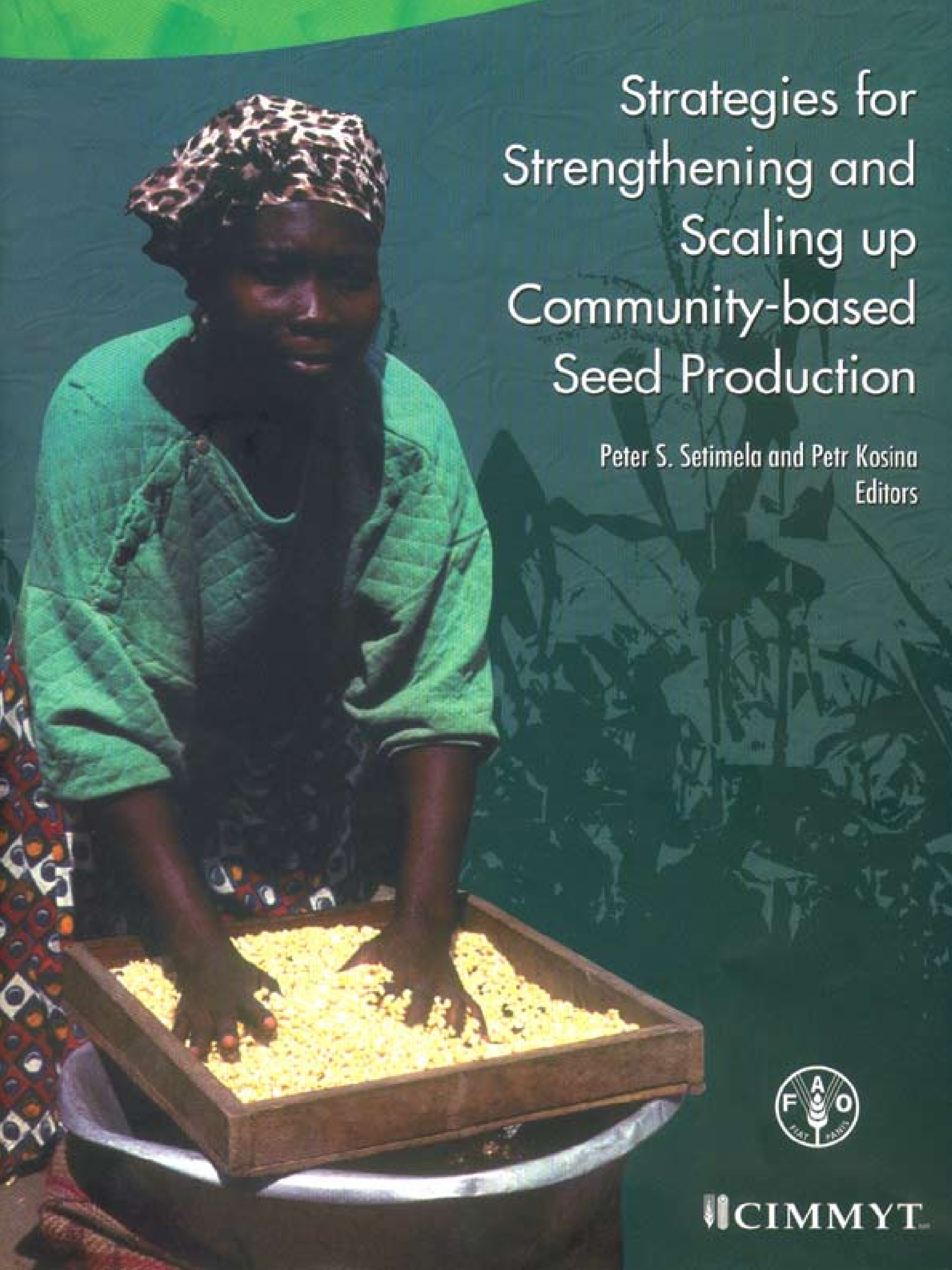

Strategies for Strengthening and Scaling up Community-based Seed Production

Peter S. Setimela and Petr Kosina
Editors

CIMMYT

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CIMMYT® (www.cimmyt.org) is an international, not-for-profit organization that conducts research and training related to maize and wheat throughout the developing world. Drawing on strong science and effective partnerships, CIMMYT works to create, share, and use knowledge and technology to increase food security, improve the productivity and profitability of farming systems, and sustain natural resources. CIMMYT is one of 15 Future Harvest Centers of the Consultative Group on International Agricultural Research (CGIAR) (www.cgiar.org). Financial support for CIMMYT's work comes from the members of the CGIAR, national governments, foundations, development banks, and other public and private agencies.

Correct citation: Setimela, P.S., and P. Kosina. (eds). 2006. *Strategies for Strengthening andScaling up Community-based Seed Production*. Mexico, D.F.: CIMMYT.

ISBN: 970-648-143-5

AGROVOC descriptors: Maize; Agricultural economics; Seed production; Plant breeding; Pollination; Hybrids; Planting date; Models; Small farms; Training programmes; International cooperation; South Africa

Additional Keywords: CIMMYT; FAO

AGRIS category codes: E16 Production Economics

F03 Seed Production

Dewey decimal classification: 338.1768

Design and Layout: Marcelo Ortiz S.

Printed in Mexico.

Contents

Acknowledgements

CIMMYT would like to thank the following organizations for their support and contributions:

- Department of Agricultural Research and Extension (AREX) within the Ministry of Lands, Agriculture, and Rural Resettlement in Zimbabwe
- Non-governmental organizations (NGOs) involved in Agriculture in Zimbabwe
- Department of International Development (DFID)-Zimbabwe and FAO for financial support.

Foreword

Maize is the primary source of calories in the diet of many resource-poor farm families in the Southern African Development Community (SADC). International agricultural research centers, in collaboration with national agricultural research systems, continue to develop and disseminate technologies for adoption by smallholder farmers. These technologies are aimed at addressing the multiple constraints that smallholder farmers face. One of these new technologies is stress tolerant, more nutritious open-pollinated maize varieties (OPVs) and hybrids.

Although many of these new varieties have been released by the national systems, smallholder farmers continue to encounter difficulties in accessing maize seed. To overcome this problem some non-governmental organizations (NGOs) have initiated community-based seed production schemes to assist farmers with selecting, multiplying and saving seed of the improved OPVs to meet their own needs, and sometimes those of neighbouring communities.

Community-based seed production schemes are most commonly initiated where the formal seed system is unreliable and the seed supply infrastructure is poor. However, NGOs and extension workers training farmers on seed production require sound knowledge of the differences between maize OPVs and hybrids, variety characteristics, strategies for community based seed production, and scaling up methodologies. It is to fill this need that this publication was compiled.

CIMMYT hopes that this publication will become a useful resource for development workers involved in community-based seed production schemes and related facets of smallholder agriculture in the region.

Marianne Bänziger
Director, CIMMYT Global Maize Program

CHAPTER 1

Maize Hybrids and Open-Pollinated Varieties: Seed Production Strategies

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Introduction

Maize varieties may be either hybrid or open-pollinated. **Hybrid** varieties are made by crossing selected **parents** (sometimes known as **inbred lines**) in the field, while **open-pollinated varietie**s (OPVs) are broad populations of many parents. Open-pollinated varieties show greater variability than hybrids, but have the advantage that unlike hybrids, their seed may be saved for re-planting without much yield loss. These differences are explained in greater detail below.

Maize hybrids

Hybrid plants are produced by cross-pollinating two unrelated male and female parents. Crosses made between two unrelated **inbred parents** are known as **single-cross hybrids** (Figure 1). Those from three parents are **three-way hybrids** (Figure 2), and those from four parents as **double-cross hybrids** (Figure 3). The female of a three-way hybrid is a single cross hybrid, while the male is an inbred line. The parents of a double cross hybrid are both single-cross hybrids. Another type of hybrid is the **top-cross**, in which one of the parents is an OPV, and the other is a single-cross or an inbred line.

Plant breeders carefully select the parents of hybrids over many years of testing and evaluation. Hybrid parents are chosen based on characteristics such as early maturity, disease resistance, drought tolerance and yield potential. The resultant hybrids are evaluated for yield potential and field characteristics appropriate to farmers. Only the best hybrids are advanced to commercial seed production and sale. In order to ensure consistent uniformity and performance of the hybrid, the parents are maintained in a very controlled manner, and the production of hybrid seed is done following strict procedures.

Hybrid seed production

Hybrid seed is produced in a controlled fashion far from other maize fields, in order to avoid contamination. Male and female parents are inter-planted in alternating rows (Figure 4), usually composed of 3 to 6 female rows and 1 or 2 male rows. The female plants are **de-tasselled** (i.e. their male inflorescence is removed) before a single tassel starts to shed pollen, and pollination of the female is achieved with pollen from the male plants.

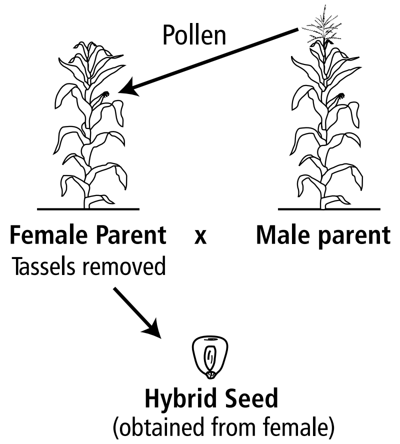

Figure 1. The formation of a single-cross hybrid involves crossing a male parent with a de-tasseled female parent.

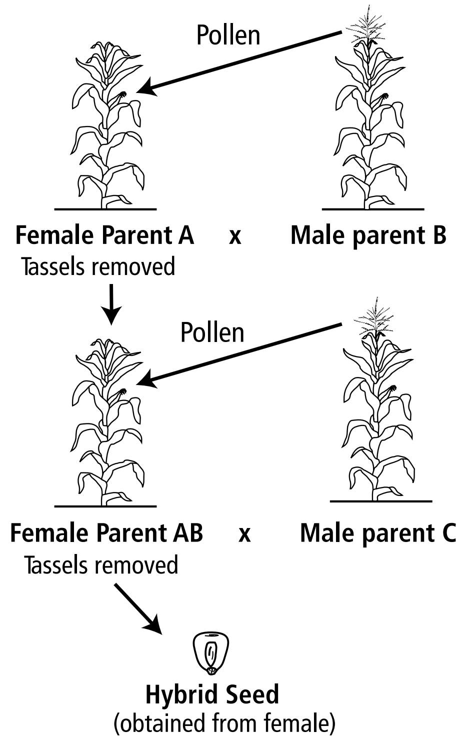

Figure 2.The formation three-way cross hybrids involves crossing a single-cross hybrid (de-tasseled female parent) with a different inbred male parent.

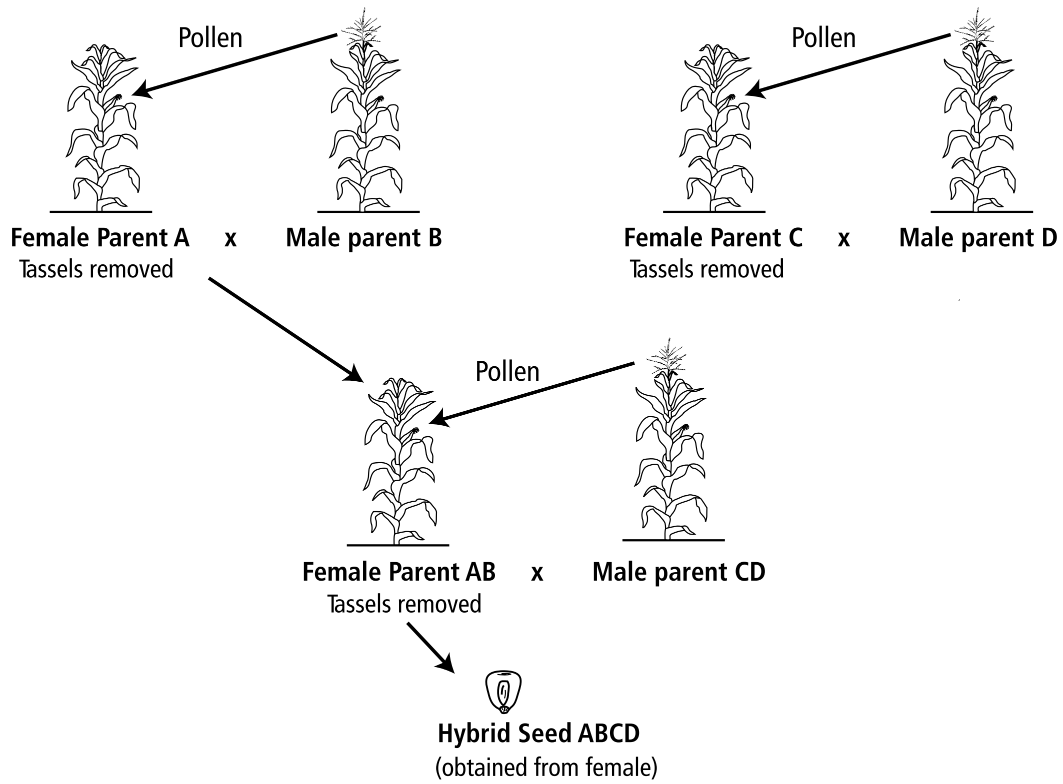

Figure 3. The formation of a double-cross hybrid involves crossing two single-cross hybrids.

Field inspection is done regularly to ensure that emerging tassels on the females are all removed, and that there is no contamination by pollen from the female rows or surrounding fields (see **isolation distance** below). To avoid seed mixing during harvesting the male parent rows are cut down once they have provided pollen to the female parents.

A key factor in both yield and quality of hybrid seed production is the coincidence of flowering of the male and female parent plants, known as **nicking**. If male pollen flow begins after the emergence of the female silks or ends before the female silks are fully emerged, not only will less seed be set, but the risk of contamination by foreign pollen increases.

In most countries the **isolation distance** for hybrid seed production is about 400 meters. This is the distance that has to be maintained all around the hybrid seed production unit. Four hundred meters is greater than the normal dispersal range of maize pollen, so the isolation ensures that pollen from neighbouring fields does not reach the hybrid seed production site.

Both parents of single-cross hybrids (inbred lines) have low vigor and low seed yield, and therefore need excellent crop management for good seed production. Three-way and double-cross hybrids have as one of their parents, a single-cross hybrid, which is vigorous and high yielding, but they, too, require good crop management.

Figure 4. Hybrid seed production field showing alternating two male rows with tassels and six female rows without tassels.

Characteristics of hybrid plants

Hybrid plants are uniform in colour, maturity, plant height and other plant characteristics (Figure 5). The uniformity of hybrid plants enables farmers to carry out certain operations, such as harvest, at the same time, which is useful for those farmers using combine harvesters. Hybrids are usually higher-yielding than OPVs, but they generally require much higher standards of field management than OPVs to achieve their yield potential. The higher yield of hybrids is the result of a biological effect known as **heterosis,** which describes the superiority of the first generation over the parents.

However, hybrid plants will not reproduce uniform plants similar to themselves if the hybrid grain is recycled as seed in the following season. Furthermore, the yield following recycling will decrease by 30–50%, depending on the type of hybrid originally grown, due to an effect known as **segregation**.

Single-cross hybrids suffer much greater yield reductions from recycling, than do three-way or double-cross hybrids. For best results, therefore, fresh hybrid seed should be purchased every year.

Figure 5. Hybrid plants, especially single-cross hybrids, are uniform in plant height and plant characteristics.

Advantages and disadvantages of growing hybrids

Hybrids are higher-yielding than open-pollinated varieties (OPVs). Research has shown that the yield advantage of hybrids over OPVs is about 15%, depending on the varieties being compared. Some improved OPVs may yield as well as some poorly adapted hybrids. Therefore, farmers in high potential environments who can afford inputs such as fertilizer, stand to benefit the most from growing adapted and suitable hybrids (Table 1.1, Figure 6).

Table 1.1. Farmers' checklist on when to grow a hybrid or OPV.

When to grow a hybrid	When to grow an OPV
• The farmer expects to harvest more than 2 tons/ha (15 bags per acre) of maize grain.	• The farmer does not expect to harvest more than 2 t/ha of maize grain.
• The costs of hybrid seed will be recovered from its yield advantage. Hybrid seed costs about 10 times the price of grain, and therefore the yield advantage of the hybrid should be at least 250 kg/ha.	• The costs of hybrid seed may not be paid for by its yield advantage over the OPV.
• The farmer is located in a high potential environment and can afford inputs such as fertilizer and pesticides.	• The farmer is located in a low potential environment and cannot afford extra inputs.
• Hybrids adapted/suitable for local conditions are available.	• No locally adapted/suitable hybrids are available.
• The farmer can obtain seed for timely planting.	• The farmer cannot readily obtain seed.

Open-pollinated varieties (OPVs)

Open pollinated varieties are known sources of open pollinated plants. Some have been improved and have variety names. **The grain of an OPV may be saved for replanting if it is isolated from other maize varieties, or harvested from the middle of the field.** The recycled seed will grow and yield as well as the original plants. Compared to hybrids, OPVs are less uniform (Figure 7) and usually lower-yielding than hybrids in optimal environments. OPVs, however, have the advantage of being more stable than hybrids in low-yielding or stress environments.

Stages of seed production

For both hybrid and OPV seed production there is a three-stage process of seed multiplication, as follows (see also Figure 8).

The first stage, the production of **breeder's (or pre-basic) seed,** is carried out by the breeder. This stage produces the least amount of seed, with the highest level of varietal purity. Breeder's seed is produced in small plots where a breeder can monitor the plants to ensure that there is no pollen contamination, and that the plants are **'true to type'**. The breeder or the developer of the variety is responsible for maintaining breeder's seed, i.e. ensuring that its genetic purity is maintained.

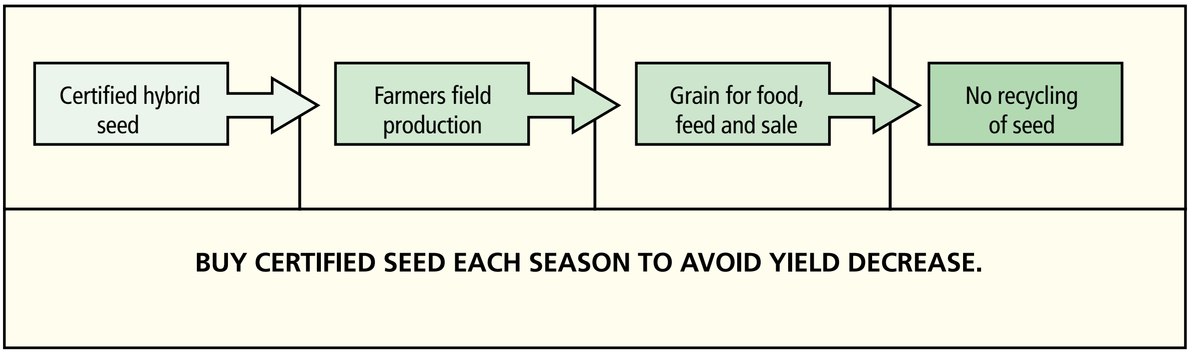

Figure 6. How to grow hybrids.

Figure 7. Maize OPVs usually exhibit plant variability.

Foundation or basic seed is the first increase of the breeder's seed. The seed is produced in isolation and with great care to ensure the variety remains true to type. The foundation seed is produced by breeders or by seed companies. The seed companies will sell foundation seed or give it to selected farmers to produce certified seed under contract.

Certified seed is the last stage in seed multiplication. Seed companies contract farmers to produce certified seed. The seed is produced from foundation seed and grown in isolation and under controlled standards to ensure purity and identity. This seed is processed and packaged for sale to farmers to produce grain.

The quantity of seed produced increases from one stage to the next. Only small quantities of breeder's seed are produced, while large volumes of certified seed have to be produced to meet the demand for the grain production (Figure 8).

Standards for certified seed

Before seed is certified, the authorizing agency must check that the seed meets all the set quality and purity standards. The agency also provides labels and makes spot checks at points of sale. Physical seed quality tests include laboratory testing for moisture content, seed purity, germination, viability, and absence of pests and diseases. This ensures that the seed is viable and healthy. Seed certification for maize is mandatory in most countries. Some countries may allow OPV seed to be sold as **'truthfully labelled'** or standard seed. Truthfully labelled seed meets minimum standards for purity, and its producer guarantees the quality as described on the label.

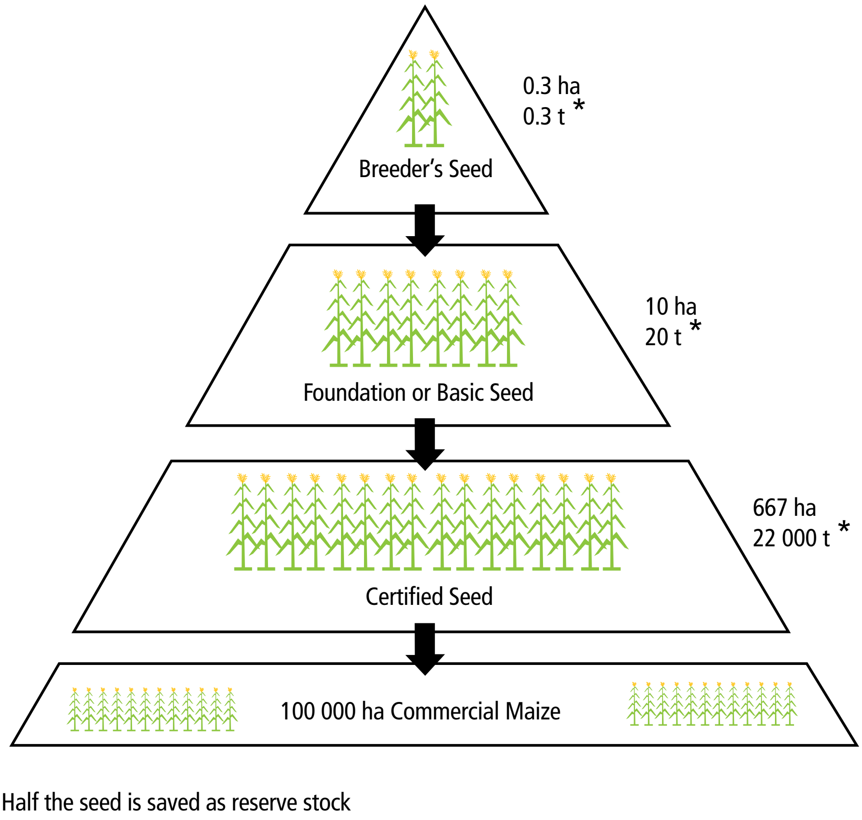

Figure 8. Stages of seed production.

In order to protect farmers from poor quality seed, the government seed certification agency verifies the source of the seed, through field inspections (of foundation and certified seed production fields) at specified stages of the growing season and after harvest. Field inspectors check that the seed is planted according to the quality standards required, isolation distances are met, the fields are free of weeds, and all the **'off type'** plants are removed from the field. If the field inspector finds that some of the requirements are not met, he/she may recommend that the crop is destroyed, or that the harvest is used only as grain, or that certain field operations are carried out immediately (rules vary from country to country).

OPV seed production

Farmers who are far from seed retails shops can benefit from growing maize OPVs, as the grain they harvest may be replanted as seed without significant yield loss. ***OPV seed may be recycled for a maximum of three seasons without significant yield loss.*** The longer a farmer recycles OPV seed, the greater the risk of contamination by pollen from neighbouring fields, and deterioration of the variety.

Seed production of OPVs is simpler than that of hybrids, because only one variety is planted and there is no need for detasseling. **Nevertheless, maintenance of the OPV and production of the foundation seed of OPVs requires some special procedures, similar to hybrid seed production.**

The OPV seed production fields may be **isolated in space or time,** or both. The isolation distance for OPV seed production is normally 250–350 m. Isolation by time requires a planting interval (difference in sowing time) of 4 to 6 weeks to ensure that there is no pollen contamination of seed plots by other maize fields. The number of days to **tasseling** and **silking** of the seed field and neighbouring fields helps to determine the proper time isolation (Figure 9).

If farmers cannot isolate by time or distance they may harvest from the middle of their fields to minimize contamination, and the field should be at least about one hectare.

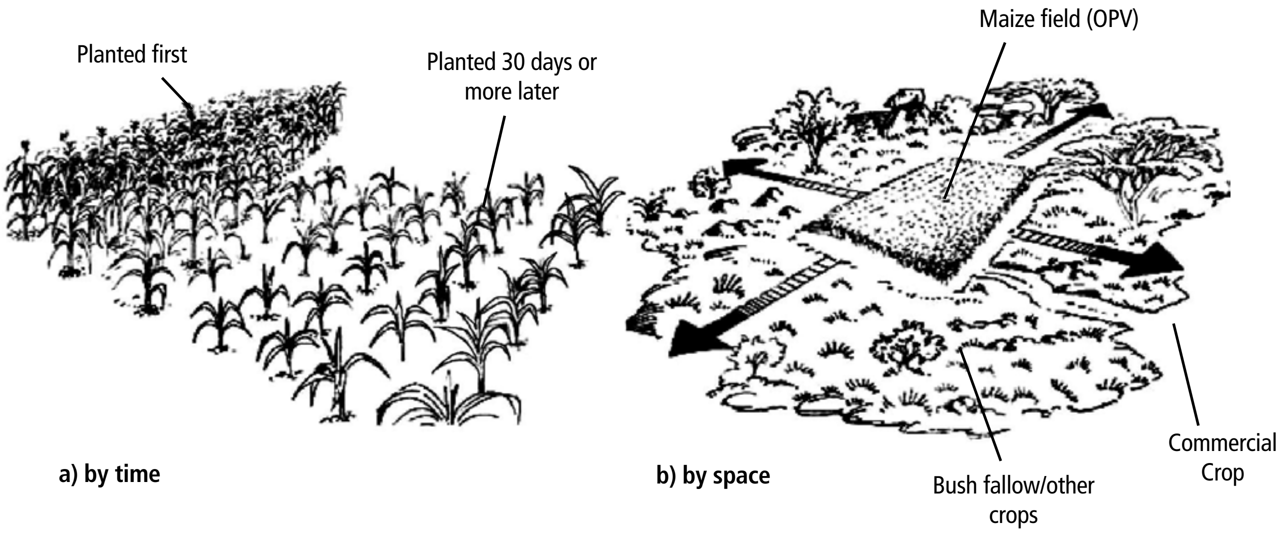

Figure 9. Isolation by time and space of an OPV maize seed field.

How to harvest, dry, shell, and store seed

At least 500 cobs should be harvested to ensure that the OPV maintains its own distinct variability. It is recommended that farmers harvest their ears at a grain moisture content of about 16–20 % (i.e. once the husks are dry) and sun-dry to about 14 % moisture content before shelling. The cobs are husked, selected for uniformity and quality (i.e. pest- and disease-free, not discoloured) and spread out in the sun for drying. In most areas, farmers may sun-dry their seed to the desired moisture content. When sun-drying, ensure that the seeds are turned frequently to prevent "sun-burn" damage to the embryo. Most farmers sun-dry their maize seed on a concrete slab, but if this is not available, the seed may be spread out on black plastic sheeting.

Shelling may begin once the grain has reached a moisture content of 14%. Farmers can apply a simple test to check whether the seed has reached 14% moisture content: Shell a cob and mix about 100 kernels with one gram of salt; if the salt feels moist after 5 minutes then the cobs need to be dried further, but if salt remains dry then the shelling can begin.

Shelling by hand minimizes seed damage, but if a mechanical sheller is used, lower the settings (speed and severity of threshing action). The shelled seed may then be cleaned (winnowed), and any chipped or diseased seeds removed by hand.

The seed is then treated with insecticides and fungicides against storage pests and fungi. When treating with pesticides, observe safety recommendations, and ensure that the seed is uniformly treated. Treated seed must never be used as food for animals or humans. The seed is then stored in bags or in bulk a cool, dry place, away from direct sunlight. Ideally, seed should be stored at 12% moisture; low seed moisture increases the viability and storability of the seed.

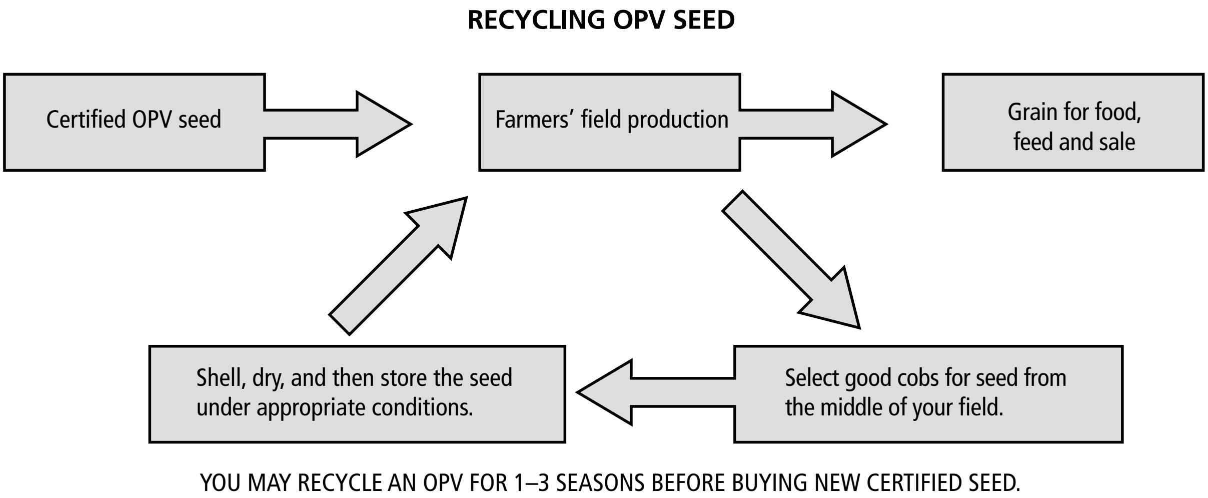

Figure 10. How to grow OPVs and retain your own seed.

CHAPTER 2

Analysis of Community-Based Maize Seed Production and Supply Schemes in sub-Saharan Africa

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Introduction

Farmer recognize seed as one of the most important inputs in agricultural production. Seed carrying traits such as earliness, disease resistance and increased yield potential can improve productivity as well as the value of the commodity on the market.

Regardless of the crop, most of the seed in sub-Saharan African comes from the informal seed sector, namely farmers' own saved seeds, farmer-to-farmer seed exchange, and local seed markets. This sector supplies mainly local landraces, local and improved varieties, and recycled hybrids. The seed markets in the informal sector are unstructured and usually lack marketing strategies. The seed quality is assured primarily through existing trust between seed buyers and sellers. Sometimes the seed provided through these channels may be of poor quality (low genetic purity, contaminated with pests and diseases, or poor germination).

To improve seed availability and quality, government institutions and non-governmental organizations (NGOs) and have initiated **community-based seed production and supply schemes** (CBSPS) with the aim of improving the availability of quality seeds of improved varieties. The CBSPS are informal in the sense that seed quality standards required in seed production are not as stringently enforced as in the formal seed sector. Many CBSPS have been effective in disseminating improved varieties; others have been unsustainable, and this is attributed to various factors, including the following:

- Farmers and NGOs staff have inadequate knowledge and skills in seed production, quality-enhancing measures and seed systems.
- Advice on seed issues and extension, mainly provided by government seed service units, does not reach small-scale farmers due to poor rural infrastructure, and sometimes, too few extension workers.
- Some plant breeders and researchers do not make an effort to promote their varieties, so they remain unknown to farming communities.
- The seed demand within the community is difficult to estimate.The formal seed sector is unreliable for crops that it considers unprofitable such as mungbeans; cowpea; minor millets; and even maize OPVs, on which private seed companies do not hold exclusive marketing rights.

- Issues pertaining to sustainability are not well thought through in the establishment of CBSPS.
- Poor linkages of CBSPS to agricultural research, seed market information, seed companies, and extension have resulted in limited supply of foundation seed.
- Many of the new improved varieties do not meet farmers' needs, and so farmers do not adopt them.
- Seed policy pertaining to community-based seed production is not well understood, or it does not exist.
- Due to the small land holdings, isolation distance requirements for quality seed production are problematic, if not impossible to achieve in some community areas.

Strengthening the capacities of partner organizations involved and interested in CBSPS is key to empowering farmers in availing and accessing quality seed of improved varieties.

Most of the seed policies in sub-Saharan Africa are aimed at the formal seed sector, and the informal sector, including CBSPS, has been long neglected. It is only recently that the importance of the informal seed sector, which provides more than 85 % of the seed requirements of resource-poor farmers in sub-Saharan Africa, is being appreciated (Monyo et al., 2004, Figure 11). It is therefore necessary that CBSPS are strengthened, as a means of empowering farming communities, increasing their productivity and ultimately their incomes and food security.

Purpose of community-based seed production and supply schemes

Setting up a CBSPS starts with understanding farmers' existing seed systems, including their seed channels/suppliers, the type of crops they plant, and their major farming constraints. Before setting up a CBSPS, its purpose should be well defined. This might be to increase farmers' access to improved and preferred varieties in order to generate income, or to achieve better seed security. Usually the income generation aspect is only thought of after a CBSPS is in place, but without the business skills to manage the seed production/sale as a business, the scheme often falters.

Seed production starts with a few kilograms of a specific preferred variety, which a seed grower multiplies and makes available to other farmers in the community. The demand for seed of a preferred variety within the community should be assessed, so that quantities to be produced are estimated, to prevent under- or over-supply of seed.

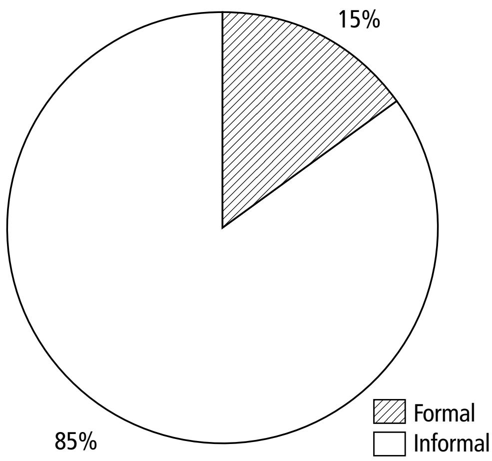

Fig. 11. Seed supply to resource-poor smallholders in sub-Saharan Africa.

For CBSP, certain conditions must be met, e.g.

- Planting material must meet specific quality standards, to ensure variety attributes and the quality of seed.
- The seed grower must know the variety and be able to recognize it; this minimizes contamination from other varieties.
- Adequate crop protection and other quality/yield enhancing techniques should be used.
- The produced seed should pass germination/quality tests.

As such, seed production is a unique (specific) business, and not any farmer can be a seed grower. Seed growers are usually lead farmers in the community, who understand the technical aspects of seed multiplication. They should also be socially accessible, so that other farmers can readily access the produced seed.

Elements of sustainable CBSPS

Unfortunately, most of the CBSPS started in southern Africa have not been sustainable. Once external support is terminated the schemes have collapsed and the farmers have reverted to experiencing shortages of improved seed.

If a CBSPS succeeds and becomes efficient and sustainable, the farmers could become future contract seed producers for seed companies, and continue meeting their communities' seed requirements. Information on new improved OPVs, their characteristics, and prices should be provided to farmers by the producers of the OPVs, and extension workers. This, and other elements of sustainable CBSPS, are summarized in Box 1, and Figure 12.

Box 1. Elements of sustainable CBSPS

- Continuous exposure of farmers to new promising and preferred varieties in a way that stimulates the market. Smallholder farmers should be informed of the advantages of buying fresh seed.
- Strong linkages between national agricultural research and extension systems (NARES), international agricultural research (including the CGIAR) centers, seed companies, small-scale seed producers, and extension.
- Ready supply of improved germplasm and relevant information.
- Seed production models that suit the target communities.
- Farmer empowerment with business skills and training on technical aspects of seed production.
- Analysis of the entire production chain—from seed/grain production through to consumers/buyers—to discover where interventions would be most beneficial.
- Agricultural policies that favor and strengthen the informal seed sector.
- Marketing and distribution strategies for small seed producers.
- Promotion of alternative income sources – e.g., a women's group in Uganda produces OPV seed and also re-packages fertilizer for sale to smallholder farmers who cannot afford to buy large quantities.

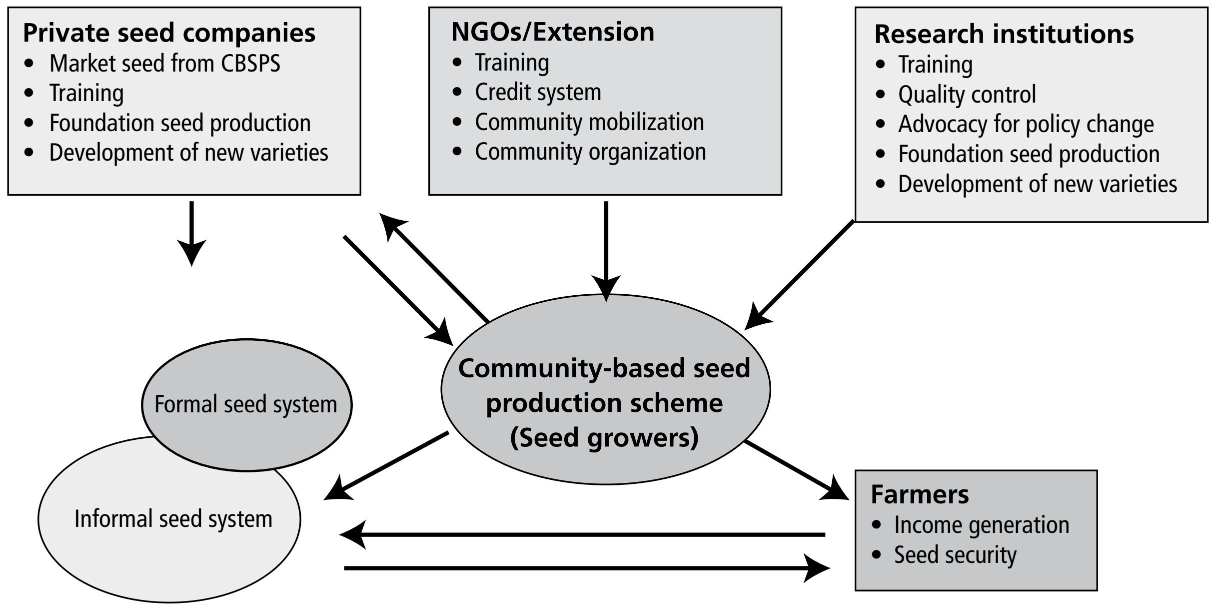

Figure 12. Important linkages in community-based seed productions schemes.

Overcoming the problem of isolation distance within communities

In many smallholder communities in the region, it is difficult to find farmers with large enough fields to meet the isolation distances needed to produce maize seed (see Chapter 1). Several approaches could help overcome the problem of isolation distance in a community, as summarized in Box 2.

Box 2. Overcoming the problem of isolation distance in a community

- Farmers involved in seed production should be allowed to plant before other farmers (time isolation). However, this is often difficult because of irregular rainfall in many areas.
- Farmers in the immediate surrounding of the seed growers can be offered for free (or at a lower price) seed of the same variety, to minimize contamination.
- Seed production can be done during the off-season (time isolation) if irrigation is available. Usually this is the best time to produce seed as there are only a few crops in the field, and disease pressure is lower.

Accessing foundation seed

Seed growers within communities should be linked to NARS or other institutions such as seed companies, which can provide them with foundation seed. Both the seed growers and their support service providers (such as NGOs and extension services) should be aware of seed policies governing CBSPS in their countries. In most countries, seed policy allows CBSPS to market and sell seed only within the communities. If a CBSPS plans to markets and sell its seed farther afield, it has to follow additional regulations and process, such as registration as a seed producer.

Selecting a variety for community-based seed production

Because of the above policy restrictions on the sale of seed, CBSPS can only multiply and sell seed of crop varieties that are adapted to local farming conditions, and are known and preferred by other farmers within their community or region. The process for variety selection for CBSP is usually as follows:

- NARS issues promising varieties for testing by farmers in a community.
- Farmers' skills and knowledge in the areas of crop agronomy, and variety selection is enhanced.
- Group of farmers, individually or by consensus rank the varieties of their choice.

Roles of various partners in the setting up CBSPS

The success of a CBSPS depends on the support and goodwill of multiple parties from the public and private sectors.

- **Government** should develop agricultural/economic policies that promote CBSPS.
- **NARS** should support communities with foundation seed of improved varieties.
- **Extension and NGOs** should train farmers and their communities in quality seed production, entrepreneurial skills, and sustainable resource management; most farmers lack initial credit to start CBSPS, and NGOs are well placed to source the initial credit to support farmers.
- The **private sector** should link more closely with the communities. As the communities acquire more experience in seed production they can become contract seed growers for private seed companies. Such linkages would also provides a sustainable market for the community to sell their seed.
- The international and national **research communities** should continue to develop and promote new improved varieties that farmers want to grow, and information targeted at extension and farmers.

Recommeded reading

Monyo, E.S., Mgonja, M.A., Rohrbach, D.D. (2004) New Partnership to strengthen seed systems in Southern Africa: Innovative community/commercial seed supply models. *In* Setimela P.S., Monyo E.S. and Banziger M. (eds.). 2004. Successful community-based seed production strategies/Produção de sementes de culturas alimentares na região da SADC, CIMMYT. Mexico D.F.

Chapter 3

Case Study of a Community-based Seed Production Scheme in two Districts of the Limpopo Province, South Africa

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Introduction

The community-based seed production scheme in the Limpopo Province, South Africa was initiated in 2000, with the aim of addressing the seed security of smallholder farmers. The project focused on Vhembe and Capricorn districts, and was supported by Gesellschaft für Technische Zusammenarbeit (GTZ). Before the start of the project, smallholder farmers in the two districts had been exposed to field trials aimed at addressing their specific environmental and socio-economic constraints.

Farmer variety selection

In 2002/2003 farmers in Mashushu community of Capricorn district selected ZM 421, an open pollinated variety. The main reasons for selecting this variety were its comparative high and stable yield, drought tolerance, and early maturity compared to other varieties in variety evaluation verification and observation (VEVO) trials. Its early maturity was especially attractive, because it eased the burden of guarding the crop from destruction by baboons.

Farmers in Vhembe district selected two OPVs, ZM 521 and *Grace*, in 2000/2001. ZM 521 was high yielding, matured early and had good milling properties. *Grace* was selected for its suitability for making green mealies (boiled green maize). Both varieties were released in 2001.

Farmers were trained in producing the seed of their preferred varieties, for local seed security and income-generation.

South African National Seed Organization (SANSOR) has been involved in the seed certification of ZM 521 since 2002. SANSOR works closely with farmers producing this variety, to ensure that the seed that they produce is certified.

Seed production involves registration of seed units within 28 days from the date of planting (Table 3.1), inspection of the seed units at different plant physiological stages, and presentation of seed samples for certification. Four officials from the Department of Agriculture Limpopo Province (DALP) completed the SANSOR course for authorised seed inspectors.

The first certified seed was produced in 2003, and the project was officially launched on 7 August 2003. Madzivhandila College of Agriculture was registered with the National Department of Agriculture (NDA) as a seed establishment, authorized to carry out seed cleaning and packaging.

Seed growers associations have been formed in the two districts, and a seed growers' cooperative, and seed collection and processing points identified. Farmers grow the seed for the cooperative individually, but they obtain many services communally, including transportation and processing of seed.

Department of Agriculture Limpopo Province (DALP) has made available R 100,000 for the renovation and construction of a Service Cooperative, as well as seed collection and processing points. The seed producers are now selling their excess seed to the outside market, after meeting their communities' seed demand.

Three seed units planted in February 2004 were harvested and certified in September 2004. The yield was lower than expected due to poor quality of basic seed received from Capstone Seed Company, South Africa; prevalence of maize streak virus (MSV); and poor soil fertility management.

At the time of going to press, the seed units at Mbahela, planted in September 2004, had been harvested, the seed cleaned at Madzivhandila College and presented for certification. Those planted in January 2005 had been registered with SANSOR, and the seed inspections carried out at different physiological stages.

Table 3.1. Registered seed units in Limpopo Province in 2004/2005 seasons.

Seed units	Planting date	Hectares	Status
Maraxwe	6 Feb 2004	12	Certified
Tshiombo Block II	6 Feb 2004	10.5	Certified
Tshiombo Block III (Mathombo – Tshwuka)	30 Feb 2004	16	Certified
Mbahela	1 Sep 2004	18	Certified
Sptizkop	4 Dec 2004	15	Certified
Maraxwe	10 Jan 2005	18	Certified
Tshiombo II	24 Jan 2005	18	Certified
Mianzwi	24 Jan 2005	9	Certified
Tshiombo Block III	10Jan 2005	9	Certified
Total		107.5	

Provision of basic seed

Agricultural Research Council (ARC) has provided basic seed for multiplication, as shown in Table 3.2. Seed units in Capricorn and Vhembe district have been registered and certified. At the beginning of the project the farmers were given basic seed for free, but this was found to be unsustainable. The farmers are currently buying basic seed at R8.00 (1US$ = R 6.20) per kilogram.

Quality protein maize

Basic seed of Obatanpa, a quality protein maize (QPM) variety, has been made available to farming communities in Vhembe and Capricorn, as shown in Table 3.2. Initially the basic seed was offered free to farmers, but they are now paying R8.00 per kilogram. Analysis by the University of Pretoria showed that on average, Obatanpa has amino acid levels 40 to 80% higher than normal white maize (Table 3.3).

Awards

Mrs. Rosinah Lebago won first prize in the SANSOR Emerging Seed Entrepreneur of the Year 2004 contest in South Africa. The prize-giving ceremony was held in May 2005 in Durban (Fig. 13).

Figure 13. Mrs. Rosinah Lebago, SANSOR Emerging Seed Entrepreneur of 2004, with her award.

Table 3.2. Projects that received basic seeds from Agricultural Research Council, South Africa (ARC).

Projects	District	No. farmers	Area planted (ha)	Variety
Dzumauli	Vhembe	106	25	Obatanpa
Mulodi	Vhembe	10	6	Obatanpa
Nana	Vhembe	19	2	Obatanpa
Mianzwi	Vhembe	22	6	ZM 521
Maraxwe	Vhembe	43	12	ZM 521
Mphambo	Vhembe	32	12	SAM 39
Tshiombo Block III	Vhembe	38	16	ZM 521
Hlalahala-Madonsi	Vhembe	8	6	ZM 521
Strytskraal	Sekhukhune	9	4	SAM 37
Mogalatsane	Sekhukhune	3	1	SAM 43
Mashushu	Capricorn	6	2	Obatanpa
Mashushu	Capricorn	15	6	ZM 421
Jack Mafarane	Capricorn	33	13	ZM 521
Monare	Capricorn	5	2	ZM 521
GaThaba	Capricorn	6	2	ZM 421
GaThaba	Capricorn	6	2	ZM 521
GaMogano	Capricorn	4	2	ZM 521
Total		365	119	

Table 3.3. Nutritional analysis of Obatanpa, a quality protein maize (QPM) variety.

Amino acid	QPM	White maize	% increase of essential amino acids in QPM compared to normal maize
Aspartic acid	0.96	0.52	85%
Glutamic acid	2.02	1.49	36%
Serine	0.66	0.39	69%
Glycine	0.54	0.30	80%
Histidine	0.31	0.25	24%
Arginine	0.77	0.40	92%
Threonine	0.51	0.32	59%
Alanine	0.88	0.53	66%
Proline	1.17	0.77	52%
Tyrosine	0.50	0.24	100%
Valine	0.68	0.38	79%
Methionine	0.28	0.15	86%
Cysteine	0.35	-	-
Isoleucine	0.41	0.24	71%
Leucine	1.11	1.06	5%
Phenylalanine	0.51	0.39	30%
Tryphtophan	0.10	0.06	67%
Lysine	0.44	0.27	63%

Seed Growers Associations

Ten seed growers associations (SGAs), one in each village, were formed in Vhembe district (Table 3.4). These SGAs have been trained by Yebo Cooperative on management of SGAs and seed co-operatives. The Cooperative also assisted the SGAs to register a seed service cooperative with the Registrar of Cooperatives in December 2004.

Seed Growers Service Cooperative

Currently, the farmers in Limpopo Province are selling seed at R 17.50/kg (1US$ = R 6.20). However, economic analysis of the seed production schemes shows that the seed's total production and processing costs are approximately R 21.60/kg, which includes both invisible and visible costs. This high production cost is due to opportunity costs (invisible costs) which make up about 38% of the total. These include organization of meetings, time, storage of the seeds in the homestead, security, and support from DALP. The umbrella body organization constitutes 4% of the invisible cost, which is paid in kind by farmers. The Limpopo agricultural extension contributes 10% of its time and resources to the project. Visible costs make up 48% of the actual cost, and include land preparation, purchase of basic seed, registration of units, seed treatment/processing, seed inspection, and purchase of plastic bags. The farmers pay for these goods and services in cash.

Three villages in Tshiombo produced 13.33 tons of seed during the last season of 2004. Seed processing was done at the Madzivhandila College of Agriculture, where the farmers spent 1–2 weeks at a time treating and packaging the seed. A simple concrete mixer is being used for treating the seed with Gaucho. As there are no alternative chemicals or generic forms of Gaucho in the market at present, seed treatment has been expensive, making up more than 40% of the total seed production costs. It is expected that generic forms of Gaucho will soon be available in the market, which will reduce seed treatment costs.

If the above-mentioned challenges (especially the high cost of seed dressing and processing) cannot be addressed properly, the current community based seed production model of Limpopo Province will not be sustainable.

Functions of the Seed Growers Service Cooperative

The formation of a Seed Growers Service Cooperative and seed collection/processing points will help reduce the cost of seed production by undertaking complementary functions. The Cooperative will be located in the center of the participating villages, so it is accessible to all. The SGA will be registered with NDA Genetic Resources as a seed establishment, and it will have the following functions:

- Serve as a seed storage, processing and packaging establishment. This will reduce costs of transport incurred by farmers.

Table 3.4. Seed Growers Associations (SGAs) in the two study districts.

District/SGA	Number of members/ Seed growers
Vhembe	
Mianzwi	33
Maraxwe	62
Mbahela	45
Tshiombo	34
Matombotswuka	37
Dzimauli	114
Mulodi	13
Jerome	107
Malavuwe	26
Mpambo	83
Capricorn	
Sptizkop	38
Lekgothoane / Ga Thaba	42
Mashushu 3-4TON	20
Ga -Mogano	18
Zebediela	4
Total	676

- Trade and negotiate prices on behalf of the farmers, including negotiating discounts on Gaucho (seed treatment insecticide), and other products.
- Liaise with DALP and SANSOR inspectors for inspection and certification of seed. Qualified seed inspectors from Limpopo Department of Agriculture (LDA) will assist in seed inspection and submission of seed samples from the farmers to the National Department of Agriculture for germination and purity tests.
- Organise for marketing of seed surpluses from the local seed production scheme.
- Provide the seed growers with basic seed; the cooperative may source the basic seeds from ARC and other suppliers.

Collection Processing Point (CPP)

This will be managed by local seed growers associations, and have the following functions.

- **Storage of seed after harvesting.** Storage is currently a serious problem. Farmers normally store their seeds in their kitchen and bedrooms after harvesting, which makes fumigation difficult. During the harvesting season children have to vacate their bedrooms and stay with relatives until all the seed has been threshed, fumigated, and sent to the College for treatment.
- **Ease transportation.** Seed is currently treated in Madzivhandila Agricultural College. Farmers living far from Madzvhandila have difficulty transporting their seed to and from the college. At the moment the farmers around Vhembe village (about 60 km from the college) are transported to and from the college daily, but some stay on for 2–3 days to do the seed treatment and packaging. The costs incurred in this exercise include transportation, meals and accommodation.
- **Host equipment and supplies**, including a weighing scale, seed treatment equipment and a moisture meter for the farmers' use, as well as packaging materials such plastic bags, labels and seals bought from the Seed Services Co-operative. The above equipment and materials will facilitate seed cleaning, dressing, packaging and labelling. It will be possible for farmers to receive maize flour or fertilizer in exchange for their seed through the CPP.

Chapter 4

Scaling Up Strategies in Reference to Agroforestry

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Introduction

Following more than 15 years of successful demonstration of the potential of agroforestry technologies to make a positive impact on the livelihoods of smallholder farmers in the region, the World Agroforestry Centre-ICRAF Southern Africa has been focusing its efforts on scaling up these technologies to reach as many farmers as possible in the five countries (Malawi, Mozambique, Tanzania, Zambia and Zimbabwe) where the project operates. The project has focused on a process of institutionalizing agroforestry in the research, extension and development policies of these countries.

Strategies employed by ICRAF to enhance this institutionalization in the program countries are: capacity building, developing effective partnerships and networking, and promoting policies more conducive to adoption, with the central focus being strengthening the capacity of farmers for agroforestry innovations that meet their needs. Among the key interventions of the strategies are the following fundamentals: farmer-centred research and extension approaches; establishment of strategic partnerships; knowledge and information sharing; establishment of viable seed systems; developing market options; local institutional capacity strengthening; diversification of agroforestry options; and influencing policy at different levels.

ICRAF is building the capacity of farmers in management and problem-solving skills through a four-pronged scaling up strategy that involves:

1. Direct training of farmer trainers and local change agent teams (group of agroforestry trainers selected by the community;
2. Training of partners to undertake farmer training and other forms of extension;
3. Facilitating farmer-to-farmer extension and exchange;
4. Supporting national extension initiatives on sustainable agriculture.

The four-pronged approach outlined above is supported by other activities aimed at creating awareness of agroforestry options through farmer field days, and development of extension materials. We discuss the approach in greater detail here, and examine further refinements that would improve agroforestry adoption and its positive impacts.

Prong 1. Direct training of farmer trainers and local change agent teams

Through this approach, ICRAF staff members go directly to the community and train the locally formed groups to become trainers in agroforestry technology establishment and management. The communities select the individuals that should receive the training. The trainers are trained over two years through a practical, field-based modular agroforestry training plan (year 1 on food security and year 2 on income generation). Other critical development issues such as HIV/Aids, community mobilization and farmer organization are integrated. The training is modular, and allows farmers to implement one stage of training outputs before starting the next module. This 'Farmer first' approach to capacity building has been found to be efficient (Boehringer, 2002) as it ensures that farmers enhance their skills and knowledge through training.

Farmer trainers have been very effective in promoting the adoption of agroforestry technologies when the trainers themselves have experienced the benefits of practicing agroforestry on their own farms. The project's experience has also shown that the multiplier effect of this approach can be significant when the farmer trainer is highly motivated and committed.

Prong 1 has been implemented as the major approach in the pilot scaling up areas (PSUAs) of the USAID-supported TARGET project in Malawi, Mozambique, Zambia and Zimbabwe. PSUA change agent teams (each comprising 24 farmers, two traditional leaders and four local extension officers) were selected. In the project, ICRAF facilitated group formation. During the sensitization meetings, the community would be advised on the importance of selecting good representatives that would ensure the communities benefited from their involvement as trainers. Alternatively, selection was done through partners who mobilized and assisted communities to form training groups.

By training the local change agents, the project has built partnerships that are beneficial to the sustainability of agroforestry dissemination at community level, as well as implementation of other development activities in the area. The change agent teams have the potential to become effective community based organisations (CBOs) for development of other enterprises in their communities. Continued collaboration of the change agents from the different PSUAs also allows for the establishment of community-based networks for agroforestry development work.

Training farmer trainers

The training could either take 2 years, or be done as an intensive week-long course. The modules presented in both approaches are the same and include:

- Introduction to agroforestry (all agroforestry technologies described);
- Nursery establishment and management;
- Transplanting, tree management, and horticulture (budding and grafting);
- Leadership, team building, marketing, farmer organization;
- Enterprise development.

Other activities such as farmer competitions, review meetings, exchange visits and field days are conducted with farmers to complement their activities in the field.

The farmer trainers are also exposed to skills and practice on preparing and presenting lessons. At the end of the training the farmer trainers make an action plan for their area, which includes a program for training, distribution of seeds, setting up of a nursery and monitoring of activities.

Roles and responsibilities of the trainers

Farmer trainers are expected to undertake the following tasks: create awareness among their fellow farmers on agroforestry; train fellow farmers; source and distribute seed; establish nurseries; and monitor field activities. In addition, the trainers establish their own fallows, so as to lead by example. Trainers are also expected to conduct field days and host farmers' tours.

While it stands to reason that capacity building at the local level is an effective way of creating sustainable dissemination of agroforestry technologies, experience from the field, especially in the Chinyanja Triangle (TARGET) Project, covering Malawi, Mozambique and Zambia, has shown that the approach requires enormous levels of continuous technical and logistical support. It has also emerged that ICRAF does not have the capacity (human and otherwise) to offer direct support to farmers. Major modifications to the approach include a significantly reduced role of community mobilization by ICRAF. It is expected that this shift will contribute to enhanced local ownership of community dissemination work.

Prong 2. Training of partner staff

Prong 2 is designed to build the capacity of partner organizations (largely NGOs) that work at the grassroots level. Ideally, partner NGOs should be able to contribute financially to the training of their staff/farmer trainers, alongside their core business. This approach has led to mutual learning amongst partners by directly sharing information and experiences, and an increase in joint planning and implementation of agroforestry and other activities.

In this approach partner organizations select some of their staff to be trained, and invite ICRAF to provide the training. These partner staff are expected to, in turn, train their community groups. However, staffing limitations within partner organizations have stood in the way of this approach; so far, partners have only been able to mobilize community groups they wish trained, and provide resources for the training.

The project has established partnerships with a wide range of development agencies that include NGOs, CBOs, and faith-based organisations (FBOs) in all five countries. It has been found that partners with a strong grassroots presence are best able to reach large numbers of farmers, and monitor field activities at the farm level. Where such partners have long-term commitment in the community, sustainability of the adoption of agroforestry technologies is more secure, The most effective partners are also those that consider agroforestry a priority in their development agendas. Such partners typically commit substantial resources towards promotion of agroforestry in their areas. For Prong 2 to be effective therefore, ICRAF needs to identify and work with partner NGOs/CBOs that use appropriate participatory approaches and are genuinely committed to the empowerment of local community development structures, including the establishment of viable community based seed production systems.

Prong 3. Farmer-to-farmer exchange

This approach involves exposing new farmers to agroforestry by facilitating their visits to farmers who have been practicing agroforestry for some time and have started to reap its benefits. For farmers, "Seeing is believing." (Pretty, 1995). The process of farmer-to-farmer training starts with the host farmers being approached on the willingness to host their fellow farmers. After agreement is reached, the host farmers meet as a group in their own area and assign roles to different individuals. These roles include training, guiding the field visits, and appointing a moderator who is responsible for logistics. As the benefits accruing from agroforestry technologies (especially the soil fertility improvement options) take time, showing new farmers the benefits realized by fellow farmers from the technologies is a very powerful way of promoting adoption.

Farmer-to-farmer exchange visits were a major approach for enhancing adoption of agroforestry technologies in the TARGET project. In this project ICRAF facilitated cross-border visits of farmers between Zambia, Malawi and Mozambique. Local change agent teams were the target audience for the exchange visits. The visits helped team members hear first hand, the experiences and benefits of agroforestry from practicing farmers. Furthermore, other farmers within the locality of host farmers, joined in the visits, and learnt about agroforestry.

Exchange visits are, however, expensive and therefore should not be used on their own, but to complement other scaling up pathways. Where ICRAF works through partners, exchange visits could be encouraged and costs shared with partner organizations. It is expected that partners will be willing to pay for exchange visits because of their effectiveness in enhancing adoption. Ultimately, however, the most sustainable way to support exchange visits, is by the farmers themselves contributing towards their costs.

Prong 4. Support to existing initiatives

In all five countries there has been substantial institutionalization of agroforestry in the national research and extension system. However, the level of government support for promotion of agroforestry technologies varies from country to country. Each of the countries has a National Agroforestry Steering Committee (NASCO) responsible for facilitating the institutionalization of agroforestry in research, extension and development.

Specifically the NASCOs' roles include

- identifying priority research areas and guiding donor support accordingly;
- reviewing the research proposed by various departments and advising them on areas for collaboration;
- developing policies on the development of agroforestry;
- liaising with extension services to facilitate technology transfer; and
- organising seminars and workshops on agroforestry. Hence the NASCOs are critical for facilitating vertical processes of promoting the adoption of agroforestry.

However, the operations of the NASCOs have been severely hampered by funding constraints, and as such they have not been very effective in attaining their mission, particularly at the development level. Furthermore, the NASCOs have not been as effective in influencing government policies as expected, likely because the committees are external to government decision-making structures.

NASCOs' memberships have typically been skewed towards the national research system, extension, and to a lesser extent institutions of higher learning. It has been recognized that such a composition is not ideal. Inclusion of NGOs and the private sector is essential. This fact is appreciated by some of the NASCOs and reconstitution of membership has been initiated in Zimbabwe.

The role of public extension agents in scaling up

It is important to note that the ultimate goal of scaling up, regardless of which prong is used in dissemination, is to reach more farmers, through trained farmer trainers. However, the sustainability of this local farmer-to-farmer extension depends on continued support from the local public extension system.

In areas where extension officers are present, it becomes easy to organise the farming community into groups for training and other events. Farmers and the local farmer trainers require continuous technical backstopping, which can best be provided by personnel that live within the community, such as agricultural extension officers. Many NGOs have high staff turnovers and sometimes, as a result of their short durations in the farming communities, are not able to connect effectively with them. Hence, prong 4 becomes important as it aims to develop and enhance the capacities of these agricultural extension staff to a level that enables them to confidently provide technical backstopping to the farmer trainers and farmers, as well as partner staff.

While Prong 4 has great potential for facilitating horizontal processes of promoting adoption of agroforestry technologies (scaling out), a major challenge has been under-investment in the public research and extension systems.

Additional Prongs

In reviewing the different approaches and documenting lessons learnt in scaling up strategies, four additional prongs have been proposed:

- **Prong 5. Training of partner staff/farmer trainers by established trained local partners or consultants.** This prong is similar to Prong 2, except that instead of ICRAF, a local institution or consultant does the agroforestry training. This approach can be used to train partners based far away from where ICRAF operates. The CBO, NGO, National Agroforestry and Education Training Teams (NAFTs) carrying out the training will have gone through agroforestry training by ICRAF (prong 1 or 2). This prong ensures that more training requests from interested organisations can be accommodated, eases the burden on ICRAF staff, and builds local capacity.
- **Prong 6. Support to agroforestry networking.** This involves support to agroforestry networks, as a means to cater for the less strategic organizations, as well as updating existing well established partners. Grouping all interested organisations and stakeholders into agroforestry networks can cut costs and increase outreach. These networks should primarily be seen as fora for the exchange of knowledge and experience, and fostering collaboration among participants. Network members are encouraged to meet frequently on an individual basis, share reports and materials, organise exchange visits and synchronise their activities more.
- **Prong 7. Establishment and strengthening of school community links.** Reaches farmers through agroforestry activities in schools.
- **Prong 8. Sensitising policy makers about the benefits of agroforestry.** By producing policy briefs and use of public media channels and events (local radio, TV programmes, documentaries, field days, agricultural shows etc.), it may be possible to reach policy shapers including parliamentarians, provincial-, district- and village-level administrators, and traditional authorities. This can catalyse the adoption of agroforestry in their respective constituencies.

Conclusions

The paper has reviewed the scaling up concept for ICRAF Southern Africa by analysing the initial four prongs that have characterized dissemination work, and highlighted lessons learnt so far. Recommendations of new approaches have then been made. There is no single recipe to scaling up, and different approaches can be successful depending on the innovation, the environment, and the resources at hand (Franzel et al., 2004). The paper has also highlighted the important success factors necessary for scaling up: farmer-centred research and extension approaches, knowledge and information sharing and facilitation, and building of local capacity and facilitation.

Recommended reading

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