural communities, the performance of these organizations is poorly understood (Khanal and Maharjan 2010, Witcome, Devkota and Joshi 2010, Khanal and Maharjan, 2013) and reasons for it is not clear. This paper attempts to measure the performance of these organizations and analyzes the impact of the performance indicators on household level economic indicators.

2. Conceptual framework for measuring performance of CBSPOs

Normally each CBSPO forms an executive committee to exercise power in the organization following democratic principles. It is believed that the executive committee could address internal (management) and external factors (climate, market) by developing appropriate strategies: incentive system, participation, business plan and linkage. It is believed that the incentive system could address the issue of variability, frequency and economy of scale of CBSPO outputs. Similarly, members'

participation could also contribute to enhancing organizations' efficiency by enhancing members' accountability towards their organizations as better informed households would be more loyal and more accountable towards their organizations' decisions (Gray and Kraenzle 1998). To address the external factors, CBSPOs could develop mechanical, adaptive, reactive or interactive strategies, and make contingent decisions (Brinkerhoff and Goldsmith 1990) in line with organizations' efficiency. Moreover, these strategies define a mechanism for maintaining authority, formality, hierarchy, and information flow in the organization, thereby enhancing institutional innovations for organizations' efficiency in different risk scenarios (Cromwell and Wiggins 1993, Mywish, Julie and Ducan 1999, David 2004, Bishaw and van Gastel 2008).

3. Methodology

3.1. Study area and sampling technique

This study was carried out in three Tarai districts of Nepal: Siraha, Chitwan and Kailali, representing eastern, central and western parts of the country. So, the district selection was purposive but four CBSPOs with at least two years experience in producing rice seed and registered in agricultural development office were selected randomly from the available CBSPO's list in each of the districts. Then, 15 households from each CBSPO were chosen from household survey, marking the total sample size 180 in total. Data collected from household survey was used for measuring Technical Efficiency (TE) and proportion of seed sold by household in the market. However, to measure the performance of CBSPOs, information collected from group discussion with executive committee members and documentary study was utilized.

3.2. Selection of indicators and data collection

CBSPOs' performance was measured in terms of major indicators: participation, incentive system, business plan and linkage. Five sub-indicators under each of the above indicators were developed and assigned a score (1 to 4 scale) in accordance with their level of development (Annex 1). For example, in case of 'participation', sub-indicators were developed considering who are the vulnerable groups to participate, and in what activities members need to participate. The study considers women's participation, strategies to address poorer members' concerns in the organizations, members' participation in annual meeting, and activeness of sub-committee members (technical, financial and marketing sub-committee). Moreover, CBSPOs of Nepal have followed the traditional cooperative structures and membership in these organizations is low. It was hypothesized that addition of new members in the existing CBSPOs could enhance social capital and economy of scale in seed marketing. Similarly, a business plan is the key operational document that shows how organizations implement their policies to achieve intended outputs, and to minimize risks from internal and external factors. CBSPOs' business plans were analyzed considering the clarity of sub-committee members' roles to implement annual activities, methods adopted by CBSPOs in market research, product diversification, quality control mechanism and publicity of seed in the market.

CBSPOs argued that members could realize incentives through two ways: economic benefit, and transparency of information (social benefit). The sub-indicators reflecting the economic benefits include a system of collecting shares in the organization as it could enhance members' motivation to sell seed in the market through their CBSPOs, payment system for executive members based on their work load, and incentive system to seed growers so that they could sell majority of seed produced at households to their organizations. Similarly, indicators reflecting transparency in the organization include a system of sharing executive committee's decisions to general members, and system for common property management. The common property in this case stands for materials (e.g., sprayers to manage diseases and pests) CBSPOs get from development projects. These materials may be utilized for household's benefit in addition to their common benefit while being used at organizational level. It would be more likely that executive members misuse their power in using these materials in their personal activities if a proper system is not established.

After assigning a score for each sub-indicator, average score of the major indicators were calculated. Then, using the average score, major indicators are categorized as low, average, good and very good. The relationship of these categories and score is as follows: If score <2.5 = low, 2.5-3.1 = average, 3.2-3.7 = Good, > 3.7 = Very good.

4. Results and discussion

4.1. Participation

The study shows that except three CBSPOs of Siraha, women are in the executive committee across CBSPOs (Table 1). Presence of women in executive committee means that women could raise their voice in the organizations. However, women were never in the most influential position, i.e., chairperson, in any CBSPO.

Table 1. Performance of CBSPOs with respect to participation

Districts	CBSPOs	Sub indicators						
		Women	Poor	General assembly	Sub-committee	Entry of new member	Mean	Remarks
Kailali	Krisak	4	3	3	3	2	3	Average
	Kisan	4	3	3	3	2	3	Average
	Sayapatri	4	3	3	3	2	3	Average
	Kalika	4	3	3	3	2	3	Average
Siraha	Fulbari	4	2	3	2	2	2.6	Average
	Sagarmatha	2	2	3	2	2	2.2	Low
	Janadibya	2	2	3	2	2	2.2	Low
	Sampaid	2	2	2	1	2	1.8	Low
Chitwan	Unnat	4	4	4	4	4	4	V. good
	Shreeram	4	3	4	3	3	3.4	Good
	Pragati	3	3	3	3	3	3.0	Average
	Bijbridhi	4	4	3	4	4	3.8	V. good

Source: Survey, 2011

All CBSPOs have policy of prioritizing poor people in credit or timely payment of the seed they sell to their organizations. However, only two CBSPOs (Unnat and Bijbridhi) have adopted the practice of providing both services (credit facility for implementing seed production activities, and early payment of seed for their poorer members). Similarly, though all CBSPOs have system of holding general assembly in a yearly basis, except Shreeram and Unnat, the same people are in the executive committee from the beginning of their organizational establishment. In most of the cases, sub-committees have been formed but they are functioning only in two CBSPOs (Unnat and Bijbridhi). In most of the cases, there was no entry of new members since the establishment of the organization, and those who have been added as members after the establishment of CBSPOs, have not received an equal number of shares as the founder members.

4.2. Business plan and its implementation

All CBSPOs have drafted their annual business plan but except in Bijbridhi there was no detail information on who should lead on what activity (Table 2).

Table 2. Performance of CBSPOs with respect to business plan

Districts	CBSPOs	Sub-indicators						Remarks
		Role clarity	Market research	Product diversification	Quality assurance	Publicity	Mean	
Kailali	Krisak	2	3	4	3	2	2.8	Average
	Kisan	2	3	4	3	2	2.8	Average
	Sayapatri	2	1	3	2	2	2.0	Low
	Kalika	2	1	2	2	2	1.8	Low
Siraha	Fulbari	2	2	3	3	2	2.4	Low
	Sagarmatha	2	1	3	3	2	2.2	Low
	Janadibya	2	1	3	2	2	2.0	Low
	Sampaid	1	2	2	2	1	1.6	Low
Chitwan	Unnat	3	4	4	4	3	3.6	Good
	Shreeram	3	4	4	4	3	3.6	Good
	Pragati	2	3	3	4	3	3.0	Average
	Bijbridhi	4	4	4	4	4	4.0	V. good

It was found that Unnat and Bijbridhi consult with farmers, agrovet and NGOs before preparing their annual business plans but in case of Kalika, Sayapatri, Janadibya and Sagarmatha, there was no system of doing any market research. However, they produce rice seed based on the accessibility of rice source seed from development projects regardless of the types of rice varieties they receive. In case of Fulbari and Sampaid, they organize meetings with local community before preparing the business plan. The organizations from Kailali and Pragati consult with local agrovet and local community in this process. The study shows that all the CBSPOs grow both modern and farmers' varieties of rice but only Krisak, Kisan, Unnat and Bijbridhi sell fertilizer to their members in addition to seed. These CBSPOs argued that diversifying products help CBSPOs minimize the management costs as well as reduces the necessity of taking loan at organizations. Only CBSPOs of Chitwan sell their seed in the truthfully labeled bags (including the name of crop and variety, germination %, weight, seed treated with pesticides or not and name of the producers' organization). However, Janadibya, Sampaid and Sayapatri CBSPOs sell rice seed without tagging. Among CBSPOs of Chitwan, Bijbridhi sells >70% of the total rice seed production using proper labeling and bagging.

4.3. Incentive system

All CBSPOs have adopted the practice of collecting cash amounts in their organizations. They call it 'share', and there is a system that profit made by organizations from seed marketing activities would be distributed to the members/shareholders based on the proportion of share amount they deposited in the organization. Less than half of the members have collected share in CBSPOs of Siraha and in two CBSPOs of Kailali. However, majority of the members (>75%) deposit share in CBSPOs at Chitwan. Only two CBSPOs (Unnat and Bijbridhi) distributed the profit generated from seed marketing to their members based on the proportion of their share ownership (Table 3). However, in other cases the share amount has contributed to increase their organizations' cash reserve.

In the case of six CBSPOs (four from Siraha and two from Kailali), there was no system of providing incentive to the executives though they were involved in various stages of seed marketing. In CBSPOs of Chitwan (Unnat, Bijbridhi and Shreeram) executive members are paid based on their involvement, especially in rouging (i.e., removal of diseased or unwanted plants/weeds from seed production plots). It was found that Unnat, Bijbridhi and Shreeram provide seed and fertilizer in subsidy to

Table 3. Performance of CBSPOs with respect to incentive

Districts	CBSPOs	Sub-indicators					Mean	Remarks
		Share collection	Incentive to executives	Incentive to growers	Information management	Common property		
Kailali	Krisak	3	2	2	2	3	2.4	Low
	Kisan	3	2	2	2	3	2.4	Low
	Sayapatri	2	1	2	2	2	1.8	Low
	Kalika	2	1	2	2	2	1.8	Low
Siraha	Fulbari	2	1	2	2	2	1.8	Low
	Sagarmatha	2	1	2	2	2	1.8	Low
	Janadibya	2	1	2	2	2	1.8	Low
	Sampaid	2	1	2	1	1	1.4	Low
Chitwan	Unnat	4	4	4	4	3	3.8	V. good
	Shreeram	4	4	4	4	3	3.8	V. good
	Pragati	4	3	2	3	3	3.0	Average
	Bijbridhi	4	4	3	4	4	3.8	V. good

their seed growers, but other organizations have not developed such practice. Similarly, CBSPOs of Chitwan have better performance in record keeping as compared to CBSPOs from other two districts. Moreover, CBSPOs get different materials (such as sprayers, grading machine and so on) from development projects. However, only Bijbridhi has adopted the practice of providing these materials to their members for their household activities on payment basis (for example, members have to pay NRs. 20 to use the organization's one sprayer for one day).

4.4. Linkage

Nepal Agricultural Research Council (NARC) provides source seed to seed producers no matter whether seed production is carried out individually or by group, but priority is given for farmers engaged in CBSPOs. It means it is easier for farmers to access source seed if they approach to NARC through their organizations. It was found that except CBSPOs of Siraha, all other organizations were found to have bought rice source seed visiting NARC stations. However, the two-way communication has been established only in Chitwan (Table 4). It means in Chitwan not only CBSPOs visit NARC stations to access source seed but NARC professionals also visit CBSPOs in the process of monitoring their rice crop at field. CBSPOs argued that NARC professionals' visit has been useful to enhance seed quality as farmers get technical advice from these professionals in pests and disease management as well as roguing. CBSPOs were also found to have consulted with seed lab for testing seed quality, and District Agriculture Development Offices (DADOs) to access agricultural training. The relationship of CBSPOs with seed lab and DADOs is also similar in these districts as it is with NARC stations. Moreover, even if the National Seed Policy 2000 envisioned Village Development Committee (VDC) as an important local resource center to support CBSPOs from the government side, there is poor coordination of CBSPOs with VDC. Except in CBSPOs of Sayapatri which built a seed storage house with partial support from VDC, there is poor communication between VDCs and CBSPOs. As in the above cases, CBSPOs of Chitwan have taken loan from Nepalese government bank, 'Krisibikash Bank', which has a mandate to provide loan to the farmers. In other districts, CBSPOs have not taken loan from the same bank though it has branches in other districts as well. Executive members from these organizations argued that they could not access loans from the bank as they are not able to offer any collateral. In spite of the requirement for putting collateral in Chitwan, executive members were found to put their households' properties, especially land, to get credit for their organizations.

Table 4. Performance of CBSPOs with respect to linkage with service providers

Districts	CBSPOs	Sub-indicators					Mean	Remarks
		Agri. Research	Laboratory	Agri. Extension	Village Development Committee	Government bank		
Kailali	Krisak	3	3	4	3	3	3.2	Good
	Kisan	3	3	4	3	2	3.0	Average
	Sayapatri	3	2	3	4	2	2.8	Average
	Kalika	3	2	3	2	2	2.4	Low
Siraha	Fulbari	3	3	3	2	2	2.6	Average
	Sagarmatha	3	3	4	2	2	2.8	Average
	Janadibya	3	3	3	2	2	2.6	Average
	Sampaid	2	2	2	1	1	1.6	Low
Chitwan	Unnat	4	4	4	3	4	3.8	V. good
	Shreeram	4	4	4	3	4	3.8	V. good
	Pragati	4	4	4	2	4	3.6	Good
	Bijbridhi	4	4	4	3	4	3.8	V. good

4.5. Impact of organizational performance indicators on economic indicators

There is positive impact of organizational performance indicators on household level technical efficiency (TE) and proportion of seed sold by households in the market. However, the degree of impact of the performance indicators on marketing is higher than they have on TE. The coefficient for the impact of participation on TE is 7.68, which means that one unit increase in participation tends to increase the TE of household by 7.68 units. It is also clear from this analysis that participation has the highest impact on TE as compared to the other performance indicators. Similarly, linkage has the highest impact on marketing and its coefficient is 28.88 (Figure 1). It means one unit increase in linkage leads to increase the households' seed sold proportion by 28.88 units.

To complement the above analysis, the performance indicators and economic indicators were summarized at CBSPOs level (Table 5). It is clear from the table that CBSPOs of Chitwan have better economic and performance indicators as compared to those from other two districts. Moreover, the

Table 5. Organizations' performance and household level economic indicators

District	CBSPOs	Participation	Planning	Incentive	Linkage	Technical efficiency (%)	Seed sold (%)
Kailali	Krisak	3	2.8	2.4	3.2	85.6	63.4
	Kisan	3	2.8	2.4	3.0	85.3	49.4
	Sayapati	3	2	1.8	2.8	82.8	53.2
	Kalika	3	1.8	1.8	2.4	82.4	15.0
Siraha	Fulbari	2.6	2.4	1.8	2.6	67.5	62.4
	Sagarmatha	2.2	2.2	1.8	2.8	73.1	90.1
	Janadibya	2.2	2	1.8	2.6	66.0	37.6
	Sampid	1.8	1.6	1.4	1.6	73.6	53.4
Chitwan	Unnat	4	3.6	3.8	3.8	87.6	92.4
	Shreeram	3.4	3.6	3.8	3.8	87.0	67.9
	Pragati	3	3	3.0	3.6	83.5	61.0
	Bijbridhi	3.8	4	3.8	3.8	85.0	89.0

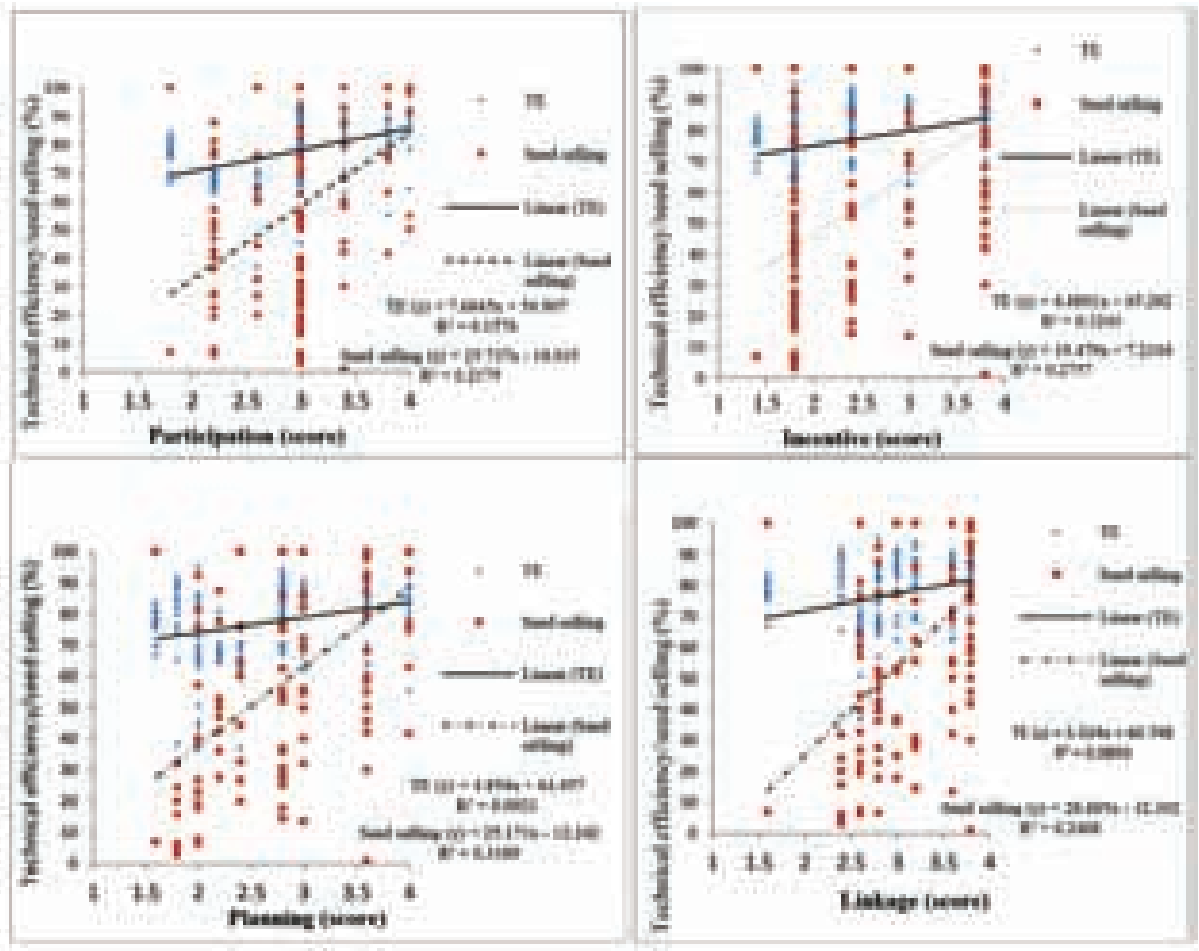

Figure 1. Impact of organizational performance indicators on technical efficiency (TE) and seed selling (n = 180)

performance indicators were also compared with characteristics of the CBSPOs' leaders (Table 6) considering that their leaders characteristics could be related to organizations' performance. Though there are 7–11 members in the executive committee of the selected CBSPOs, the chairperson and secretary who were chosen in the analysis as CBSPOs argued that these positions are most influential in organizations' decision-making process. So, characteristics (age, years of formal education and training) of these two positions were compared with CBSPOs' performance indicators. Here, age represents experience whereas education and training represent the intellectual ability of the leaders. It means CBSPOs with higher intellectual leaders can have better performance.

The result shows that there is similarity in age of the leaders across CBSPOs. However, variation exists in education level and leaders' attendance in business plan training. As shown in Table 6, leaders' education is higher in Chitwan as compared to Siraha and Kailali. There is also similar trend in average education level of CBSPOs members across the districts (Chitwan: 10.4 years, Kailali: 6.0 years and Siraha: 6.5 years). It means average education level of general members reflect the leaders' education in this study. Similarly, CBSPOs' leaders from Chitwan district received business plan training from development agency whereas it was not provided to leaders in other districts. The attendance of business plan training by CBSPOs' of Chitwan might be due to their higher education level as higher educated leaders might have better linkages with development projects.

Previous studies have also recognized the importance of education for the better performance of agricultural cooperatives (Acharya 2009; Witcombe, Devkota and Joshi 2010) as the leaders having these skills could show better performance in the organizational performance. Nkhoma (2011) argued that illiterate leaders are more likely to be corrupt and opportunistic, which turned the

Table 6. Comparison of CBSPOs' performance with their leaders' characteristics

Districts	CBSPOs	Partici-pation	Planning	Incentive	Linkage	Chairperson			Secretary		
						Age	Edu.	Train.	Age	Edu.	Train.
Kailali	Krisak	3.0	3.0	2.4	3.2	43	7	1, 2, 5	42	10	1, 2, 5
	Kisan	2.8	2.8	2.4	3.0	58	4	1, 2	45	7	1
	Sayapati	2.0	2.0	1.8	2.8	45	10	1	42	10	1, 2
	Kalika	1.8	1.8	1.8	2.4	48	8	1, 2,	49	10	1
Siraha	Fulbari	2.4	2.4	1.8	2.6	66	8	1, 2	35	14	1, 5
	Sagarmatha	2.2	2.2	1.8	2.8	39	14	1,2,3,5	45	10	1
	Janadibya	2.0	2.0	1.8	2.6	35	12	1,2,3,5	29	10	1
	Sampid	1.6	1.6	1.4	1.6	38	12	1,2,3	45	10	1
Chitwan	Unnat	3.6	3.6	3.8	3.8	45	14	1, 2, 3, 4	50	12	1,2,3,4
	Shreeram	3.6	3.6	3.8	3.8	60	12	1, 2, 3, 4	60	12	1
	Pragati	3.0	3.0	3.0	3.6	67	12	1,3,5	32	12	1, 5,4
	Pithuwa	4.0	4.0	3.8	3.8	70	11	1,2,3,4,5	47	14	1,2,3,4,5

Note: Edu. = Education i.e. formal schooling years, Train. = Training (1= Seed production, 2= Marketing, 3= Leadership, 4= Business plan, 5= Account)

organizations towards financial mismanagement and nepotism. These types of leaders might not want to develop system for proper allocation of incentives in a transparent way.

Similarly, accountability is another aspect affected by low education level. Generally, less educated leaders are less accountable towards what they are supposed to do. These leaders get better opportunity to misuse power such as diverting activities in accordance to their own priorities without doing proper consultation with other members or designing activities in the interest of political parties (Chriwa *et al*., 2005). It is clear from the study that especially three CBSPOs: Bijbridhi, Unnat and Shreeram are better in both economic and organizations' performance indicators. These three organizations were also promoted by development projects but leaders of these organizations were school teachers (higher educated). Being local teachers, they had capacity to motivate farmers to organize in group/cooperatives, developed planning and incentive system, and could make linkage with development projects to access resources. They argued that system of collecting share in the organization is vital in the success of CBSPOs because this system makes the members accountable towards their organizations.

When these organizations implemented share collection policy, some members dropped the organizations because they were not confident about the safety of their investment. But after few years (especially in Unnat and Bijbridhi), some of dropped out farmers rejoined the same organizations looking at CBSPOs' progress. It means better performed CBSPOs have experienced co-evolutionary pathways which are driven by efficiency gain, and this phenomena is similar to what Morris and Smale (1998) used to discuss the evolution of maize seed industry.

5. Conclusion and policy implication

This paper measured the performance of CBSPOs with respect to participation, business plan, incentive system and linkage, and impact of these indicators on household level economic indicators. The result shows that in general CBSPOs have better performance in participation and linkage as compared to incentive system and business plan. There is positive impact of organizations' performance on households' economic indicators, i.e., technical efficiency and proportion of rice seed sold in the market. This provides the basis that if extension agencies facilitate CBSPOs for designing their policy measures/indicators, benefits will be realized at household level. Low

education level of the organizational leaders is the challenging issue in many CBSPOs, and better performing organizations have higher educated leaders than that of lower performing one. It means both organizational performances as well as benefits at household level could be improved if higher educated leadership exists in these organizations.

There might be three ways to enter higher educated leaders in the organizations. First, these leaders could be searched from the existing members and if development projects facilitate these organizations to prepare strategic plans, new qualified members might be attracted to be in executive body as incentive system could attract them. If such leaders are not there, CBSPOs could invite new higher educated members from the community. The third option might be that the development project could arrange higher education for CBSPOs leaders. This does not mean that just changing the higher educated leadership could improve the organizational performance; the leaders need to be empowered and accountable towards their organizations through appropriate rules and monitoring and evaluation system.

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End Notes

[1]SRR is the ratio of improved seed supplied in the area divided by total seed requirement

[2]TE is the technical efficiency is the capacity of farmers in combining five major inputs: operational land, source seed, chemical fertilizer, animal manure and human labor in rice production. It was estimated by stochastic frontier production model in Cobb Douglas production form and technical efficiency was estimated as the ratio of observed rice yield divided by potential rice yield (Aigner, Lovell and Schmidt 1977, Meeusen and van den Broeck, 1977, Khanal and Maharjan 2013).

Appendix 1. Indicators and scores used to assess the capacity of CBSPOs

1. Participation

Sub-indicators	Scores			
	1	2	3	4
1.1 Participation of women	<10% women members in the organization	11-25% women members in the organization	26-50% women members in the organization	Women in the executive committee
1.2 Participation of poor (support strategies to poor)	No system	System exists but not operational plan to support	Special consideration for poor in credit or timely payment	Special considering for poor in the payment and credit both
1.3 General assembly (Annual meeting of CBSPOs)	Not held	Held but not regular	Regular but same members in the executive committee from the beginning	Held regular, and some members changed
1.4 Sub-committee	Not formed	Formed but not functional (no meeting within a year)	At least one sub-committee functional (≥2 meetings in a year)	At least two committees functional
1.5 Entry of new members	No system for entry of new members (only founder members exist)	System exists but no members entered in the organization	New people entered in the organization without equal share	New people entered in the organization with the provision of equal share

2. Business plan and its implementation

2.1 Role clarity in the business plan	Not available	Available in draft form but operational plan not developed	Operational plan developed in terms of activities and their time of implementation	Detail operational plan and roles specified
2.2 Market research	Consultation is not done with stakeholders	Consult with local farmers	Consultation local farmers and local agrovets	Consultation with farmers, local and distant agrovets
2.3 Product diversification	Seed production of only one crop	Seed production of two or more crops	Two or more crops and inclusion of local varieties	Sell two or more crops seed and other inputs
2.4 Seed quality assurance measures	Simple bagging but no tagging	Seed packaging in branded bags but no tagging	Seed packaging in branded bags, use of tagging for <50% seed	Seed packaging in branded bags for >50% seed
2.5 Publicity of products	No publicity	Sending letter to organization	Sending letter and demonstration of seed in agri-fair	Publicity through FM radio

3. Incentive system

Sub-indicators	Score			
	1	2	3	4
3.1 Share collection from members in the organization	No system of collecting share	<50% of the members	50-75% of the members	>75% of the members
3.2 Incentive to executives	All voluntarily	Occasional basis only to chairperson	Occasional basis both chairperson and executives	Defined norms to pay chairperson and executives
3.3 Incentives to growers	No system for providing incentive to seed growers	Technical facilitation or subsidy on fertilizer/seed exists	Technical facilitation and subsidy exist but not crop insurance	Technical facilitation, subsidy and crop insurance
3.4 Information management	Written documents do not exist	Very raw, unclear and poor record keeping system	Draft type of simple record keeping system	Good record keeping system using ledger books
3.5 Common property management	No system for the use of common property	System exists but not in function	Mobilized based on rotation	Mobilized based on payment to the organization

4. Linkage with service providers

Sub-indicators	Scores			
	1	2	3	4
4.1 Linkage of CBSPOs with agricultural stations (NARC) for source seeds	No linkage	Poor linkage with some communication	Visit to NARC station and source seed received	Two way visits and source seed received
4.2 Linkage of CBSPOs with seed testing laboratory	As in 4.1			
4.3 Linkage of CBSPOs with VDC				
4.4 Linkage of CBSPOs government bank				
4.5 Linkage of CBSPOs with DADOs				

Strategies to build viable community seed system in India for sustainable seed and food security

Sushil Pandey[1], Chitra Devi Pandey[1], Vilas A Tonapi[2] and Sandeep Kumar[3]
[1]National Bureau of Plant Genetic Resources, New Delhi, India
[2]Directorate of Sorghum Research, Hyderabad, Andhra Pradesh, India
[3]Indian Agricultural Research Institute, New Delhi, India

Correspondence: sushil_pandey@nbpgr.ernet.in; sushilpandey_iari@yahoo.com

Abstract

Agro-ecosystems encompassing crops ranging from cereals like rice and wheat, to coarse millets like maize and sorghum, minor millets, pulses and many underutilized crops are characterized by subsistence farming, where most of the crops are grown for self-consumption and where farm saved seeds provides the bulk of the seed requirements in India. Although the seed sector in India provides a dynamic and flexible seed supply, usage, handling, trade and exchange, continuous use of untested seeds inevitably leads to degeneration of seed quality. Though farm-saved seeds promote the use of local or traditional varieties to some extent thus conserving the landraces, over time it does not provide adequate choices to the farmers to diversify and thus limits productivity. One of the most pressing concerns related to the seed supply of modern varieties is how to establish sustainable seed provision systems for commodities that cannot be economically supplied through a centralized, formal seed industry. Despite the penetration of the markets in local economy, traditional cropping strategies based on local processes of seed exchange are still important. The Mulkanoor Cooperative Society of Andhra Pradesh is a success story beyond excellence which started with 754 metric tons of paddy seed in 1991 and produced 8135 metric tons in 2005. This cooperative environment linked to the community seed systems has potential to revolutionize the process of enabling the farmers to produce quality seeds and deliver them in an organized structure. Similarly, the case study on village-based seed banks suggest that smallholder and marginal farmers are often at a disadvantage in absorbing agricultural technology related to genetic enhancement, because of centralized production and distribution of improved seeds. Although the organized sector is able to produce large quantities of seeds, the supply chain is unable to cope with the local demand across the length and breadth of the country, due to the high volume and low value nature of the crops which adds to the transport processing and bagging costs, making them expensive for the marginal farmers. Village based seed banks provide an alternative solution to this problem and help farmers become self-reliant. Building viable local seed system will also need support in form of initiatives and policy framework for institutional backstopping and continued interaction between different institutions, policymakers and stakeholders to strengthen local seed systems for sustainable seed and food security.

1. Introduction

To make available affordable good quality seed at the right time requires a well functioning seed supply system. This, in turn, will help to ensure seed security and enhance productivity in dryland areas. Given the critical role that improved varieties can potentially play in increasing the production of conventional cropping systems, developing an integrated and effective seed system capable of generating and delivering improved seed varieties in a cost-effective way is a challenge. It has been estimated that more than 90% of the crops in the developing countries are still planted with farmers' varieties and farm saved seed. The formal seed sector focuses on high value and hybrid crops and most favoring agro-ecosystems as trading in these crops and areas is most profitable. Thus, open pollinated varieties and self-pollinating crops are left to the mercy of small-scale unorganized seed companies and public sector seed companies and the informal seed systems. As the access to the quality seed becomes acute, smallholder farmers save their own seeds required for the next season, thus reducing opportunities for seed replacement with new varieties. With privatization

or commercialization of public sector seed activities, the formal public sector seed activities have tended to focus on a narrow range of crops grown by large-scale farmers, thus reducing supplies of seed of new varieties of subsistence crops to smallholder farmers. The existing seed systems involve the formal seed sector, which is an official or private control of seed monitored through the entire process of breeding, multiplication, processing and storage, leading to the final product. The informal seed sector is simply the farmers themselves who provide each other and themselves with seed for sowing. This seed may be cleaned manually, but is otherwise untreated and thus a potential carrier of various diseases. Therefore, strengthening the seed system at community level should involve all possible aspects of modern seed activities. In industrialized countries the formal seed sector provides the vast majority of seeds to farmers, while both seed systems are present in the developing countries. Despite large investments in formal seed systems in developing countries over the past 30 years, the seed demand of about 90–95% of smallholder farmers are still met by informal sources at the farm and community levels.

2. Scenario in India

A robust seed system guarantees the sustainability of its agriculture to ensure that the products of modern plant breeding and local farmer ingenuity are widely available. National seed systems usually include several elements. A commercial seed sector is necessary to ensure efficient seed supply. Both public and private seed systems are relatively well developed in India; hence, the possibilities of delivering plant-breeding innovations to farmers are better. An unanswered question however is: how do resource-poor farmers react to a complex commercial seed provision system? Recent innovations in adaptive and participatory research go a long way in addressing this concern, but still much remains to be done regarding seed system diagnosis. Even in a relatively mature seed system such as the Indian one, the movement of information between farmers and seed providers leaves much room for improvement. Seed secure farmers tend to maintain their own varieties with limited influx of new varieties. In addition, awareness about variety selection is not always well developed in traditional farming communities. It may also reflect that in traditional self-contained seed systems, the same genetic material may be easily available from the neighbors, thus reducing the risk of seed procurement and accesses. The proportion of the farming community involved as seed producers/ distributors is very small. Furthermore, it is often difficult to establish whether these local seed suppliers are making a conscious effort to produce high quality seed, or if they are simply well-endowed farmers. They always have surplus grain to sell the grain as “seed” during the next planting season. Seed resources have been related to the wealth status, with rich farmers maintaining their own seed stocks but poor farmers being required to buy or borrow seed every year.

The quantity of seed requirement and the quality seed distributed at the national level is presented in Table 1. To make the analysis of seed requirement and distribution, the supply gap for quality seed for cereals, pulses, oilseeds and fibers in the country was estimated by Singh and Chand (2011) under three scenarios corresponding to 25%, 33%, and 100% seed replacement rates (SRR). These estimates show that even for achieving the minimum SRR of 25% at the national level, there is a deficit of quality seed to the tune of 36.4 lakh quintal for cereals, 7.8 lakh quintal for pulses and 12.7 lakh quintal for fiber crops. However, a closer look at seed demand for individual crops shows that there is adequate quantity of quality seed to achieve more than 25% SRR for maize, pearl millet, rapeseed/ mustard, sunflower, soybean and cotton. These estimates show that there is huge market demand for good quality seed both for hybrids and self-pollinated crops. Except for crops like maize, pearl millet, sunflower, cotton, hardly one-third of demand for quality seed is met by present availability of seed.

Table 1. Quality Seed Requirement and Gap in Demand

Crop	Seed Requirement	Seed Distributed (lakh qtl.)	Gap (SRR: 25%)	Gap (SRR: 33%)	Gap (SRR: 100%)
Cereals	735.32	147.43	36.40	97.68	587.89
Paddy	323.79	58.18	22.77	49.75	265.61
Wheat	367.71	74.83	17.10	47.76	292.68
Maize	18.77	7.94	-3.25	-1.68	10.83
Pearl millet	4.93	2.20	-0.97	-0.56	2.73
Pulses	82.67	12.88	7.79	14.68	69.79
Oilseeds	142.07	39.49	-3.97	7.87	102.58
Sunflower	1.12	0.80	-0.52	-0.43	0.32
Rapeseed/mustard	3.81	1.63	-0.68	-0.36	2.18
Groundnut	64.02	15.90	0.10	5.44	48.12
Soybean	71.29	20.89	-3.07	2.87	50.40
Fibers	60.83	2.55	12.66	17.73	58.28
Cotton	3.65	2.27	-1.36	-1.05	1.38
Jute	57.17	0.28	14.01	14.01	56.89

Source: Singh and Chand (2011)

3. Barriers to seed dissemination and socio-economic constraints

Poor distribution of inputs and produce in a region results from poor infrastructure. Farmers have little access to seed of improved varieties. The key to overcoming this problem is to make available a range of modern varieties to farmers and train them on how to efficiently produce seed of selected varieties using modern technologies. In fact, seed and product markets should target national and regional markets. More than 60% of the farmers purchase seed from the market through cash credit. Thus, there is need to link farmers to credit institutions. Information on seed supply and demand has to be disseminated across countries. The approach is to maintain an inventory of variety traits, growing varieties with preferred traits for evaluation and selection by farmers, and producing Breeder and Foundation seed of newly released varieties and those in advance stage of testing. These are some of the ways of establishing sustainable seed systems. Besides, organizing field days and variety demonstrations at the community level, monitoring the adoption of improved varieties, identifying constraints to broaden adoption, and developing community-based seed production systems form an integral part of the strategy. Despite the penetration of markets in the local economy, traditional coping strategies based on local processes of seed exchange are still important.

The informal seed systems are the best, where the formal sector finds seed distribution difficult and farmers cannot reach seed markets easily. They may also be appropriate in smaller, limited agro-ecological zones, where the formal seed market is disinterested or unable to cater because of limited markets for specific varieties or because widely marketed varieties may not suit that region; another important reason is an economic consideration as profit margins can be lower. They are also suitable in cases where the crops involved have a high seed rate and are bulky in nature which further translates into higher transportation costs and low profits.

4. Sustaining viability of informal systems

Most of the community-based seed production schemes are initiated because farmers are concerned about the non-availability of quality seeds at planting time. Many farmers do not have access to improved varieties; and are not able to afford them even if they were. So the introduction of alternative seed systems must impact farmers' access to seeds of improved varieties at affordable prices. The quality of seed produced by the community-based seed system or farmer seed system is guaranteed only by its seller or village seed committee, because they are not processed and are uncertified seed.

4.1. Cooperative sector for seeds in India

The agricultural co-operative credit structure is broadly divided into two sectors, one dealing with the short-term and medium-term finance and the other with the long-term credit. In the State, the short-term and medium-term credit structure is based on a three-tier system, i.e., the Apex Co-operative Bank at the State level, the Central Co-operative Bank at the district/tehsil level and the Primary Agricultural Credit Societies at the village level. The major objectives of the primary agricultural credit service societies are to supply agricultural credit to meet the requirements of funds for agricultural production, the distribution of essential consumer commodities, the provision of storage and marketing facilities and for light agricultural implements and machinery. Owing to an increasing emphasis on the development of land and agriculture, long-term co-operative credit has assumed great importance.

The PACS, as the foundation of the Co-operative system are meeting the development needs of the farmers by providing credit, inputs and storage and processing and marketing facilities. The Co-operative federated at the district and State level constitutes the Co-operative system. But it is found that the Apex institutions have grown stronger whereas the primaries and in some cases, Central Co-operatives have gone weaker. The situation has to be changed and the primaries have to grow stronger. The business of the Primary Societies has to be diversified.

4.2. The success story of Mulukanoor Cooperative Society: Cooperative as a seed producer

The Mulukanoor cooperative society is a success story beyond the threshold of excellence. The membership which was 373 in 1957 has reached the peak of 6166 members in 2005. Thus, 99.99% of their total population in 14 villages has become members. The growth of the society is the testimonial to the point that cooperatives can play a lead role in the development of rural communities to make them socially, economically and politically stronger, so they and their voices are heard.

This cooperative is an example of how a cooperative can produce, market, and sells its seeds with its own innovative strategies. This cooperative produces as many as eight kinds of paddy varieties and their seeds. The seed is produced by both members and non-members depending on the expertise and facilities available. All the inputs from seeds to fertilizers and credit and mechanized implements on hire are provided to the seed producer. The three agricultural officers of the society monitor the seed field to ensure the quality. In addition, they have trained few locals in quality control and monitoring. In order to avoid the chances of mixture and genetic purity deterioration, clusters of 2–3 villages produces a single variety. The seed thus produced is purchased back by the society at a rate marginally higher than the normal procurement rates. Thus, farmers get more money. The final payment is made to the seed grower after deducting the credit advanced to him in kind and cash for seed production. This society which started with 754 metric tons of paddy seed in 1991 produced 8135 metric tons in 2005.

The seed, after processing in the society's own seed processing facility, gets sold to various seed companies in India in the states of Andhra Pradesh, Karnataka and Maharashtra for commercial paddy production. Even the public sector organizations like Andhra Pradesh State Seed Development Corporation (APSSDC) procure seeds from this society. The unsold seed, which usually is not treated, goes to rice mill and gets hulled into rice, and is sold at premium rate both in domestic as well as export market. This exemplifies the fact that a farmers' well-organized and well-supported seed production activity can usher in a revolution of open pollinated variety production and supply. Thus, the society has made a turnover to the tune of 813.72 lakhs in 2005, which was 33.64 lakhs in 1991.

The organizational ethos, experience and structure of Mulukanoor cooperative society are worth replicating in any cooperative environment in any country where open-pollinated varieties are predominantly in vogue. In fact, the cooperative environment linked to the community seed systems

can really revolutionalize the process of enabling farmers to produce quality seeds and deliver them across in a organized structure. This can be linked to both private and public sector seed producer agencies for spread in larger areas across zones, as APSSDC in India does with its linkages with cooperative societies.

5. Alternative village based seed delivery models

The major source of seed for small-scale farmers comes from their own on-farm savings, seed exchange, borrowings and local traders. Nevertheless, farmers' community systems of seed supply are under pressure due to recurring natural calamities such as drought, crop failure, storage problems and poverty. In drought situations farmers depend on the subsidized seed supply by government agencies, which meets only 30–40% of the seed requirement of smallholder farmers (Tonapi *et. al.*, 2012). In order to strengthen the seed delivery system, interventions are required to strengthen informal seed supply systems, such as establishing village-based seed banks as alternative seed systems for seed security. The alternate village based seed delivery models tested under different projects can be harbingers of seed system sustainability upon implementation based on the environments and regions they operate. The comparative statements of the five models across each component working towards seed system sustainability are given in the Table 2.

6. The alternative integrated seed system model

The alternative seed system model envisages integration of formal and informal seed systems to achieve the objective of providing quality seed of improved varieties of self-pollinated crops at right time and at reasonable prices to small-scale farmers. This will involve farmer-participatory selection and production of improved varieties. These resourceful farmers are capable of imbibing technology faster and also have capacity to absorb shocks, if any, as compared to other small farmers. External finance is not required as the resourceful farmers can bear the expense of seed production and the results of improved varieties and yields spreads easily and hence dissemination of results is faster and more effective.

There needed to be a policy framework in the role of state and central agencies for building a viable local seed system. The ICAR institutes and State Agricultural Universities have the responsibility to select the seeds and produce them at the level of nuclear and breeder seeds. After this, the responsibility of large-scale multiplication, production and distribution at a farmer's level rests with the state government. These systemic flaws at the level of the Basic seeds at institutional level need to be improved with the involvement of farmers to meet the varietal requirement. Indian Agricultural Research Institute, which is a premier research institute in India initiated farmer's participatory seed production program in 2006–07 by involving farmers from the adjoining states. The breeder seed production program of the newly released varieties in the seed chain is taken up on the fields of the research stations and its regional stations whereas the production of truthfully labeled seeds (TFL) which was earlier taken up only on the fields of research institutes is now also taken up on the farmers field under the farmers participatory seed production program. This has resulted in the seed production of both breeder seed and also the TFL seed as depicted in Figure 1.

The participatory seed production program of TFL seed was very well received by the farmers in case of self pollinated crops like wheat and rice where the seed production at farmers field was higher that the quantity of seeds produced by the institute at its own farms (Table 3). Since capacity building and imparting training to stakeholders is an integral part to strengthen farmers capacities in seed production, the institute conducted 57 training programs during which 1344 farmers were trained in different areas, namely, seed production, seed quality control, storage and quality seed assurance. In addition, relevant literature was developed and distributed in farmer friendly language for the adoption of technology.

Table 2. Comparative chart of different seed system models

Model attribute	Model 1	Model 2	Model 3	Model 4	Model 5
Organization/ community involved	Individual farmer	VBSB[1]	SHG[2]	NGO[3]	KVK[4]
Breeder seed source	Research institute or project scientist	Research institute or project scientist	Research institute or project scientist	Research institute or project scientist	Self or research institutions
Responsibility for transport of source seed	Research institute or project scientist	Research institute or project scientist	Research institute or project scientist	Research institute or project scientist	Self
Sourcing of other inputs	Farmer	Seed bank committee/ farmers	Farmers	Farmers/ NGO	Farmers/ KVK
Choice of crop/ variety	Farmers	Farmers	Farmers	NGO/farmers	KVK
Training in seed production	Project scientist	Farmers	Farmers	NGO	KVK
Seed production monitoring	Project scientist	PS, NGO, VSBC[5]	PS, SHG	PS, NGO.	PS, KVK
Seed quality assurance	Farmer	VSBC	SHG	NGO	KVK
Cleaning, packing and transportation	Farmer	Farmers	Farmers	NGO	KVK
Marketing	Farmer	VSBC	SHG	NGO	KVK
Fixing procurement and selling price	Farmer	VSBC	SHG	NGO	KVK
Funding for seed production	Farmer	Farmers	Farmers	Farmers/ NGO	Farmers/ KVK
Funding for seed procurement	Farmer	VO[6]/SBC	VO, self	VO, self, other org.	Self, other org.
Sustainability issues	Technical support, supply of breeder seed	Technical support, supply of breeder seed, funding, takeover of role once project completed, incentives for farmers for maintaining quality.	Incentives for farmers for maintaining quality, technical support, breeder seed supply, funding for seed procurement	Farmer produce fetches low price because there is no external quality control, certification. Supply of breeder seed, funding	Marketing, cost of seed, selection of varieties, incentives for farmers to r maintain seed quality. certification

1. VBSB = Village-based seed bank; 2. SHG = Self-help group; 3. NGO = Nongovernmental organization; 4. KVK = Krishi Vignan Kendra; 5. VSBC = Village seed bank committee; 6. VO = Village organization.

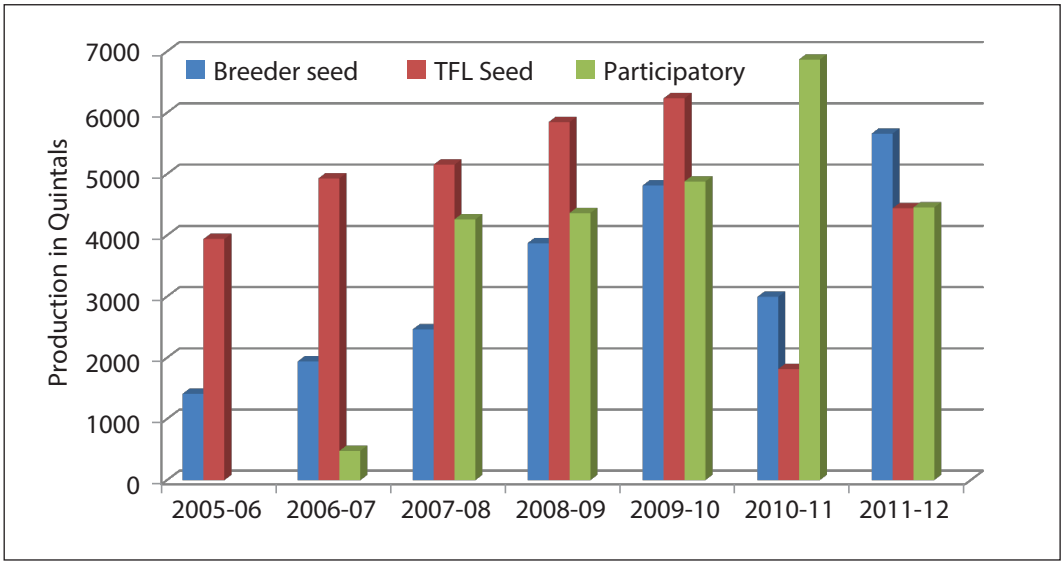

Figure 1. Seed Production at IARI (2005–2012)

Table 3. TFL Seed Production in Institute and Participatory Seed Production (quintals)

Crops	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Wheat	2897.37	3273.33	312.00	831.20	51.00	1114.26	2929.86
Participatory	-	397.62	1101.30	1480.70	2293.51	4122.00	2946.28
Rice	762.12	954.78	430.02	446.98	1072.91	502.09	1290.00
Participatory	-	-	3019.73	2783.85	2344.8	2706.30	1458.00
Maize	111.04	43.03	-	40.95	105.00	35.50	43.43
Participatory	-	-	-	-	150.00	-	-
Pulses	27.74	34.03	44.88	44.15	43.34	76.36	118.83
Participatory	-	82.33	50.45	62.73	61.80	23.75	14.59
Oil Seed	92.07	92.39	33.45	77.94	42.5	66.09	49.04
Participatory	-	-	90.17	29.68	29.00	-	-
Forage Crops	12.00	-	-	9.65	-	4.00	11.10
Participatory	-	-	-	8.00	-	-	-
Total	**3902.34**	**4397.56**	**820.36**	**1450.87**	**1314.75**	**1798.30**	**4442.26**
	-	479.95	4261.65	4364.96	4879.11	6852.05	***4418.87***
Vegetables (q)	38.20	53.40	70.00	31.12	41.20	17.59	105.79
	-	-	-	-	-	15.88	36.3
Grand Total	**3940.54**	**4930.91**	**5152.00**	**5846.95**	**6235.06**	**1815.89**	**4848.05**
	-	479.95	4261.65	4364.96	4879.11	6867.93	4455.17

Source: Tonapi *et. al.*, 2013

Encouraged by the results and experience of the farmers' participatory program, IARI has launched "BeejIndia Producer Company Ltd" with a mission of transforming group of farmers from three clusters of Hapur and Bulandshahar (UP) and Chirawa (Rajasthan) as seed Producer Company under Companies Act 1956. Several farmers' sensitization meetings were held at IARI and at farmers' homes to create awareness about the benefits of making an organized effort for producing premium seed of various field crops, vegetables, floriculture etc. under a common brand name "BEEJINDIA". This incubating company has 50 farmers with 20 subscribed founding members. It has an 8-member executive board with IARI as Advisory Director in the Executive Board. The activities have been initiated as Seed Venture since Rabi 2012 covering an approximate area of 100 hectares. The target crops for this season are wheat, pulses, oilseed, potato and vegetable crops.

7. Conclusion

An effective means of improved seed distribution is farmer-to-farmer seed exchange. This may be primed to a limited extent by supplies of improved seed from public agencies, agricultural research stations and non-governmental organizations to farmers in easily accessible villages. However, such a system is very slow. To speed up the flow of adapted improved varieties to farmers, there is a need to form a network, formal and informal or integrated seed systems between community based organizations and research institutes, public and private seed multiplication agencies, involved in various aspects of seed production. This network will identify bottlenecks in the seed production chain, and catalyze or instigate applied and adaptive research and policy changes that may be required to ensure rapid movement of new cultivars into local seed delivery system benefiting smallholder farmers and resource poor farmers who need them. This approach will require continued interaction between the different institutions, policy makers and stakeholders.

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Making seed of improved groundnut varieties more accessible to smallholder farmers: Lessons and alternative approaches in Malawi

Moses Siambi[1], Patrick Okori[2], Felix Sichali[2], Oswin Madzonga[2], and Patrick Audi[1]
[1]ICRISAT- Nairobi, Box 39063, Nairobi, Kenya
[2]ICRISAT-Lilongwe, Chitedze Agricultural Research Station, PO Box 1096, Lilongwe, Malawi.

Abstract

This paper details the seed supply experiences of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Malawi. ICRISAT has developed about five high yielding, market-preferred and well-adapted improved groundnut varieties in Malawi, but no seed companies have shown any interest in producing and marketing of seed of these varieties due to low profit margins. ICRISAT, under Irish Aid funded Malawi Seed Industry Development (MSID) project initiated two seed production and distribution models in Malawi. First, certified seed of five improved groundnut varieties was produced by use of contracted farmers of NASFAM under a "buy back" scheme facilitated by ICRISAT. At the same time, the project also facilitated certified seed production by some seed companies for marketing through available agro-dealer networks. Much of the seed from this model was channeled through the agro-dealer networks under the Government's Farm Input Subsidy Program (FISP). In three years, from 2010–2012, about 400 t of certified seed of the most preferred improved variety, CG7, was produced and distributed each year to resource-poor households in Malawi. In remote areas with poor road infrastructure, a second model of seed banks was initiated to deliver seed of improved groundnut varieties to farmers. These two seed delivery channels enhanced adoption of CG7 from 20% to about 90%. Although the MSID project established formal and informal seed production structures in Malawi, the success of the seed delivery model was mainly attributed to FISP that was able to overcome the inaccessibility constraints of seed unavailability and unaffordability. One of the main lessons learnt is that a suitable seed delivery model is location specific, and is best determined by undertaking a situational analysis to determine the constraints. Further, a public-private sector partnership, even under FISP, is important for the success of any seed delivery model in use. Continuous funding of breeder's seed production remains critical for the success of both CSP and certified seed production models.

1. Background Information and Rationale

Malawi has an estimated population of 16.5 million, with 51% of them living below the poverty level (EC Country Strategy Paper 2013). Agriculture is the mainstay of the country's economy; it contributes about 34% of economic growth, 39% of the GDP, employs 85% of the economically active population and generates nearly 90% of the foreign exchange-earning (Mucavele 2010). Agriculture in Malawi is broadly divided into large-scale farming and small-scale farming. The former comprises mostly cash and industrial crops such as tea, tobacco and sugar cane whereas the latter is for most food crops such as cereals and legumes.

Groundnut is the most widely cultivated legume in Malawi and accounts for 25% of household's agricultural income (Diop *et al*., 2003). In addition to income generation, groundnut is also an important food security crop for the rural and urban populace. Furthermore, it improves soil fertility by fixing atmospheric nitrogen. While research yield potential is 3000 kg ha^{-1}, the average smallholder farmer's yield is less than 800 kg ha^{-1}.

The yield difference between researchers' and farmers' fields was attributed to three main reasons. First, there was a lack of improved varieties; farmers grew mixtures of traditional varieties. Second, seed production and distribution networks were underdeveloped to disseminate quality seed and most farmers relied on recycled seed. Third, there was poor extension to disseminate information

on best practices for groundnut production. ICRISAT has groundnut as one of its mandate crops in Malawi and had to adopt a multi-prong approach to address the productivity constraints.

To address variety development constraints, ICRISAT, in collaboration with partners, developed and test-adapted on farmers' fields five high-yielding and market-preferred improved varieties of groundnuts[12]. After developing these varieties, wide adoption by farmers was still hampered by inaccessibility of the improved seed to resource-poor farmers due to a number of production and supply constraints, including lack of interest by seed companies citing low profit margins in groundnut seed business. It is against this background that ICRISAT undertook groundnut seed supply initiatives in Malawi with the following key objectives:

1. Deliver improved groundnut technologies (varieties and management practices) to smallholder farmers
2. Initiate and develop public and private sector partnerships in the marketing and distribution of improved groundnut seed
3. Widen the use and impact of ICRISAT's available technologies

This report details the work that ICRISAT and strategic partners have done in Malawi to improve accessibility of seed of improved groundnut varieties. It describes the existing models of seed supply, the Malawi Seed Industry Development Project and ends with lessons learnt and future prospects.

2. ICRISAT's seed supply model in Malawi

A 'seed system' is "an interrelated set of components including breeding, management, replacement and distribution of seed" (Thiele 1999). Two broad types are recognized: formal seed systems that produce and distribute certified seed and local, informal or famer-to-farmer seed systems that produce non-certified seed, often in the process of producing grain. In the recent past, a semi-formal category of seed system has evolved to meet farmers' demand for affordable high quality seed of improved varieties. The three systems often co-exist and are integrated as components of one seed "system". The decision to use one or more components to supply seed to farmers is guided by relative component strength, is usually location specific and often depends on supply constraints. The key supply constraints faced by ICRISAT for groundnuts seed supply in Malawi were:

1. Inadequate number of variety options with preferred household use and market attributes available to farmers
2. Unavailability of Breeders' and Foundation seed of improved groundnut varieties
3. Lack of production and distribution system for high quality seed of improved varieties developed by ICRISAT.
4. Poor adoption of seed of improved groundnut varieties due to high poverty levels among smallholder farmers.

Therefore, ICRISAT initiated production and distribution of formal or certified seed of the five released improved groundnut varieties. Breeder's seed of released improved varieties was produced under the supervision of ICRISAT scientists followed by production of Foundation and Certified seed by contracted individual farmers and farmer associations with a "buy back system" facilitated by ICRISAT and quality certified by Seed Certification and Quality Control Services Unit (SCQSU) of Malawi (Figure 1). This model has been largely used in the MSID project described below. However, in very remote areas with poor road infrastructure Seed Banks were initiated to fill the gap unmet by the formal seed system and the FISP. Under the Seed Bank model, producer groups, extension (for training) and agricultural village committees collaborated in selection of seed beneficiaries who received seed through a "pass on system" with a seed 'recharge' every 4 years.

12 Improved groundnut varieties released in Malawi are CG7 (ICGV-SM 83708), Chitala (ICGV-SM 99568), Nsinjiro (ICGV- SM 90704, Kakoma (JL 24) and Baka (ICG 12991).

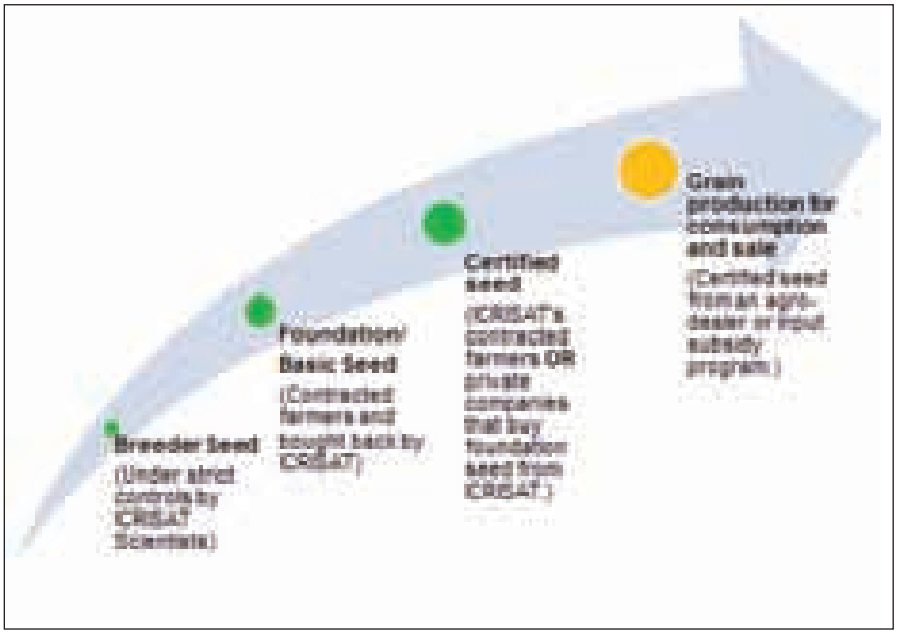

Figure 1. ICRISAT's Certified Seed Production model in Malawi.

3. Malawi Seed Industry Development Project

ICRISAT's certified seed production and distribution model was supported by Irish Aid and the Government of Malawi under the MSID project. The MSID project was designed to support the work of the Eastern and Southern Africa Seed Alliance (ESASA) in Malawi. The goal of ESASA is to increase smallholder yields and incomes through the competitive and reliable provision of high quality affordable seed to smallholder farmers. The three primary objectives of ESASA targeting the development of the seed industry are:

- Develop capacity of existing and potential local seed companies;
- Improve the policy environment for seed trade;
- Strengthen the commercial distribution network for improved seeds, complementary inputs, and resulting crop outputs.

Therefore, to meet these broad objectives and ICRISAT's specific objective of widening the use and impact of its available technologies, the project undertook the following activities in collaboration with contracted individual farmers and members of National Smallholder Farmers Association of Malawi (NASFAM), Government of Malawi, selected seed companies and their agro-dealer network, SCQS Unit, Chitedze Research Centre Scientists, extension staff, Citizen's Network for Foreign Affairs (CNFA), Seed Trade Association of Malawi (STAM), Interactive Arts, USA and Community Based Organizations(CBOs):

- Production of breeders and foundation seed of improved varieties
- Facilitation of the production of certified seed by NASFAM and channeling this seed through FISP[13]
- Identification and support for selected seed companies and their agro-dealer networks interested in marketing improved high-quality seed.
- Creation of demand for improved seed through on-farm demonstrations and field days
- Facilitate and strengthen the work of SCQS unit
- Establish linkage with FISP for distribution of seed to needy farmers

13 Identified seed needy farmers were facilitated to access (by use of seed vouchers) subsidized certified seed produced by ICRISAT and Seed companies from a network of agro-dealers under the FISP.

3.1. Contracting farmers for certified groundnut seed production

Under the MSID project, contracting of individual and NASFAM farmers has been central in production of certified improved groundnut seed in Malawi. Hence, some requirements to be met by participating farmers were set by the project:

- Above average in farm resource endowment
- Participation in seed production training course
- Purchase of Breeders' seed or Foundation seed on cash basis
- Agreement and adherence to a seed production contract
- Registration by Seed Regulatory Services as a seed producer
- Verification of status of farms for suitability to produce seed
- Inspection of seed fields by the SCQS during the growing season
- Delivery of harvested seed to ICRISAT at Chitedze Research Centre, Lilongwe
- Compulsory purity tests done by Seed Services Unit
- Payment for seed only after certification is received

3.2. Achievements of MSID project

Some commendable achievements were made by MSID project:

- Certified seed of four improved groundnut varieties was produced by contracted farmers and selected companies and distributed through agro-dealer networks and FISP
- In the three years from 2010 to 2012 about 400 tons of certified seed of CG7 (the most market-preferred improved groundnut variety in Malawi) was produced and distributed annually – reaching an estimated 200, 000 households annually.
- Four private seed companies were facilitated to produce and market certified seed of improved groundnuts through agro-dealer networks
- Before this seed supply intervention, the adoption of CG7 was about 20%, but improved to about 90% after the seed supply intervention.

Nevertheless, despite the progress made in the delivery of certified seed of improved groundnuts through FISP and/or the agro-dealer networks, the use of farmer to farmer seed sources remained high at 70% in 2012 (Table 1) and therefore improving the quality of recycled seed needed strengthening. Furthermore, it was not possible for agro-dealers and FISP to deliver seed of groundnuts to all groundnut production areas, especially the remote areas of Malawi. Therefore, an alternative seed delivery model was undertaken to fill the gap.

Table 1. Sources of improved seed of maize, groundnuts and soyabeans for smallholder farmers in Malawi

Source of seed	Maize (%)	Groundnuts (%)	Soybeans (%)
Own stock/recycled	64	54	40
Local farmers	9	16	25
Agro-dealers	27	26	30
Other retail shops	6	4	6
NASFAM	-	3	2
ICRISAT	-	5	2
NGOs	1	2	1

Source: Farm survey ICRISAT, May 2012.

4. Seed Banks

The objective of the seed banks model was to fill the gap in the certified seed production model in which the seed was channeled to farmers through the FISP and agro-dealer networks. Therefore, seed banks model was initiated in remote areas unreached by the formal seed model. The key aspects of the seed bank model were:

- Suitable farmer groups were identified and used as producers
- Extension was used in training of farmer groups
- Village agricultural committees chose "beneficiaries" who received seed through a "pass-on" system
- Recharge seed is provided after four seasons
- Farmers were encouraged to sell or exchange seed informally within the community

Advantages of seed banks

- Suited to areas with poor road infrastructure which makes certified seed more expensive or inaccessible by resource-poor farmers
- Rapid dissemination of improved varieties within the community
- Groups gained skills in seed production techniques
- Groups have been empowered and are capable to be used as seed growers by private seed companies or contracted individual growers

5. Sustainability of ICRISAT Seed delivery models

ICRISAT has spearheaded both formal and informal seed supply models in Malawi mainly to increase adoption and impact of available groundnut technologies, especially high yielding and adapted varieties. This was necessitated by lack of interest by private seed companies to produce and market seed of improved groundnuts because of unattractive profit margins. Therefore, ICRISAT considers the sustainability of seed supply models and their profitability as necessary but not sufficient (the only) criteria for determining the type of seed model to be used to deliver seed to resource-poor farmers. However, there were some aspects of sustainability realized by using ICRISAT seed models in Malawi.

- Partnership structures and capacity for seed production have been established
- Demand for high quality groundnut seed was created
- Complementary links between formal and farmer to farmer groundnut seed models have been initiated

6. Lessons Learnt

There were important lessons learnt from ICRISAT's seed work and MSID project in Malawi, of which key were:

- Subsidized seed distribution facilitated quick adoption of improved groundnut varieties and best practices.
- Community seed production through 'seed banks' ensured timely availability of seed and spread of improved varieties in areas usually neglected by the formal seed system. Thus, it can be adopted to ensure availability of seed despite the low profit margins that discourage seed business.

- Despite the emphasis on formal channel of seed distribution, the farmer to farmer seed system remains dominant, but needs strengthening.
- Public-private sector partnerships are critical in whatever seed model one chooses. Channeling certified seed produced by public sector facilitation through the local agro-dealer networks strengthened local seed distribution and marketing networks for future benefits.
- Linkage between formal and informal seed models are important due complementarity and are not mutually exclusive.

7. Conclusion and recommendations

A suitable seed model to be used in accessing seed of improved varieties depends on underlying seed accessibility constraints. If the constraints are of emergency nature such as drought or floods in a situation where private seed companies have an interest or are already producing seed of the improved varieties in question, then short-term strategies such as direct seed distribution through public–private sector partnerships could be used. However, if the underlying constraints are of chronic nature such as poverty, unaffordability and unavailability of quality seed due to lack of interest by seed companies to produce and market seed (as in the case of improved groundnut varieties in Malawi), then public sector intervention is justified as in the ICRISAT model in Malawi. That is, where the private sector has failed to avail seed due to lack of incentives it is necessary for the public sector to intervene in the production of seed. However, to reach remote areas and to further overcome poverty and un-affordability constraints community seed production models such as the Seed Bank model practiced in Malawi is appropriate.

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Sustainable Access to Quality Seed by Small Holders: The Case of Decentralized Seed Production of Common Bean in Ethiopia

KidaneTumsa[1], J.C. Rubyogo[2] and Kassaye Negash[1]

[1]Ethiopian Institute of Agricultural Research, Melkassa Agricultural Research Center, P.O. Box 436, Adama, Ethiopia;

[2]Pan African Bean Research Alliance (PABRA), International Center for Tropical Agriculture (CIAT), Regional Office, C/O Selian Agricultural Research Institute, P.O. Box 2704, Arusha, Tanzania

Correspondence: ktumsa@gmail.com

Abstract

Common beans are important sources of food and cash in Ethiopia. Access to seed of improved bean varieties is the major bottleneck to common bean production. Most of the bean producers obtain seed of improved varieties from few seed suppliers, who are unable to sufficiently produce and sell seed at reasonable price. To improve the accessibility and availability, a strategy to produce seed of improved varieties at the community level through integrated impact driven seed systems was started in 2004. Through this approach, the access to seed of market demanded varieties increased from less than 20% to about 68% across major bean growing areas from 2004 to 2011, respectively. The seed production and delivery was accompanied by improved crop management techniques to increase crop productivity per unit area. Subsequently, from 2004 to 2011, the area under beans increased by 44.3%, from 181,600 to 331,708 ha, whereas production increased three times, from 172,152.9 tons to 387,802.3 tons and average yield more than doubled from 0.615 tons/ha to 1.41 tons/ha. These improvements indirectly showed an effect on export volume and revenue from the exports. Between 2006 and 2011, export volume increased from 60,834 tons to 74,762 tons and with revenue increment from USD 8,146,125 to USD 49,654516.

Key words: Ethiopia, common bean, improved varieties, decentralized seed production

1. Introduction

Common beans (*Phaseolus vulgaris* L.), are increasingly becoming an important crop to the Ethiopian national economy (commodity and employment) and to farmers as food for consumption and as cash income for markets. Common bean is currently grown on an estimated land 340,000 ha by nearly 3.3 million smallholder farmers in the country (CSA 2012). Different market classes of the crop have been grown in different regions for different purposes. The small white (navy) beans are grown for export for the canning industries and the other types (small red, large red, large mottled and sugar) are mainly for households' for food in national and regional markets

Ethiopian National Bean Research Program (ENBRP) of EIAR and Regional Agricultural Institutes (RARIs) in collaboration with International Center of Tropical Agriculture (CIAT) and Pan African Bean Research Alliance (PABRA) developed higher yielding improved common bean varieties that are potentially suitable for a wide range of ecologies of Ethiopia. These improved varieties were also highly appreciated by consumers and market (Assefa *et al*., 2006). However, farmers continued to grow low yielding old varieties instead. The main constraint to adoption of improved bean varieties was associated with limited accessibility to seed (PABRA 2005). Before 2004, EIAR and RARIs were relying only on some farmer research groups (around research centers) and the Ethiopia Seed Enterprise (ESE), a government agency to disseminate improved varieties to farmers (Alemu and Spielman 2010**)**. These suppliers could only meet less than 1% of farmers' seed needs, and focused on few popular and old bean varieties (primarily Mexican 142, released in 1972) (Rubyogo *et al*., 2007). Therefore, relatively few farmers had the opportunity to access the seeds of the newer varieties.

ENBRP initiated a partnership with a broader range of organizations to increase availability and access of seed in the farmers' locality. The partners include governmental, non-governmental and farmers' organizations and individual farmers. Enhancing the skills and knowledge of service providers to backstop a growing seed supply sector was also part of the partnership. The partnership led to longlasting platform of bean technology transfer and marketing. All bean value chain actors are involved to identify and address the constraints in bean value chain (PABRA 2005).

This article describes the process and achievements of ENBRP with its partners in increasing the availability and accessibility of seed of improved varieties of common bean with their matching management techniques to improve production, productivity and market in Ethiopia.

2. The approach

2.1 Engaging partners

It was recognized that engaging diverse partners is very important to establish decentralized seed production in common bean in Ethiopia. Identification and engagement of those partners from different bean growing regions was done through different fora such as annual review and planning meetings at different level, regional extension and farmers linkage forum etc. After the establishment of the partnership, planning meetings were held in order to design the mechanisms and amount of seed distribution and type of varieties in each area of operation. This also provided an opportunity to share the roles and responsibilities of each partner. Table 1 describes the clear roles and responsibilities of each partner from different regions. Policy makers were also engaged so that they become part of the forum and facilitate the implementation.

Table 1. Roles and responsibilities of partners in the decentralized common bean seed production

Partners	Roles and responsibilities
National Agricultural Research System	• Production and supply of initial seed • Provision of information on new varieties • Support and enhancement of skills and knowledge of partners • Catalyze the bean sub-sector development
Ministry of Agriculture	• Support to provide knowledge and information to farmers • Policy support for bean research and development • Engage and support private sector investors • Assist distribution and recover the seed after production
Seed Enterprise	• Production and supply of basic and certified seed • Facilitate training for quality seed production and purchase produced seed
Seed producers	• Test new varieties with support from extension service providers • Produce and market seeds in local markets and to local organizations • Engage local community for wider dissemination of information and seeds
Farmers' Cooperative Union	• Mobilization of farmers (members) • Provision of agri-inputs (fertilizers, seed) to famers on loan or cash • Purchase of bean grain from members and communities • Establish market infrastructure for storage, cleaning equipment • Distribute and collect the seed
CIAT/PABRA	• Training partners in seed production and business skills • Support and backstopping in establishing community of practices • Support in the design of innovative seed systems approaches for wider impact

2.2 Improving the skills and knowledge of partners

To improve skills and knowledge of seed production, awareness creations meetings were conducted every cropping season in the regions. Training of trainers (ToT) courses were organized for the experts from the Ministry of Agriculture (MOA), community facilitators of partner NGOs, agronomists from farmer-based organizations and seed producing farmers. The training covered all aspects of seed production and marketing.

2.3 Initial seed production and distribution

In the rainy season and using irrigation, initial seed of preferred bean varieties was multiplied at Melkassa Agricultural Research center (MARC) and other research centers such as Hawasa, Areka, Jima, Bako and Pawe. All information including the name of variety and its characteristics such as maturity date and productivity and seed quality attributes such as germination, purity and production season were printed on the bag and provided in the local language.

Two approaches used to distribute the initial seed

1. ***Commercial Packs***: These packs were used to sell2 and distribute popular and commercial varieties to areas where beans are produced for marketing purposes. The sizes of these bags were 5, 12.5 and 25 kg and they were mainly distributed through primary partners, i.e., partners who participated in receiving the initial seed from the research center and producing the quality declared seed (QDS) or those who distributed to the farmers to be produced. The initial seed was distributed to the partners in loan in kind bases, which was recovered and distributed to other farmers in the area. After production, the loaned seed was recovered through primary and secondary partners to be distributed to other farmers who need to use the seed in the areas. The amount produced by farmers or other partners was bought by farmers' cooperative union (FCU) and other organizations such as MOA, NGOs and other farmers. FCU either bought at least 30% of the QDS produced by farmers or facilitated and linked the producers to seed markets. The quality of the produced seed was checked by MARC and other centers and provided with recommendation letter which described the quality of the seed.
2. ***Small Packs:*** Such packs were used to avail seed of newly released improved varieties for small-scale farmers with very small land holdings. Since the purpose of the packs was to introduce the improved bean varieties to number of farmers within a given season, more than ten varieties were distributed to different regions. The seed packs were sold with fair price (considering the purchasing power of poor farmers to initiate the ownership of the farmers). Four weight categories (250, 500 and 1000 g) were used to pack with the similar information on commercial packets.

2.4 Planning for action with partners

Each year, a planning meeting was held with partners in order to share roles and responsibilities. Basically, each partner defined their roles and responsibilities, but the purpose of the meeting was to set action plan for the cropping season. The decision on the mechanisms, amount of seed and the varieties to be distributed in each area of operation was also made in this meeting.

2.5 Implementation area

The implementation of the decentralized common bean seed system was started from Central Rift Valley (CRV) where more than 40% of the production exists. This covers six districts of Eastern Shoa zone (Boset, Adama, Lume, Bora, Dugda and Adami Tulu JidoKombolcha), three districts of West Arsi zone (ArsiNegelle, Shashamane and Shalla) and two districts of Arsi zone (Sire and Dodota). Different partners have been participating in seed production and distribution in this area. LumeAdama FCU, Meki Catholic Church, Self Help International and office of agriculture at zonal and district level are the major ones.

Since 2008, others common bean growing areas were included due to Tropical Legume II (TL II) project. In collaboration with Hararghie Catholic Secretariat (HCS), CARE Ethiopia, Haramaya University, Afrenkelo FCU, Burka Galeyti FCU and offices of agriculture, decentralized seed system began to be implemented in East and West Hararghie zones. With Southern Region Agricultural Research Institute (SARI) is the source of initial seed for the different partners in the southern regions of the country. Bako and Jimma research centers have been involved to provide seeds of improved varieties of common bean to south west and western part of bean growing regions. Pawe research center is the major source of seed for BenishangulGumiz and parts Amhara region partners. Sirinka agricultural research center has been involved in providing initial seed for the south Wolo zone. The partners of each center have been involved in production and distribution of QDS of the preferred improved varieties in each region.

3. Results

3.1. Seed production and delivery

The main purpose of the decentralized seed production and delivery system was to improve access and availability of seed of improved varieties of common bean through different partners. Hence, number of partners who are interested to participate in seed production and distribution has increased from 13 in 2004/5 to 53 in 20011/12 (Table 2). A total of 771 tons of seed of different varieties was distributed to different bean growing areas. Farmers' interest in the varieties they wish to grow was also maintained in each region.

Between 2004/5 and 2011/12, the seed distributed by ENBRP covered an area of 6939 hectares and produced 9008.7 tons of seed (Table 3). The produced QDS were distributed to different regions by

Table 2. Amount of basic seeds supplied between 2004/5 and 2011/12

Cropping season	Number of varieties	Amount of seed distributed (t)	Number of partners involved
2004/5	9	137	15
2005/6	8	66	23
2006/7	8	83	24
2007/8	7	56	27
2008/9	10	122.4	32
2009/10	7	112.2	36
2010/11	8	98.9	45
2011/12	7	95.50	53
Total		771	

Table 3. Area coverage and amount of seed produced by partners 2004/5-2011/12

Cropping season	Area covered (ha)	Amount of seed produced by partners (t)	Number of farmers reached
2004/5	1233	1179.6	10616
2005/6	594	556.4	6677
2006/7	747	827.5	12413
2007/8	504	584.1	11098
2008/9	1101.6	1648.7	13440.4
2009/10	1009.8	1671.8	114848
2010/11	890.1	1424.2	342664
2011/12	859.5	1116.4	456010
Total	6939	9008.7	967766

partners and others to be utilized by farmers. Mostly, NGOs and FCU were involved in distribution of QDS. Farmers who have been reached with the seed and information from all sources and spill-over are estimated to be 967,766. This accounts for about 31% of bean growers in the country. The numbers of farmers who have received the seed directly from the partners account for about 21% and others assumed to be reached by the spill-over effect and information.

3.2. Improvement in productivity and production

Even though, increased productivity is attributed to different production factors, improving seed supply for improved varieties plays an important role. The productivity of common bean was 0.861 t/ha in 2004/5 cropping season, but it has increased to 1.49 t/ha in 2009/10 cropping season (Figure 1). During the same period, production increased from 1,384,216 tons in 2005/6 to 3,878,023 tons in 2011/12 (Figure 2). This accounts for an increment of 42.2% and 64.3%, in productivity and production respectively.

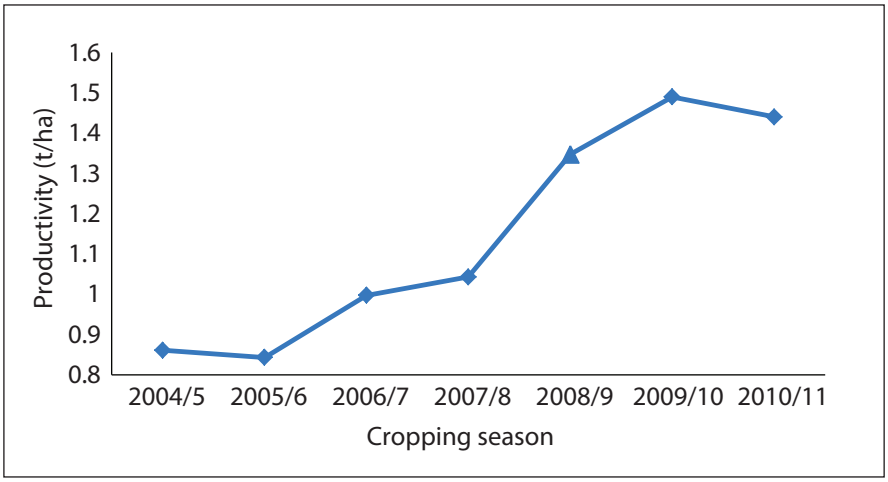

Figure 1. Common bean productivity trends from 2004/5 to2010/11
(Source: CSA, 2011)

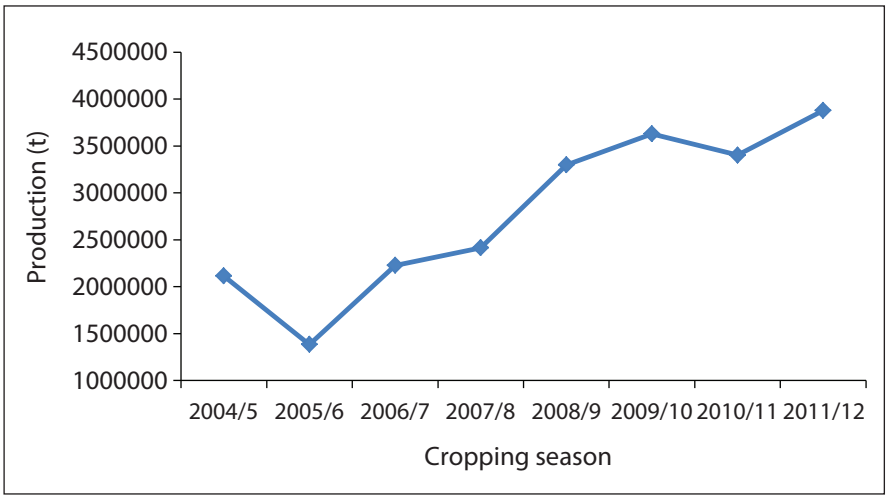

Figure 2. Common bean production (tons) trends from 2004/5 to2011/12
(Source: CSA, 2012)

3.3. Improvement in export volume and revenue

With increased production and productivity, which directly relates to the amount of common bean in the local markets, there is also an increase in the number of value chain actors from time to time. Between 2004/5 and 2009/10, the volume of bean export (particularly white pea bean) increased from 61,000 tons to 75,000 tons which is about 25% (Figure 3). Within the same period, 83% increment in revenue was also obtained which directly related to an improvement in price of the product (Figure 4). The amount exported and its value does not include other food types (small red and red mottled) exported informally to neighboring countries.

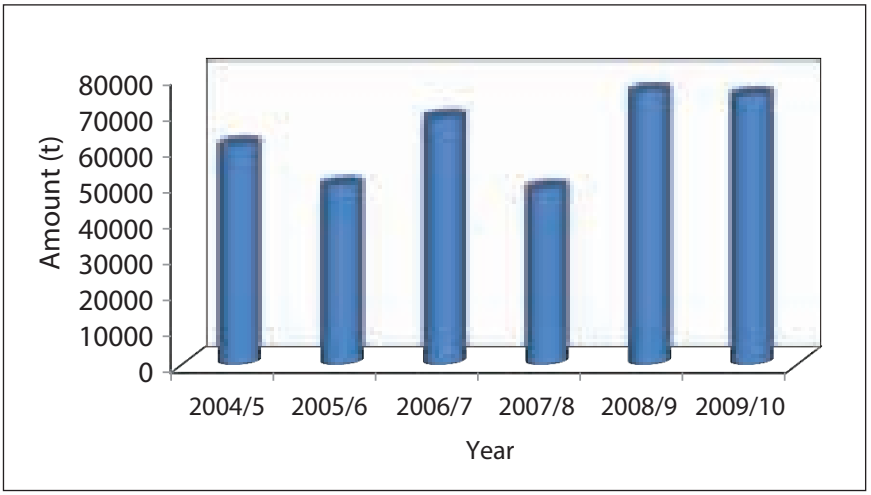

Figure 3. Trends in amount of export of common bean between 2004/5 and 2009/10

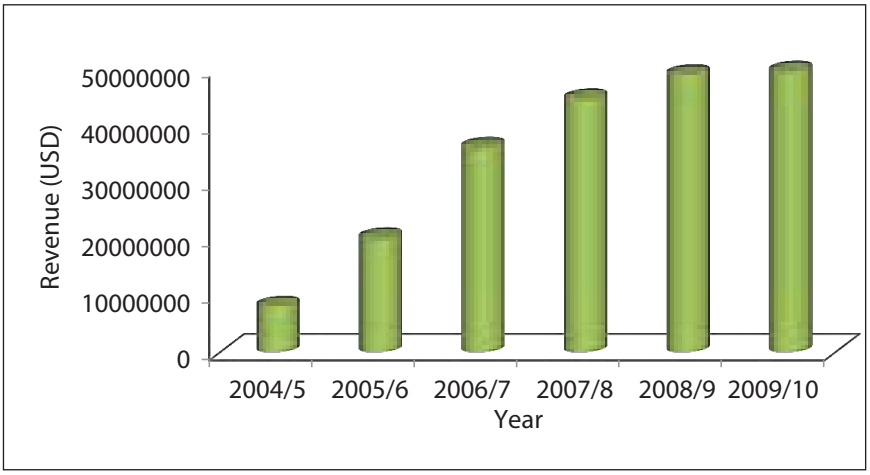

Figure 4. Trend in amount of revenue obtained from export of common bean between 2004/5 2009/10

3.4. Individual and institutional changes

Different investors were attracted to bean sectors due to improvement of production and productivity of the crop by the value chain actors (farmers, private farms, exporters). For example, the well organized and modern exporter, Agricultural Commodity Supply (ACOS), emerged in the history of bean business. ACOS processes and exports 30,000 to 40,000 metric tons per annum. The Ethiopian Commodity Exchange (ECX) was established to facilitate modernized marketing system for five crops among which small white beans are one. This also further contributed to increase in export volume and income.

4. Conclusion

Decentralized seed production contributed to the development of bean sectors with strong efforts among partners. Sufficient amount of seed can be produced by engaging diverse seed producers from different bean growing areas. With good skills and knowledge of production and marketing, it is possible to produce enough seed for many farmers to access seeds of improved varieties in their localities. The improvement of seed access and availability can further improve the livelihoods of small-scale farmers and good quality product for export market.

Diversification of initial seeds to different partners, specifically to research centers at different regions, is crucial to supply initial seed at the producers' locality on time. Well-established partnerships across the bean value chain are also important to sustain the decentralized seed system.

5. Acknowledgements

The authors appreciate the productive and impact oriented partnerships between CIAT/PABRA and EIAR, RARIs and bean value chain actors in Ethiopia. They also express deep gratitude to the donors particularly the Government of Ethiopia, the Swiss Development Cooperation, the Canadian International Development Agency, the United States Agency for International Development and Bill and Melinda Gates Foundation.

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Integrated Bean Seed Systems in Africa: Implications for Community Seed Production

E.K. Maereka[1] and J.C. Rubyogo[2]

[1]The International Centre for Tropical Agriculture (CIAT)-Malawi, Chitedze Research Station, P.O. Box 158 Lilongwe, Malawi

[2]CIAT-Tanzania, Selian Agricultural Research Institute, P.O. Box 2704 Arusha, Tanzania

Abstract

Most of the seed planted in Sub Saharan Africa (SSA) comes from the informal seed system, more so for traditional legume crops such as beans, cowpeas and groundnuts. Despite several initiatives to increase the number of varieties released, the current formal systems are evidently incapable of meeting seed demand due to limited production and poor distribution networks. To improve bean seed access, the International Center for Tropical Agriculture (CIAT) under the Pan Africa Bean Research Alliance (PABRA) framework, espoused a pluralistic approach that incorporates all channels of seed production and distribution. This decentralised approach, mostly centred on community-based seed production (CSP), has reduced the lag period between the release of a variety and its access by farmers. The first concrete step is exposing varieties to communities through participatory variety selection (PVS) trials. Second, awareness is also created through field days, seed fairs and agricultural shows. Seed of selected varieties (both new and previously released) is availed to farmers in starter packs, or at times through sale of small seed packs. This is followed by training farmers in integrated crop management and seed production. To accomplish this work, CIAT partnered with a number of like-minded institutions in SSA. The national agricultural research systems (NARS) and extension services provided the varieties, decentralized testing and backstopping services. Civic organisations that focus on food security and nutrition such as CRS, CARITAS, CARE, Concern Worldwide and others were involved in mobilizing communities. Under CSP programs, seed is not always certified, but of acceptable quality to farmers as most producers are also trained in post-harvest handling and seed cleaning. CSP schemes have taken different approaches in different countries depending on seed supply opportunities available. For instance, CSP schemes have become an integral component that feeds into the seed certification and quality declared seed (QDS) schemes in Zambia and Tanzania, whereas they have remained limited to farmer–farmer exchanges in other countries. In Zimbabwe, one community-based farmer group has gone further to avail bean seed in small packs with a clear business orientation. Legume seeds are not usually targeted by private seed companies due to low frequency of repeated sales and CSP is unquestionably filling that gap and reaching out to millions of farmers. The success of CSP hinges on synergies: NARS for the provision of basic seed and training in seed production, non-governmental organizations (NGOs) for mobilization of communities, and the participation of other stakeholders in the commodity value chain. The possibility of transforming CSP schemes into sustainable businesses remains an elusive long-term goal.

Key words: PABRA, decentralised distribution, participatory variety testing, community seed production.

1. Introduction

Limited availability of good quality seed is a key constraint that has been repeatedly acknowledged over decades by farmers and development practitioners throughout Sub-Saharan Africa (SSA). One of its major causes in the past was identified as government dominated production and distribution of seed through inefficient parastatals (Venkatesan, 1994). Inevitably, the early 1990s saw a number of SSA countries privatize their seed sectors, marking the emergence of formal seed systems duly dominated by private seed companies. Successful privatization of national seed sectors has often been associated with a rapid uptake of hybrid seed by smallholder farmers, resulting in increased

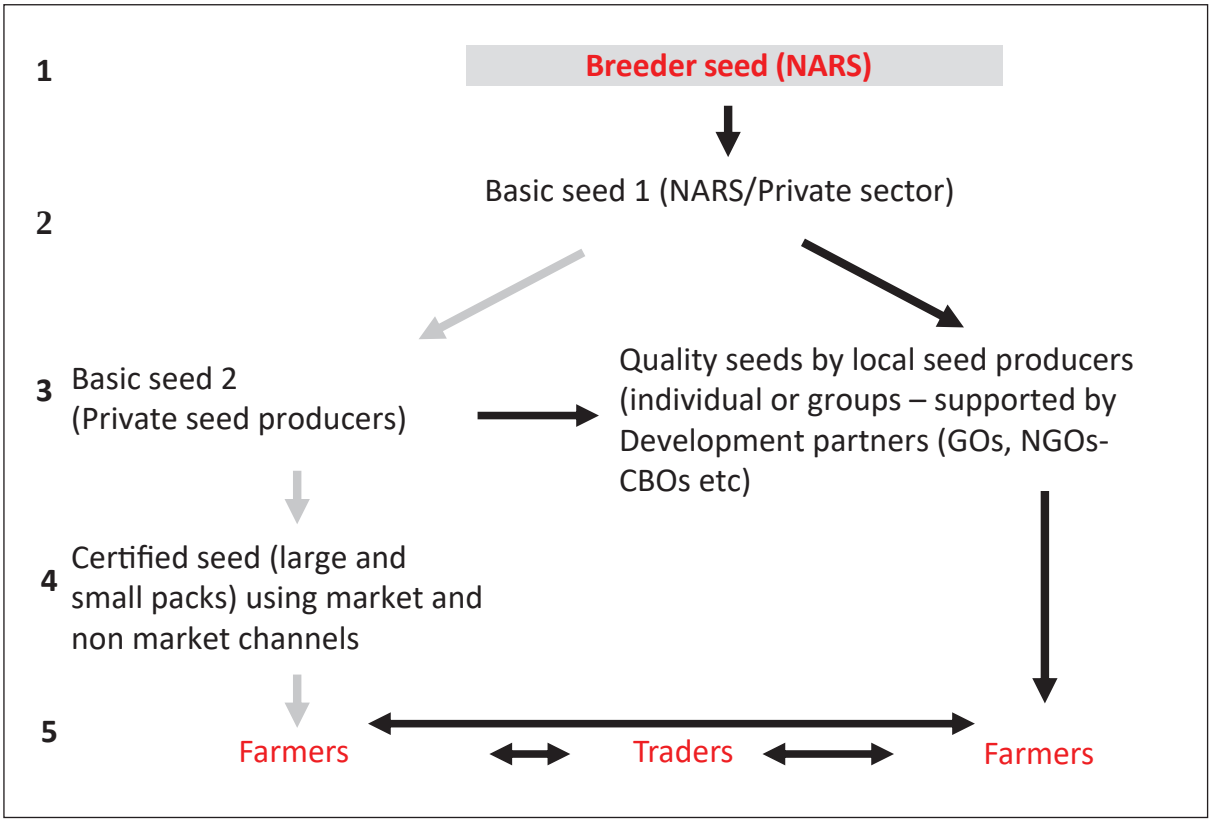

Figure 1. Schematic presentation of Integrated Seed System Approach that has been adopted by CIAT/PABRA.

yields (Mabaya *et al.*, 2013). To sustain high yields from hybrid seed, however, farmers have to purchase new seed every season as they have become well aware of the unambiguous differences in yield and genetic quality between fresh and farm-saved seed of hybrid. The use of maize hybrid seed therefore assures seed companies of repeated purchases and it is not surprising that most seed companies emerging within SSA focus on maize hybrids with very little or no attention to other crops.

It is worth noting that farmers are aware that food security goes beyond maize hybrids; they have diverse cropping systems in which they highly regard the other component crops, especially grain legumes such as beans. High seed rates, low multiplication rates and low repeated purchase value make the provision of seed of most grain legumes unattractive to commercial seed companies, leaving them 'orphaned.' Neglect by private seed companies has only strengthened the informal seed system and the role of farmers in seed supply for these 'orphaned' crops. For instance, when the formal seed system collapsed alongside the economy in Zimbabwe, the informal seed system remained remarkably resilient (Mutonodzo-Davies, 2010), supplying more than 95% of the seed sown for crops such as sorghum, pearl millet, groundnuts, cowpeas, beans, soybeans (CIAT *et al*., 2009). The same also holds for a number of other SSA countries, indicative of the converse relationship between the development of the informal and formal seed systems.

Maredia *et al*. (1999) noted that seed of many grain legumes and other self-pollinating crops can be easily multiplied by farmers and are more suited to dissemination through the informal seed system across the economic divide of users. Unlike hybrids that require extensive isolation distances for seed production, most grain legumes are self-pollinated and require small isolation distances. Also, farmers can recycle their seeds with very little loss in genetic composition if basic care is taken. Hence, community level seed production is possible. Consequently, much of community seed production (CSP) work has been on open pollinated and self pollinating crops. For a long time, CSP

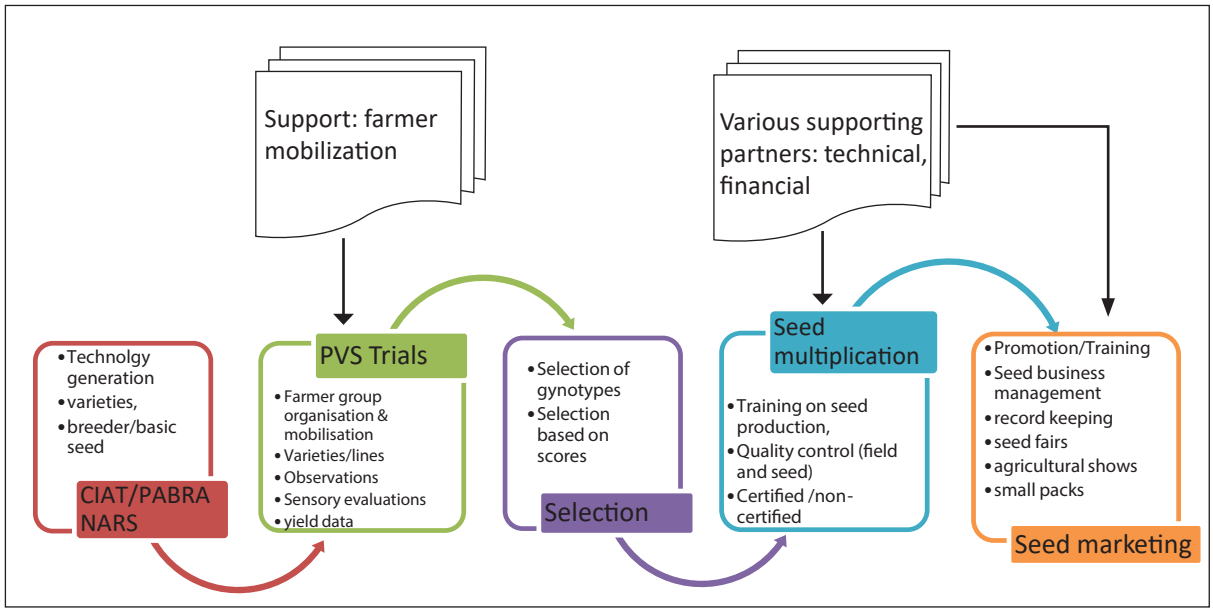

Figure 2. Sequence of seed dissemination strategy under the decentralized approach

has been associated with humanitarian non-governmental organizations (NGOs) (Mujaju, 2010) and distortion of the seed system (Tripp, 2003) when instead, it should be embraced as an indispensable component of the latter. Contrary to the formal system in which seed purchase is strictly cash, seed exchanges under CSP can be free, through barter or sometimes cash sales at local markets, thus catering for diverse user groups including resource-poor smallholder farmers.

2. Pluralistic seed system

An efficient seed system provides appropriate varieties as required by different farmer types on time and at prices acceptable to the farmers (Monyo *et al*., 2004) and "uses the appropriate combination of formal, informal, market and non-market channels to stimulate and efficiently meet farmers' evolving demand for quality seeds" **(**Maredia *et al*., 1999). Formal seed systems in SSA are quite far from this and in highlighting their inefficiency, David and Sperling (1999) reported that their use would delay the wide dissemination of newly released improved bean varieties. Accordingly, it has become crucial to adopt other channels apart from the formal system that accept, recognize and include all other players to ensure seed reaches farmers within a short period of time. Such an approach has become known as the pluralistic or integrated seed system and has been a prime mover in seed dissemination activities for the International Centre for Tropical Agriculture, (CIAT). CIAT formed alliances with National Agricultural Research Systems (NARS) under the Pan Africa Bean Research Alliance (PABRA). To date, the alliance has released numerous high-yielding, nutritionally-enhanced, climate-smart common bean varieties that are potentially suitable for a range of agro-ecologies within SSA. Within the PABRA framework, further partnerships have been established with several organizations: private, government, non-governmental, farmers' organizations and individual farmers, all with the aim of overcoming constraints to seed access (Figure 1). Under the decentralized approach, farmers may start accessing seed at schematic level 3 (bold arrow), compared to level 5 (grey arrow) under the formal seed system. The presence of seed among farmers also enables further and quicker diffusion to other farmers as the approach recognizes that farmers may not only be seed users, but suppliers also.

3. Strategies for decentralized seed system within CIAT/PABRA

Despite the evident lack of interest from the commercial sector, NARS have continued to develop new varieties of grain legumes to fulfill national mandates aimed primarily at utilizing improved varieties for increased production and responding to farmers variety demand. However, the researchers are often resource constrained to ensure sufficient production of parental seed materials

(pre-basic and basic seed). On the other hand, there are various NGOs and farmers/producers organizations often engaged in seed activities within a broader livelihoods program; and non-seed and non-agricultural partners, such as the nutritional clinics and HIV/AIDS programs promoting health in communities through the use of the grain legume varieties.

In addition to varieties and seed system approaches, PABRA also develops grain markets and promotes utilization of beans. CIAT/PABRA has supported seed dissemination work by facilitating training workshops aimed at mainstreaming small seed packs and building capacity in seed production, seed grading, packaging, good storage practices and marketing strategies. Farmers are also provided with handbooks for guidance in bean enterprise management. Therefore, the PABRA framework creates a platform on which all actors in the bean commodity chain get on board. From the foregoing, it is clear that in the unified seed system, partners may have different target groups for priority impact, diverse time-frames for action, and different criteria for measuring their success, but CIAT/PABRA has managed to harness the integrated efforts for the benefit of smallholder farmers. For instance, the framework produces seed under certification and quality declared (QDS) schemes and farmer-to-farmer exchanges depending on the partner approach. Seed production under CIAT/PABRA is guided by national seed policies, but the general sequence is outlined in Figure 2. It is worth noting that much of the seed produced using PABRA seed systems approach has been quality declared and through CSP programs.

4. Approaches of CSP Schemes

NARS in a number of SSA countries, with CIAT/PABRA support, have recently released numerous bean varieties (including the bio-fortified, rich in Iron and Zinc). Realizing that in most of these countries the seed sectors are dominated by private seed companies that have very little interest in legume seed, CIAT/PABRA had to adopt alternative approaches to the usually centralized and bureaucratic formal system to accelerate the dissemination of these varieties. Since the legumes are key staple crops, it has been appropriate to include CSP schemes to meet the ever-present demand of grain legume seed. Different approaches to CSP have reached a phenomenal number of smallholder farmer households. Some of the case studies taken on board are summarized below.

4.1. From seed loans under CSP to contract growing of certified seed

In Malawi, CARE International works with a number of farmer groups. In the 2007/8 season, five farmer groups on irrigation schemes in Dowa and Lilongwe Districts hosted bean demonstration plots and requested PVS trials. Nineteen bean varieties were tested and the farmers selected six that matched their preferences. The traits evaluated included (but were not limited to) yield, cooking quality (both grain and leaves), seed color, market acceptance and disease tolerance. The farmer groups received 2 kg packs of each of their selections as starter seed for the 2008 dry season. One group, Tadala, requested more seed of one sugar bean variety 'Kholopethe' and was supported by CARE to purchase 250 kg basic seed for 2008/09 summer season planting. The farmers harvested 980 kg and distributed to each member a 2 kg pack as a seed loan (revolving seed) repayable by doubling the quantity of seed. This seed was not certified, but quality was based on mutual acceptance. As the community accessed seed, requests for seed loans started to diminish, signaling a need to explore other alternatives for the group. The presence of government initiatives such as Farm Input Subsidy Programme (FISP), Presidential Initiative and Greenbelt Initiative has promoted bean seed production by a number of organizations, including CSP schemes that are affiliated to seed companies. As a result, the Tadala group moved on to production of certified seed that feeds into FISP. All three have components on legume seeds, in which each selected farmer accesses 2 kg of legume seed at a subsidized price.

4.2 Community-based organization with entrepreneurial orientation

Zaka Super Seeds is a community-owned seed production entity. The organization is headed by an apex committee made up of representatives from the wards that are participating in the project. Zaka Super Seeds was supported by the Swiss Agency for Development and Cooperation (SDC) under the Harmonized Seed Security Project (HaSSP), Seeds and Markets Project (SAMP) and Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN). The support was for rehabilitation of storage facilities, construction of a satellite seed testing laboratory. Some members of the farmers group are on an irrigation scheme; therefore, seed can be produced in the dry season as well. The Zimbabwe National Bean Research Programme of the Crop Breeding Institute (CBI) of the Department of Research & Specialist Services (DR&SS) in Zimbabwe in partnership with CIAT, availed basic seed of two bean varieties: NUA 45 and Gloria. In the 2012/13 season, Zaka Super Seeds produced 10 t of certified seed of each of the two varieties – an increase from three tons in the previous year. The organization now has a purely business focus. Apart from beans, Zaka Super Seeds also diversified into the production of seeds of cowpea, sorghum, upland rice and maize. The seed produced is marketed through contracts with agro-dealers on commission, plus the interim management committee on a voluntary basis. Furthermore, the organization also participates in and invites competition to ward-based seed fairs and district and provincial agricultural shows. The costs of seed fairs and costs of inspection and sampling are supported by NGOs.

4.3. Decentralized CSP and dissemination of bean seed in Ethiopia

Before 2004, bean seed production in Ethiopia was centralized; only a few farmer research groups (around research stations) and the Ethiopia Seed Enterprise (ESE), a government agency were disseminating improved varieties to farmers (Alemu and Spielman 2010). That approach focused only on a few already popular and old bean varieties meeting less than 1% of farmers' seed needs (Rubyogo *et al*., 2007). Farmers continued to produce old varieties such as Mexican 142 and Red Wolaita. Following collaboration with CIAT/PABRA, in 2004, the Ethiopian National Bean Research Program (ENBRP) initiated partnerships with several organizations to overcome constraints to seed access such as production, distribution of seeds, skills and knowledge of service providers to backstop the growing seed supply sector. Demonstration and identification of farmer preferred varieties followed by decentralized seed production hastened adoption as farmers were exposed to quality seeds of the varieties of their choices and appreciated their characteristics. Between 2004 and 2008, eight bean varieties were released through participatory variety selection (PVS).

The ENBRP in partnership with service providers (farmers' cooperative unions, public extension and NGOs) equally promoted complementary improved agronomic practices to optimize the use of varieties. In 2004, with financial support from the USAID, CIDA, SDC and Ethiopian government, EIAR, multiplied 140 t of Foundation seed of new varieties and old varieties, an amount that was supplied to both formal seed producers and decentralized seed producers supported by a range of service providers (NGOs, farmers' cooperative unions) under the supervision of the district agricultural officers. The seed multiplication activities under community-based schemes spread out to various zones of the country. By 2010, nine farmers' cooperatives, 10 NGOs and faith-based organizations and 19 individual farmers produced more than 92% of the Basic seed that had been supplied to farmers since 2008 (ENBRP Annual Reports (2008, 2009 and 2010)), indicative of how decentralized seed production (at community level) transformed the bean sector in Ethiopia. Grain traders were also engaged to enhance awareness on market requirements for grain; helping farmers sell all their grain and buy new seed thus creating sustainable seed demand.

Much of the bean crop was for export and necessary policy changes were effected to ensure a competitive export market, a trend that has seen bean farm gate prices more than quadruple. Overall, bean yields, area under production and correspondingly, production volume for both local and export market increased significantly. Following the success of decentralization of seed production, new farmer groups that produce bean seed have emerged across in Ethiopia. These groups have the support of EIAR and ENBRP through provision of Breeders' seed and technical advice.

4.4. PVS and CSP in Tanzania and Burundi

Since 2008, decentralized seed production was carried out with farmer groups, individual farmers and a primary school in Mbozi District, in the Southern Highlands of Tanzania. The district shares borders with Malawi and Zambia; and has a high level of bean trade. Ten farmer groups with memberships of 7–20 each and working with CARITAS were involved in the seed production and dissemination. A total of 10 varieties, including old and newly released were planted out for the purpose of introduction, participatory evaluation and generation of starter seeds. Farmers selected three varieties based on disease tolerance, maturity period, cooking time, palatability, broth thickness, seed colour, seed size, market and grain yield. The top two varieties were Njano-Uyole and Cal P213 (which was finally released in 2010 as Calima-Uyole). The PVS trials were also used as source of seeds; 0.5 kg was provided for each of the 10 varieties planted at 10 sites in Mbozi District. Furthermore, 2 kg were provided for free for top four selected varieties at each site. However, small quantities of 1–2 kg of seeds of farmer-selected varieties were sold to farmer groups and individual farmers. The farmer groups continued purchasing seed from Agricultural Research Institute (ARI), Uyole station for multiplication and sale in the district. The recognition of other seed classes outside the certification scheme in Tanzania facilitated the production and trade in QDS and farmer saved seed by these farmer groups.

Between 2008 and 2012 the following quantities of seed have been produced for different channels in strengthening informal seed systems; 252 t of basic seed by ARI Uyole and 557.32 t of QDS in Nkasi District, with an estimated 40,000 farmers having accessed the seed. Interestingly, one entrepreneurial farmer also expanded the seed production activities by contracting other five farmer groups as outgrowers, producing 5 t in addition to 12 t of bean QDS produced by the main groups in Mbodzi in 2013. The success of these farmer groups has attracted the attention of a commercial seed company with the intention to contract the farmers groups to produce QDS.

In Burundi, a total of 16 t of QDS of a highly marketable yellow bean variety and other four drought-tolerant varieties were produced in 2013 by farmer associations from Bugesera and Moso regions and individual seed producers, under the facilitation of public extensionists and NGOs such as DPAE Rutana and DPAE Kirundo, and Concern Worldwide. The seed produced by farmers' associations was sold to the association members and to other farmers, mostly in small packs; the 1 kg seed pack was the smallest and was mostly preferred by women.

5. Lessons learnt

i. Take off of CSP depends on availability of Basic or higher class seed of improved varieties from researchers and the involvement of farmers in variety identification.

ii. It will be insufficient to offer technical training to CSP schemes to enhance seed production capacities without strengthening connectivity in the supply and marketing chain, otherwise seed demand will collapse immediately. In Ethiopia, the involvement of bean grain traders and a market-led approach resulted in sustainable seed demand and transformation of the bean sector.

iii. CSP achieves faster adoption of new varieties and, if combined with value chain development, can make a quick impact on production and farmers' livelihoods.

iv. CSP thrives on partnerships, including external technical and financial support.

v. The FISP in Malawi has impressively promoted business-oriented CSP.

6. Conclusion

CSP schemes will continue to evolve and complement other seed delivery approaches as long as there are flaws in the formal seed systems. They are a key complementary component of African seed systems; their approach is defined by local socio-economic conditions. Enabling policies that

recognize seed outside the certification scheme will strengthen CSP and wider dissemination of seed. It is also clear that resource-poor farmers are ready to adopt improved varieties, if they are availed in a convenient and inclusive delivery system.

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The future of community seed production in light of modern plant breeding and global seed regulations

Guy Kastler[1], Antonio Onorati[2] and Bob Brac de la Perrière[3]
[1]Réseau Semences Paysannes (France): www.semencespaysannes.org
[2]Antonio Onorati, Centro Internazionale Crocevia (Italy): www.croceviaterra.it
[3]BEDE (France) www.bede-asso.org/lang/angl/home.php

1. Introduction

Agricultural biodiversity is a result of long history of interaction between nature and the communities that continually adapted to new challenges for survival. It is a story of co-adaptation of the human race and its food source. Over the years, peasants have contributed significantly to biodiversity through preservation and selection of plant varieties and animal breeds purely within the social, economic and cultural contexts in which they developed their production. The seeds produced on-farm and the informal exchange of those seeds was the bedrock of peasant contribution to biodiversity. Peasants had collective rights governing access to resources to re-sow, preserve, protect, exchange and sell their seeds in their farming systems. However, the advent of industrial agriculture and, of late, modern plant breeding techniques brought severe changes that have marginalized peasants' rights to seed exchanges.

First, it remains noteworthy that modern breeding used traditional seeds as a biodiversity resource base; with collection of many accessions and storing them in large seed banks as a key step. Peasants have contributed free accessions to the international public gene banks, especially for the international agricultural research centers. On one hand, public seed banks are disappearing in the developing countries (due to lack of funding and political will, when they are not being plundered in times of war) and they are now less useful compared to genetic sequence databases. On the other hand, seed banks of developed countries are increasingly becoming privatized. Once the genes have been modified or simply described, they are put under protection by IPR, which privatizes and hampers their distribution.

Second, the seed industry now has stringent standards and regulations for seed trade globally. This trend is strongly reflected in the reform of the European Union (EU) regulatory framework on seeds[14]. The EU plays a fundamental role in global governance of genetic resources in agriculture and food. For example, it uses "cooperation" agreements to influence seed legislation in developing countries and plays a major role in the International Union for the Protection of New Varieties of Plants (UPOV) and in the World International Property Organization (WIPO)[15]. Furthermore, the proposed new legal framework does not cater for traditional/local/farmers' varieties, except only as part of research or in farmers' networks controlled by gene banks. These rules are already in free trade agreements (see the agreement between Europe and Canada)[16] and might soon be applicable globally. Going forward, it will be extremely difficult for small seed companies or peasants to conform to the new rules, contributing to their exclusion from producing, exchanging or marketing their seeds.

In other words, the industrial seed system has abolished peasants' seed systems by confiscating and subsequently eradicating traditional seeds in favor of new few industrial varieties controlled by Plant Breeders' Rights (PBR).[17] This system has resulted in the emergence of a highly concentrated seed

14 "Animal and Plant Health Package: Smarter Rules for Safer Food." *Health and Consumers*. European Commission. http://ec.europa.eu/dgs/health_consumer/pressroom/animal-plant-health_en.htm

15 See documents from the WIPO-UPOV Symposium on Intellectual Property Rights in Plant Biotechnology, Geneva, 24 October 2003. www.upov.int/en/documents/Symposium2003/index.html

16 See the Trade Justice Network website: http://tradejustice.ca/en/section/24

17 Since the1991 Act of the International Union for the Protection of New Varieties of plants (UPOV), the PBR has banned or taxed seeds produced on the farms.

sector[18] and reduced diversity options for peasants and farming systems. Peasants cannot select the varieties they need from the modern seeds that have been standardized, genetically manipulated and registered by the industry. Only local, traditional varieties provide a solid selection basis, but in some countries, peasants are finding it increasingly difficult to gain access to the gene banks where local varieties are locked away. In worst scenarios, peasants are prosecuted for violating industrial intellectual property rights every time they reproduce their own varieties that have been contaminated by patented varieties (see case of native maize in Mexico[19]).

Meanwhile, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)[20] recognizes the enormous contribution of farmers, local and indigenous communities in all the regions of the world to the conservation and development of plant genetic resources. The treaty also entrusts governments with the protection of farmers' rights and includes a list of the measures that could be taken to protect and promote these rights. These include not only the rights to save, use, exchange and sell farm-saved seed and other propagating material but also to participate in decision-making regarding the use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising from their use[21].

From the foregoing it is clear that the time-honored practice of saving and selling traditional seed has now been banned in many countries due to increasingly restrictive international rules. A global strategy needs to be established to facilitate the participation of peasants in defining and implementing the international rules and legal framework governing access to genetic resources.

2. Community seed production initiatives to conserve local seeds

On all continents, men and women farmers are working to safeguard biodiversity, the key to our future. Below are some examples of efforts to maintain community seed production.

2.1 A Farmers' Seeds Initiative in Senegal

The Senegalese Association of Traditional Seed Producers (ASPSP) was set up in 2003 by nine farmers in leadership positions from different regions in Senegal. Its goal is to make its members independent and self-sufficient in their use of high quality seeds appropriate for the climate and soil type of the country's different zones. The ASPSP includes associated producers and "nodal farmers," individuals at the center of the network that promotes the exchange and enhancing of seeds. The association's exchange model is not commercial, but reflects the idea of making donations and the principle of social and human reciprocity.

Managed by farmers, ASPSP is a movement for civic research on biodiversity that proposes alternatives to genetically modified organisms (GMOs) and combats abusive use of pesticides. ASPSP's research is adaptive and decentralized, focusing on its member federations located in Senegal's main agro-ecological zones. It examines variations in growing conditions and different micro-environments (for example, pasture, rice fields, vegetable gardens, strip farming and orchards). The research is also inclusive and ASPSP promotes a loose institutional structure to encourage dialogue between formal scientific research and farmers' innovations.

To achieve this, ASPSP draws on culture and local knowledge. It considers traditional seeds to be part of a cultural heritage transferable from one generation to the next. The association's goal is to strengthen the locally existing cooperation between informal seed and variety exchange systems, towards creating a social, semi-formal seed network among its membership. The idea is to make

18 Only 4-5 seed companies share the global market including Monsanto with 27% of world sales in 2009, DuPont (Pioneer): 17%, Sygenta: 9% and Limagrain (Vilmorin): 5%; "Who Will Control the Green Economy?" *ETC Group*, 1 Nov. 2011. www.etcgroup.org/content/who-will-control-green-economy-0

19 L. Ceballos and B. Eddé, *Contamination of Mexican Maize: The Scientific Controversy* – File Inf'GMO n° 43 – BEDE Montpellier, November 2003. www.infogm.org/spip.php?article1306

20 The International Treaty on Plant Genetic Resources for Food and Agriculture was adopted by the 31st meeting of the Food and Agriculture Organization of the United Nations (FAO) on 3 November 2001. ftp://ftp.fao.org/docrep/fao/011/i0510e/i0510e.pdf

21 *Ibid.*, Preamble and Article 9.

ASPSP's members independent and self-sufficient in seeds so they can play a leading role in seed production by owning a sufficient quantity of high quality seeds.

Training and skill enhancement is provided to ensure better use of traditional seeds and greater awareness focusing essentially on quality, monitoring, storage, seed management and promoting *in situ* preservation.

2.2 Périgord's Farmers' Seed House for Organic Farming in France

AgroBio Périgord is a not-for-profit organization that has been working towards the development of organic farming in the Dordogne, in southwestern France since 1990. It is administered by a board of directors comprising organic farmers of the Department. The organization supports producers in implementing environmentally friendly agricultural practices.

AgroBio Périgord is federated with the regional structure Bio d'Aquitaine, which is affiliated to the National Federation of Organic Agriculture (NFOA).

The first experiments conducted by AgroBio Périgord in 2001 concerned the evaluation of 11 varieties of Guatemalan open pollinated maize. Subsequently, the project was oriented, toward the collection of rare varieties that had been preserved for personal use by peasants. In addition, the French Institute for Agricultural Research (NIAR/INRA) provided some additional (maize) varieties that had been conserved in gene banks.

Gradually, the project included more and more varieties/populations of maize. Then, according to the producers' demands, the diversification of species focused on other crops: sunflower, soybean, forage, etc.

Meanwhile, a collection of skills was acquired through experience exchange during travels in farming communities, particularly in Brazil, and through meetings with plant breeding professionals. The re-appropriation of farmers' knowledge and skills in the field of seed selection and self-production became a main focus of the program.

During an exchange trip to Brazil in 2003, the coordinators of the "Aquitaine cultivates biodiversity" program set up the idea for a Farmers' Seeds House. Local groups of traditional seeds storage and exchange that focused on participatory plant breeding were established. These communities were often supported by a technician of an institutional agricultural structure or a cooperative.

Gradually, the project reached a regional level and in 2003 became the program «Aquitaine cultivates biodiversity», supported by regional authorities. The program now has about 90 open pollinated varieties of maize, 10 of sunflower, as well as varieties of sorghum, soybeans, moha, lupine, etc. In 2009, these varieties were tested and grown on 31 ha and by more than 200 organic and conventional farmers throughout France.

The Farmers' Seeds House objectives are to maintain and develop crop biodiversity through the dissemination and exchange of both seeds and know-how. It consists of a 'Field crops' section for farmers and a 'Market gardening' section for professionals and individuals. It has two main tasks: a) the provision of seed lots and b) the sharing of know-how.

The Farmers' Seeds House fosters experimentation conventions by providing seed lots to farmers and private partners, so as to enable these varieties to be grown in fields and be the objects of in situ experiments. In light of the fact that seed distribution is allowed in "*experimental settings",* the activities of the Farmers' Seeds House are consequently legal. The varieties made available to professional farmers are selected on the basis of the production system, the farmers' objectives, and the territory on which the operation will be conducted. To date, most farmers are still evaluating the varieties and recovering technical procedures related to seeds selection and self-production.

The Farmers' Seeds House has also developed a dialogue with public research professionals and technical specialists both in France and abroad. This connects field practice and scientific knowledge.

Farmers' Seeds House is engaged in a process of dynamic management of crop biodiversity through its activities in conservation and in-situ evolutionary selection of populations. In addition, this organizational concept has the advantage of allowing the distribution and the recovery of these seeds, while not opposing binding legislation.

2.3 Outer Hebrides - Scotland - Promoting Development and Commercialization of all varieties, primarily farmers' varieties/landraces and under-utilized species. Mixture approach

The case of *Avena strigosa* and *Secale cereale* as Mixed Corn in High Nature Value Crofting Agriculture on the Outer Hebrides - Scotland

A special characteristic of Hebridean landrace cereal cultivation is the species mixtures, a cultural practice known since medieval times. The majority of townships in Hebridean Scotland still produce their own seed through crofters. Species mixtures give genetic diversity and form a buffer against very risky, unpredictable environments. The strategy of yield stability through mixtures is considered a defining element of landraces and can be seen as an important part of the sustainability strategy by crofters. The vast majority of crofters use local seed ostensibly for their reliability to produce yield even under poor weather and poor soil nutrition. Rye and bere[22] are mixed in to bulk up and the rye as guarantee for yields in dry years. Seed sourcing occurs through an informal network of seed growers across the islands. Crofters who provide seed to others thus perform a community service.

An estimated 10% of the cropped land is reserved for seed production. Seed production is very much dependent on the combination of availability of machinery (combines or reaper-binders), favorable weather, and availability of labor.

Local seed production of landraces has seen bottlenecks in recent years due to seed losses through storms and heavy rain. Furthermore, there has been a decrease in the number of seed growers in recent years, due to a combination of ageing crofters, and a lack of machinery and labor at harvest time.

By studying local adaptation and genetic diversity of Scottish *A. strigosa* local varieties, the Scottish genepool was documented. The trial contained an element of variety testing, including new oat varieties. The trial aimed at enlarging the options for crofters and increasing their genetic diversity portfolio, in line with ITPGRFA article 6d: *"...broadening the genetic base of crops and increasing the range of diversity available to farmer*s". Although not explicitly designed to be participatory, crofters visited the open days and gave their evaluation. Some of them have started experimenting with the new varieties.

2.4 The *Semences Paysannes* Network[23]

The "*Semences Paysannes"* Network (*Réseau Semences Paysannes)* is composed of more than a hundred organizations, all involved in initiatives intended to promote and protect crop biodiversity and its associated expertise in France. As well as coordinating and consolidating local initiatives, the *Semences Paysannes* Network promotes collective protection and management methods of farmers' seeds. It also contributes to the scientific and legal recognition of peasants' practices, including producing, exchanging and commercializing seeds and plants.

Recently in France, various peasants' initiatives have been seeking to redevelop local varieties, and sometimes to adapt new species to local conditions as well as reclaiming farmers' independence in seed production, use and preservation. The "*Maison de Semences Paysannes"* [24] (Farmers Seeds House) are new forms of collective management of crop diversity coordinated at France national level by Reseau Semences Paysannes. By exchanging seeds and know-how, these houses can provide the ground work (answering technical and social queries, etc.), which is necessary to promote autonomous seeds systems within a regulatory framework that leans more towards banning them.

22 *Bere* is a six-row barley

23 For more information consult: www.semencespaysannes.org

24 Ref to 2.2

Box 1.

The **European Commission** is drafting a proposal for a reform of the regulations on the marketing of seeds, plant health and inspections, which has been submitted to a vote in the European Parliament in 2013. Small farmers' representatives and civil society are taking action. In particular, Via Campesina's Europe Coordination is analyzing the most recent proposal, which is still under discussion. "*Its objective is clearly to control all exchanges of seeds between farmers and gardeners and to lock them into the narrowest niche possible. We cannot support this, nor call for a widening of this niche since this would be abolished at the first opportunity.*"

"*... Peasants' seed autonomy and the food sovereignty and self-sufficiency of our communities are inalienable rights and not commercial niches. Exchanges between farmers are not part of a market place and should not be subject to trade inspections. The problem is the expansion of trade in patented and genetically manipulated seeds, not whether varieties are old or new. Rather than limiting the quantity on the market or the size of the traders marketing them the solution lies in giving farmers the right to freely exchange their seeds and in encouraging wide-spread trade in seeds, free from both IPR and genetic tampering.*"[29]

[29] Translated from : Guy Kastler, Réforme européenne sur la commercialisation des semences : où en est-on ?, 12 février 2013. www.semencespaysannes.org/bdf/bip/fiche-bip-191.html. See also "The European Commission Organizes the Pollution of Our Fields by Industrial Patented Seeds." European Coordination Via Campesina (ECVC), Press Release, 7 May 2013 and Appendix 1 (technical) : First synthetic analysis of the proposed regulation on seeds of the European Commission (available on the same page). http://viacampesina.org/en/index.php/main-issues-mainmenu-27/biodiversity-and-genetic-resources-mainmenu-37/1408-the-european-commission-organizes-the-pollution-of-our-fields-by-industrial-patented-seeds

Box 2. The Law on the Protection of Biodiversity in the Region of Latium (Italy)[30]

This text, proposed first by CROCEVIA on 1996, has been in force since 2000 and is also accepted as a reference by the European Union. The text distinguishes between tangible goods (the plant) and intangible information – all genetic, cultural and social information associated with each seed. It confirms the existence of private property rights over the tangible aspects of plant and animal varieties by including them on a list managed by the regional authorities, but recalls that the heritage of these genetic resources belongs to local communities. Thus, the physical part of the plant belongs to its owner, but the genetic information that gives it its characteristics belongs collectively to all peasants.[31] The law therefore creates a completely different way of gaining access to genetic resources, unlike the privatization of resources through intellectual property rights. Recognizing a collective right implies that access to information can be negotiated by society with the owners of such collective rights. Seeds are not free for all and do not belong to humanity, but to a local community: the farmers of the Latium region. So if other farmers, or any other person/company, want access to this material they must negotiate directly with those farmers.

[30] Regional Law n°15 of 1st March 2000. See in Italian: www.arsial.it/portalearsial/default.htm
[31] Regional Law n°15 of 1st March 2000. See in Italian: www.arsial.it/portalearsial/default.htm

2.5 The European Case for Farmers' Seeds

Following a long seven-year process starting in 2005, inspired by annual gatherings of the European movement on agricultural biodiversity, a European Coordination Network for farmers' seeds was

officially created in 2012: *European Coordination: Let's Liberate Diversity (*EC-LLD)[25]. Its members are organizations from different countries and cultures, farmers' trade unions, small seed businesses, associations and networks supporting traditional seeds and agricultural biodiversity. The founding organizations are the *Scottish Crofting Federation* (Scotland), *Pro Specie Rara* (Switzerland), *Réseau Semences Paysannes* (France) and *Red de Semillas "Resembrando e Intercambiando"* (Spain). Membership is open to any organization that shares its values and objectives of the Coordination. Crocevia and Italian Peasant Seeds network "Rete Semi Rurali" are also members.

EC-LLD's objective is to coordinate the positions and actions of national networks and other members to regularize biodiversity on farms and in gardens. In order to achieve this, the coordination network pursues dissemination of information, knowledge and expertise associated with farmers' seeds, their use and promotion, the collection, training and inventory, experimenting, researching and advocating for a legislative framework favorable to farmers' rights as well as gardeners' and small seed companies' rights over biodiversity.

The EC-LLD is a new tool of the European social movement, providing a platform for both the exchange of ideas and for developing the arguments that will enable different stakeholders to meet and share their points of view in front of EU. This pooling of resources is crucial at a moment when European laws on seeds and intellectual property rights are strengthening industrial control of the food chain. Civil society needs to increase its internal consultation in order to effectively coordinate their future actions.

3. Community Seed Production (CSP) and farmers' rights: A conclusion

The spread of the patented market, where seeds are monopolized by PBRs and/or genetically manipulated, is a danger to biodiversity and will not resolve current crises. The only solution is for the legal system of each country to acknowledge and effectively defend farmers' rights[26].

If seeds are to remain a pillar of food security and sovereignty, the following urgent issues must be addressed:

1. the protection of seeds as part of defense of collective rights, by recognizing the collective rights of peasants to develop (in an inclusive manner involving public research or/and amongst farmers), use, commercialise and freely exchange between them their seeds.
2. the generalized marketing of seeds without intellectual property rights and free of any genetic tampering, adapted for independent traditional organic farming for small-scale transformation methods and local[27] food systems.
3. the rebuilding of a multitude of territorial seed systems, managed locally by peasants and communities.
4. the involvement of peasants' organizations in defining the rules and laws governing access and control of genetic resources and their implementation, given their unique expertise in the area.
5. citizens' monitoring of discussions on public policy regarding agricultural biodiversity and resistance against any steps by industry to monopolize seeds.

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25 For more information consult: www.liberatediversity.org

26 The Human Rights Council of the United Nations is working on a Declaration on the rights of farmers and other persons living in rural zones. This process is based on the Declaration of Farmers' Rights -Women and Men adopted in 2009 by La Via Campesina. The Declaration is available at this address: http://viacampesina.net/downloads/PDF/EN-3.pdf

27 *"... 'Local' can **mean** different things in different contexts. Sometimes it refers to the range of daily activity, at others to the national economy as contrasted with the international; often it means the regional economy including urban-rural linkages. **'Local' is not simply a geographical concept**, but one that combines geographic, economic, social and cultural dimensions in **a complex matrix**…." (cfr: "* Family farmers for sustainable food systems: A synthesis of reports by three African farmers' regional networks on models of food production, consumption and markets." - EUROPAFRICA , 2013 *)*

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About ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

The **International Crops Research Institute for the Semi-Arid Tropics** (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, of whom 644 million are the poorest of the poor. ICRISAT innovations help the dryland poor move from poverty to prosperity by harnessing markets while managing risks – a strategy called Inclusive Market-Oriented Development (IMOD).

ICRISAT is headquartered in Patancheru, Telangana, India, with two regional hubs and six country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

About ICRISAT: **www.icrisat.org**

ICRISAT-India (Headquarters)
Patancheru 502 324
Telangana, India
Tel +91 40 30713071
Fax +91 40 30713074
icrisat@cgiar.org

ICRISAT-Liaison Office
CG Centers Block, NASC Complex,
Dev Prakash Shastri Marg, New Delhi 110 012, India
Tel +91 11 32472306 to 08
Fax +91 11 25841294

ICRISAT-Ethiopia
C/o ILRI Campus, PO Box 5689
Addis Ababa, Ethiopia
Tel: +251-11 617 2541
Fax: +251-11 646 1252/646 4645
icrisat-addis@cgiar.org

ICRISAT-Kenya (Regional hub ESA)
PO Box 39063, Nairobi, Kenya
Tel +254 20 7224550, Fax +254 20 7224001
icrisat-nairobi@cgiar.org

ICRISAT-Malawi
Chitedze Agricultural Research Station
PO Box 1096, Lilongwe, Malawi
Tel +265 1 707297, 071, 067, 057, Fax +265 1 707298
icrisat-malawi@cgiar.org

ICRISAT-Mali (Regional hub WCA)
BP 320, Bamako, Mali
Tel +223 20 709200, Fax +223 20 709201
icrisat-w-mali@cgiar.org

ICRISAT-Mozambique
C/o IIAM, Av. das FPLM No 2698
Caixa Postal 1906, Maputo, Mozambique
Tel +258 21 461657, Fax +258 21 461581
icrisatmoz@panintra.com

ICRISAT-Niger
BP 12404, Niamey, Niger (Via Paris)
Tel +227 20722529, 20722725
Fax +227 20734329
icrisatsc@cgiar.org

ICRISAT- Nigeria
PMB 3491
Sabo Bakin Zuwo Road, Tarauni, Kano, Nigeria
Tel: +234 7034889836; +234 8054320384,
+234 8033556795
icrisat-kano@cgiar.org

ICRISAT-Zimbabwe
Matopos Research Station
PO Box 776, Bulawayo, Zimbabwe
Tel +263 383 311 to 15, Fax +263 383 307
icrisatzw@cgiar.org

ICRISAT's scientific information: **http://EXPLOREit.icrisat.org**

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