SEED PRODUCTION BY SMALLHOLDER FARMERS

Proceedings of the ILCA/ICARDA
Research Planning Workshop
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International Livestock Centre for Africa (ILCA)
International Center for Agricultural Research
in the Dry Areas (ICARDA)

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Contents

Workshop objectives

The International Livestock Centre for Africa (ILCA) and the International Center for Agricultural Research in the Dry Areas (ICARDA) are part of the Consultative Group on International Agricultural Research (CGIAR), working on increasing food production in the developing world. Lack of seeds has been identified as an important limitation to increased food production and both ILCA and ICARDA have established Seed Units to address this constraint and promote the supply of seeds of their mandate crops.

Much of the seed used for sowing crops in developing countries is produced in the informal sector by farmers. This is especially important for minor crops where there is no organised commercial activity. The major producer at this level is the smallholder farmer, who is considered to be resource poor, working relatively small land holdings and with most of the labour being supplied by the household.

Recognising the importance of this informal seed production by farmers, ILCA and ICARDA agreed to convene a workshop with the objectives:

- to assess the knowledge base on seed production by smallholders
- to identify constraints to increasing seed production
- to identify areas where further research is required to support smallholder seed production
- to make recommendations to assist ILCA and ICARDA develop their programmes in this area.

The workshop was structured in three parts to assist discussion:

- Assessment of the current state of seed production by the smallholder farming sector and the knowledge base available
- Identification of constraints and areas where research is needed, possible interventions and the role of IARCs in developing smallholder farmer seed production
- Recommendations on the role of IARCs and the research areas needed to support seed production by smallholder farmers.

Summary of discussions

1. Identification of the components of seed production systems

The Workshop participants discussed the components of seed systems and tried to identify researchable problems which are currently constraints to the development of seed production by smallholder farmers. The major factors to be taken into consideration when developing seed production systems for use by smallholder farmers were listed and grouped as:

I) Diagnostic studies/need assessment

- Information on local seed systems
- Farming system
- Gender issues
- Farmers attitude and skills
- Seed consciousness
- Physical isolation of target group
- Local variance
- Needs assessment and impact studies

II) Policy issues

- Legal
- Institutional roles
- Institutional linkages

III) Market issues

- Market linkages
- Price
- Demand forecast
- Market intelligence
- Timeliness
- Availability

IV) Appropriate technology requirements

- Harvesting
- Conditioning
- Storage
- Local seed testing

V) Seed system studies

- Terminology - conceptualisation
- Alternatives for producer organisations
- Alternatives for seed procurement
- Integration into farming system

- Institutional roles

VI) Inputs

- Stock seed
- Linkages to research
- Technical assistance
- Farmer skills
- Adequate variety

VII) Strengthening national capacity

- Documentation/Dissemination of information
- Training
- Transfer of technology

VIII) Funding

2. Possible strategies for developing smallholder seed systems

There is very little well-documented description and analysis of smallholder seed production projects. Although a number of projects have been attempted or are underway, there is as yet not a set of guidelines for making such projects sustainable. The experience in forage seed production at the small farm level is even more deficient.

Any planning for the establishment of smallholder seed production capacity will require a long-term strategy and support over many years. This is not to say that such an effort will be excessively expensive, but there are several stages to any effort and at each stage a degree of testing and initial support is necessary.

It may be helpful to think of several stages in a continuum of research.

Stage I	Stage II	Stage III
Agro-economic systems research	Agro-economic and seed systems research	Seed systems research

No matter where one is in the continuum, strategy development requires a selective approach that is specific about countries, agricultural systems and species. A global, all-on compassing strategy cannot be developed. The specific identity of the species under consideration is crucial for defining seed multiplication and seed production options.

Agro-economic systems research, with significant farmer participation, is required as the initial stage, in order to set priorities and identify species that are candidates for promotion. If this type of work is already underway, as it is at ILCA and ICARDA, a critical synthesis and evaluation of the work, in which the International Agricultural Research Centre (IARC), national partners, and other national institutions as full partners, is called for. The debates and conclusions of such an analysis should be well-documented and should serve to identify "best-bets" for the next stage of research. The best-bets" are identified by country, system, and species. Once candidate species are agreed upon, stage II should further refine crop production aspects and critically analyse seed supply necessary for promotion. Thus attention should turn to seed multiplication, so that there is a clear assignment of responsibilities between IARCs and national programmes with respect to the maintenance and multiplication of stock seed. This will almost certainly include some training and other support provided by the IARC.

The final stage in the continuum involves strategies for seed production. ILCA and ICARDA have the reasonable goal that seed production eventually be carried out in a self sustaining fashion at the local level. The exact manner of achieving this will depend on the country, the species, and the farming system. There are several guidelines useful for organising the research required in stage III. First, there should be no preconceptions about who will ultimately be the most efficient seed producers; the possibilities range from farmer-saved seed to provision from outside the target area. Second, analysis should include a thorough understanding of local seed systems and the related organisational and farming experience that may prove useful in stabilising new seed systems for a new species. Whatever seed production option is selected, its chances of success are highest if it builds upon local systems and knowledge. Third, terms such as public/private or formal/informal may get in the way of designing an innovative seed system. An appropriate strategy would be to organise a demonstration of the species and its place in the system; farmers demand for seed; and current seed production/supply problems. This demonstration should be at the national, or more local level and should be attended by the range of institutions that might be able to contribute to, or even bid on, the development of a seed production system. This would include farmer groups, NGOs, entrepreneurs, and state agencies. The best solution may involve a combination of several of these institutions. IARCs will then have to provide some initial support for the establishment of the system.

These three stages cover the development of seed production, where stage I is mostly initial seed production of germplasm, stage II includes multiplication of promising material and stage III is seed production of specific adapted varieties/cultivars.

Many organisations will be involved in the development of seed production. The major players in the three stages will be among others:

I	II	III
NARS (extension)	NARS	Farmer seed
producers	IARCs/advanced institutes	Extension
IARCs/advanced institutes	Farmers	NGOs
Farmers (clients)	(NGOs)	(IARCs/advanced inst)
(NGOs)	(Seed Industry)	

The goal of the seed production system should be provision of seeds of adequate varieties for use by small farmers. Farmers at different levels have different needs. The group identified four major requirements for effective farmer seed production:

1. Outlet/market
2. Training the trainers in how to do it
3. Awareness at the policy level
4. Starting point of seed supply of adequate variety

The identified activities will be targeted during the three phases as:

	I	II	III
Research			
	Diagnostic	Diagnostic	
	Policy	Policy	Policy
		Marketing	Marketing
		Technology	Technology
	Seed systems	Seed systems	Seed systems
Support			
	Inputs	Inputs	Inputs
	Documentation	Documentation	Documentation
	Training	Training	Training

3. Role of International Centres

The participants suggested that the role of the IARCs should be to work through existing national structures, including extension, seed industry, national institutes and ministries. The IARCs should assist in training, research support through collaborative projects, support for transfer of technology, supply of stock seeds, establishing a network to exchange information, developing policy and creating awareness to influence governments and evaluate and assess impact of the work.

All participants agreed that the IARCs should have a supporting role to develop national seed production to get the results of IARCs research to farmers, but should not be executing the work themselves.

4. Workshop recommendations

The participants recommended the following actions by ILCA and ICARDA to advance farmer seed production:

1. Research should be done on diagnostics, production methodology and seed systems, including the development of methodologies for incorporation of indigenous knowledge on seed systems.
2. Attention should be given to assembling and dissemination of information and documentation through a newsletter and workshops and creating public awareness.
3. Training should be focused towards training trainers and producing training materials to support the activities in seed production and seed systems.
4. IARCs should assist in the provision of stock seed in the initial stages to enable seed production.
5. IARCs should be active in evaluation and monitoring, including impact assessment studies.

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APPENDIX I

List of presented papers

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Proximity is a plus: the economics of farmer seed production and distribution in developing countries.
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J E Ferguson.

Smallholder seed production techniques

R G Griffiths

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Abstract

Seed crop production aims at maximising yield and quality. It is little different to grain production for smallholder farmers and few specialise in the production of seed. When seed is produced, the crop and/or variety is chosen on the basis of simplicity of production and individual farm needs. Difficult seed production locks up resources. Traditional techniques do exist and should be recorded and made known. Improvements in techniques on a scale appropriate for use by the smallholder farmer are still possible.

Introduction

Definitions of the smallholder farmer category generally concern the overall size of the farm. The farm size varies between countries and continents depending on the availability and tenure of land among other factors. In Bangladesh, for example, large farms are considered as 3 hectares and above with smallholdings ranging from 0.2 to 1.0 hectare scattered over wide areas. The type of smallholder farming, whether subsistence or market oriented, depends on resources, markets and alternative more lucrative forms of employment away from the land. For most of these farmers, seed production is no different to grain production. A few specialize on crops and varieties chosen on the basis of demand and simplicity of production.

Smallholders often use their own seeds or resort to their neighbours' or local markets. No effort is made to store seed from one season to the next if seed is readily available. The smaller the holding the less likely the farmer will store seeds and purchase is often left to a last-minute operation immediately prior to planting. The primary source for such material is a recognised local crop producer whose resultant crop seeds always perform reliably. This reputation within the community ensures that the "seed" receives the necessary care and attention during its production. It is fair to say, however, that in the majority of cases "seed" represents left-over grain.

Where a seed production system does exist it falls into a recognised pattern of opportunist or specialist activity. Opportunists note seasonal shortages and work accordingly. This may involve sowing extra areas suited to the farming system by inter- or relay-cropping, and then harvesting and storing surpluses, acting as intermediaries in the supply of seed and seedlings or even illegal cross-border trading.

Production techniques

Several stages in the crop cycle require attention if the crop is to be used for seed. Correct site selection, good crop establishment and management, together with careful harvest and storage of the seeds are essential to ensure quality. Seed production techniques differ from crop to crop. Crops that lend themselves to vegetative reproduction or transplanting also have different requirements. Hybrids do not lend themselves to farmer seed production, although many farmers do sow the produce. Species with breeding systems requiring cross-pollination are at great risk and may not produce seeds. Seeds may also be lost during storage in unsuitable seed storage climates.

Research has shown that the prime components of seed yield (shoot density, seed numbers and harvest recovery) are severely affected by weather and farming practices. The best seed crops are produced in unbroken periods of suitable radiation, temperature and rainfall for vegetative growth, favourable photoperiod and temperature for floral induction and calm dry weather during maturation and harvest. Grower facilities (storage, inputs, equipment and labour) coupled with timely technical competence and the temperament to recognise seed as seed and not grain is also vital. For traditional crops most of this information and the required skill is handed down from generation to generation. Care must be taken when handling cross pollinating crops in order to minimise genetic contamination. Block production or varietal zoning within a given area is often attempted for isolation. This has achieved only varying degrees of success due to neighbouring farmers independence. Legislative support has helped enforce such activities. If time and space isolation is not possible, wind flow direction and plant selection from the centre of crop plots are less suitable alternatives.

Successful establishment (seedling emergence) depends on a complex interaction involving placement, size, genotype, seed characteristics (hardness) and the soil micro-environment. Farmers must ensure conditions favour germination, emergence and continued seedling growth. Local practices vary with season as well as with the crop, variety or the land. Climatic variables may also affect the seed crop but are generally beyond the control of the smallholder, unless fortunate enough to have access to for example irrigation facilities. At planting, seed hardness is probably the characteristic most easily modified by the farmer. The seed can be soaked, scarified or cut to reduce hardness to a practical level of 40%. Access to inoculants is difficult. Rotating or introducing leguminous crops are the best practical means to overcome this problem. Recommendations as to crop establishment for seed production often indicate reduced plant populations but thereafter follow general cropping recommendations.

New crop variety introductions may change characteristics over two or three seasons as small scale, interested farmers continuously select from the seeds and the mother plants. Women are increasingly extending their traditional seed selector and keeper role. Selection of the mother plant now seems to be part of their mandate. Farmers require only a few plants, often hand picked, as seed for the next season. Seed areas are seldom designated in the field. If so, they may change depending on crop appearance throughout the growing cycle. In many cases selection is by seed from the grain crop only. In vegetables the best produce is sold, the second best is consumed by the family and the worst left for seed! Thus a new introduction may differ considerably after only 1 season.

Seed crop management is geared to maximise yield and quality. For crops with climbing, sprawling growth habits, additional possibilities exist through vertical production using support systems. Crops with biennial and perennial life cycles will require appropriate seasonal renovation. They tie up land for considerable amounts of time and may therefore be seconded to less fertile areas, boundaries or bunds.

The type of inflorescence will determine the harvesting technique. Dehiscence may delay or accelerate the operation by allowing material to be brushed or picked off the ground or harvested either as the whole plant or the seed bearing part for threshing and winnowing at the homestead or farm centre. Small scale activities allow for manual harvesting and cleaning. This is more accurate, although time consuming. Improvements in output are still possible at the smallholder level, for example through use of scythes instead of sickles. Synchronised heading in all crops is recognised as vital but only experience and regular observation can really provide the basis for timing the harvesting operation. Simple examination of the inflorescence of the same small number of plants from flowering through to shattering will indicate the amount of time available for collection of seed to obtain optimum yield and quality. Farmers are aware of the various techniques for delaying or improving operations according to weather or crop appearance. These techniques include stooking sheaves and manually rolling or winnowing standing crops.

Post harvest operations are the activities that have been most dramatically mechanised. The scale of the operation determines the degree of mechanisation. Seeds harvested from smallholder fields seldom have weed seeds in the sample (except for sprawling types), because the harvest technique leaves them behind. They do, however, often result in dirty samples because of threshing on earthen floors, which if adjacent to other seeds can result in varietal admixture. The crop and dirt admixture is easily picked out by hand. No machine can select and clean as well as the manual operation. Seed cleaning focuses on winnowing and sieving/selecting seed size. Local farm labour has done this since time immemorial. What has not been done, is the regular separation of seed from grain, unless the inflorescence (as in maize and rice) can be stored as such. Simple winnowing by pedal driven or hand powered fans can complement natural wind. Enclosure in a box will allow concentration of effort in time and space.

Smallholder storage is an area which still requires attention. Crops and varieties traditionally suited to the tropics will naturally store better than crops suited to temperate conditions. Crops introduced under diversification policies may not store well. In these cases, small areas of farm land may have to carry the seed as a crop until the climatic conditions improve. Research has shown that drying seed to a hard bite test and sealing inside one or more layers of plastic of 480 microns thickness will help maintain quality during storage. The whole harvest should be stored in rat proof containers. Traditional selection of cool storage locations should continue, as should the inclusion of local vegetative matter known for their insecticidal properties. Sometimes, however, tradition requires that these sealed units be reopened after/during the wet season for further drying.

Local seed testing is not common. Petioles of bananas and aroids slit longitudinally can be used to wrap seeds for germination. A percentage of 80% plus is acceptable. A simple overnight soaking to verify the success or otherwise of hard seed treatment is seldom done.

How can seed production techniques be improved?

The national agricultural research systems (NARS) are expected to solve farmers problems. This frequently does not happen. Reasons vary from the absence of an operational extension research linkage to the NARS having a fixed programme which is unable to respond. Often there are simply insufficient resources available.

Recent trends in the use of participatory rapid appraisal surveys (PRAS) by both NARS and the extension services have highlighted issues and farming practices previously unknown or considered not worth bothering about. They highlight farmer resourcefulness which should be harnessed to provide possibilities to develop more efficient technology.

Many research and extension reports show that most problems refer to inaccessibility of seed or poor emergence. The former concerns inadequate supplies or high prices from the formal sector, whether public or private, and may be compounded by frequent natural disasters. The latter refers to poor storage techniques. Such techniques may be adequate for "grain" but not for seed. The question of emergence must of course be put in context as the germination rates are seldom known. Genetic quality is seldom ranked as very problematic, presumably due to the regular selection by farmers.

Suitable solutions can be found to increase availability and seed quality either by research or information. Farmers are excellent communicators. They could be even better if the NARS and extension linkage and information services were improved. National, regional and international networking can assist in this area.

The international agricultural research centres (IARC) are mandated to work with the NARS. Their involvement in adaptive research is limited but varies between institutes. Information exchange through formal linkages is already established. CIAT and ICARDA seed production activities have been confined to the more formal seed programmes and the establishment of seed associations. Can the IARCS help the smallholders, who for the most part are independent of the formal seed system?

Proximity is a plus: the economics of farmer seed production and distribution in developing countries

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Abstract

Using information collected as part of the Overseas Development Institute's on-going seeds research programme, this paper investigates the economics of farmer seed production and distribution in developing countries, including their social equity and gender aspects. The paper concludes that the conventional contract grower approach to involving smallholders in seed production, which copies formal sector organisational structures and methods, does not necessarily make economic sense. Instead, the paper suggests re-thinking the approach, to support and build on the traditional seed production and distribution mechanisms that already exist within small farm communities. The role for external organisations in supporting these alternative farmer-based seed schemes is discussed.

Introduction

This paper uses information collected as part of the Overseas Development Institute's on-going research programme into the organisation and economics of seed supply in developing countries. During the last four years, ODI has carried out farmer seed surveys in Malawi, Nepal, Zambia and Zimbabwe and produced case studies of the seed sector for 21 countries. In addition, the Institute maintains an extensive collection of published and grey literature on individual countries and seed matters in general.

The conventional approach uses small farmers as contract growers; it is used mainly by government and private sector seed companies, but in setting up their seed activities some non-governmental organisations (NGOs) have also copied this formal organisational approach.

Seed projects and programmes could set up farmer-based seed schemes that use and build on traditional seed systems, as alternatives to copying formal sector smallholder seed production schemes. A number of NGOs are now doing this and some government seed programmes are beginning to follow suit.

Conventional smallholder seed production schemes

Many governments, seed companies and in recent years an increasing number of non-governmental organisations (NGOs) have set up schemes to involve small farmers in seed production. Until recently, most schemes followed a more-or-less standard pattern. The small farmers involved are treated as contract growers. Thus, they are provided with source seed by the organiser of the scheme and are supervised in the production of a seed crop following formal field standards, usually laid down by the national seed certification authority. The farmers involvement with the crop ends after harvest, when it is sold to the scheme organiser for a premium above prevailing grain prices. The organiser then takes responsibility for arranging the processing and certification of the seed, and its distribution – usually using a national input distribution network, either government- or company-run. Most of these schemes deal exclusively with seed of modern varieties (MVs).

There are numerous examples of this type of scheme in developing countries. The Ministry of Agriculture in Zambia runs its own scheme (GRZ, 1989); the governments of Nepal and The Gambia have mandated NGOs working locally to assume responsibility for a substantial portion of national seed supply using smallholder seed growers (Cromwell et al, 1992; Wiggins, 1992; Cromwell et al, 1993). Increasingly, NGOs seeking to consolidate their rural development activities have started seed production projects based on this approach – often in areas where government and private sector services fail to reach. Examples include the Mennonite Central Committee's vegetable and soyabean seed schemes in Bangladesh, and the take-over of abandoned government seed facilities in Niassa Province, Mozambique by the Italian NGO Crocevia (Cromwell et al, 1993).

However, the performance record of this approach is mixed. As far as the local communities are concerned, the existence of the seed scheme may do little to improve seed supply in their immediate vicinity, because the seed is usually transported out of the area for processing and distributed using the national input distribution network, which may or may not cover the local area. Furthermore, scheme organisers tend to select the larger, better-resourced farmers as contract growers because they are able to comply with the exacting field standards that are required; the seed scheme therefore provides income opportunities only for a select portion of the community. Within households, too, any benefits associated with the scheme tend to be directed to male members of the family. Seed crops are viewed as cash crops and are therefore usually a male preserve and scheme organisers tend to deal with male household members when handing over inputs, passing on production advice, etc.

As regards the economics of this kind of conventional smallholder seed production, the evidence is that such schemes do not save costs compared to company seed farms or large-scale contract growers. In Malawi, for example, the state marketing corporation found that it had to sell seed produced by smallholder growers at a loss (Cromwell and Zambezi, 1993). In fact, costs are often increased because higher levels of supervision are required, and dealing with large numbers of small growers adds to logistical costs for input delivery, field inspection and seed collection. In addition, there can be problems caused by the difficulty of ensuring the necessary isolation distances within a small farm community.

These costs are additional to the normal premium over grain prices that has to be paid to seed growers. At the same time, the demand for certified seed of modern varieties is relatively elastic with respect to price amongst the majority of farmers in developing countries. These are the 300 million farmers who operate in areas of comparatively low potential, which Chambers (1989) classifies as 'complex, diverse and risky' (CDR). These farmers tend to have limited resources of land and capital at their disposal and they are often unwilling to pay for MVs: seed is selected for its ultimate benefits (primarily increased or more secure production), so where MVs cannot provide these benefits – which is often the case in CDR areas – they will not be bought; and furthermore, even when there appear to be advantages to purchasing seed, households in CDR areas may not have the cash to pay for it. Added to this, supplying seed to CDR areas is more expensive in terms of increased transport costs, supplying suitable varieties, and gathering the necessary information about households' preferences.

All these factors result in there being significant imperfections in the market for seed produced by smallholder growers. This is illustrated in Figure 1, which shows farmers' demand for this kind of seed and the supply of seed by smallholder growers. Other things being equal, seed would have to be offered at price Po in order for the market to clear i.e. for farmers to purchase the full quantity supplied by smallholder growers. Seed suppliers in fact charge Pt, due to the increased cost of seed produced by smallholders and the additional transactions costs (the additional costs of doing business in markets which are not perfectly functioning) of serving CDR farmers. The cost of gathering information about households' seed preferences in order to supply appropriate varieties, is higher, as are transport costs. Furthermore, given the additional transaction costs faced by farmers in CDR areas, such as the difficulty of assessing the quality of strange seed from visual appearances alone, then the demand for seed in these areas is reduced. Thus, instead of supplying quantity Qo at price Po, the price charged is increased to Pt and the quantity supplied is reduced to Qt.

Alternative farmer-based seed schemes

Based on our studies of the seed sector in many developing countries, it is our contention that re-thinking smallholder seed production could bring a number of economic benefits, both to seed producers and to seed purchasers. A growing number of NGOs are now experimenting with alternative farmer-based seed schemes derived from this kind of re-thinking. In Ethiopia, for example, the Canadian Unitarian Service Committee's Seeds of Survival Programme, in conjunction with the Ethiopian Plant Genetic Resources Centre, has organised multiplication of teff and sorghum seed using an adaptation of farmers' traditional seed systems. And since 1989 the Ecuadorian centre for agricultural services, CESA, has supported a similar scheme for potato seed multiplication and sale in local markets in the Ecuadorian Andes (Cromwell et al, 1993).

Some changes would need to be made if schemes made greater use of existing traditional seed systems within communities rather than copying formal sector production and distribution systems. Proximity of seed production and distribution is important. This emphasis on local level factors is not meant to suggest that greater use of traditional seed systems is a panacea, but failure to address these factors has led to failures in both conventional seed system development. Note that the precise economics of seed demand and supply varies between crops, depending on seed biology and also, importantly, on crop utilisation: what follows is only an outline of some of the principal points to be taken into account. These suggestions relate to generatively-propagated food crops, such as maize, beans and groundnuts.

The diversity of demand

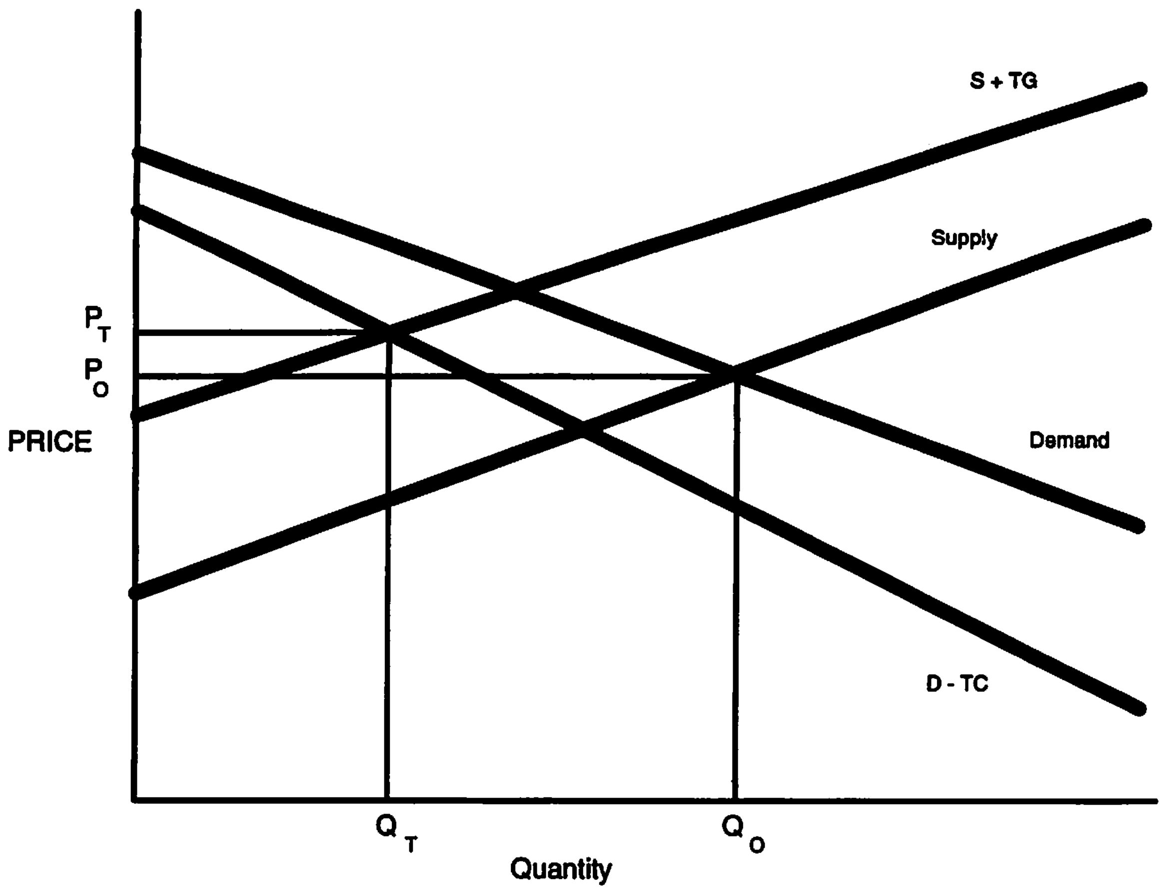
In CDR areas, households want seed for a large number of different crops. They also want seed of various cultivars for each crop. It is now widely recognised that farmers select cultivars on the basis of criteria that go well beyond the yield potential envisioned in conventional plant breeding schemes (Haugerud and Collinson, 1990). Cultivars of different maturities are often required to accommodate early or late planting, variability in rainfall, or compatibility with intercrops or rotations; storage characteristics often assume greater importance for the farm household than for the plant breeder; local food preparation techniques and preferences often favour one cultivar over another; utilisation of non-grain biomass (leaves, stalks, etc.) for fodder, fuel or building material provide additional selection characteristics; and local crop markets may reflect a different set of demands from urban ones. These (and other) factors are not ethnographic curiosities but rather form part of the rigorous selection criteria that farmers use in accepting, or rejecting, seed of a new cultivar.

Richards (1985) describes 60 distinct rice varieties in one village in Sierra Leone, with each household growing 4–8 varieties. Equally important, he describes the gradual turnover of these local cultivars, as farmers continually seek better performance and as environmental and economic conditions (and hence selection criteria) change. These rice farmers are more interested in the evolution and improvement of their rice cultivars rather than in the maintenance of particular varieties. This combination of diversity and change means that, in comparison to larger farmers, small farmers are both more demanding of the seed system in terms of varietal characteristics, and more tolerant in terms of varietal purity. This argues for more local involvement in the varietal selection and seed production process, and less emphasis on the usual release criteria of distinctness, uniformity and stability.

Size of demand

Not surprisingly, resource-poor farmers tend to demand relatively small quantities of seed. This is not only a function of land holding. We have seen that farmers often grow several cultivars of the same crop. In addition, most farmers attempt to save seed from one season to the next, in order to avoid cash expenditure. This is not to say that small farmers are not potential customers for good

Figure 1. Small farmer market for seed



seed; Pray et al (1991) describe the widespread purchase of hybrid millet seed by small farmers in India, for instance. But in general, seed replacement takes place less frequently than recommended.

Surveys in Zambia and Burundi respectively indicate that households typically seek to acquire no more than 10 kg of maize seed and 15 kg of bean seed per cropping season (ARPT, 1991; Sperling, 1993). Similarly, a survey carried out by Cromwell and Zambezi (1993) in Malawi reports typical quantities as being 5 kg for maize, 14 kg for groundnuts and 6 kg for beans. These amounts contrast to the standard pack sizes provided by conventional seed schemes, which are often sufficient to plant a hectare at recommended seeding rates. The pack size itself is cited as a significant disincentive to buying formal sector seed (Friis-Hansen, 1992; Cromwell and Zambezi, 1993). Formal seed schemes are now learning to package and distribute seed in smaller quantities, but this obviously adds to the cost. A more flexible system of accommodating small and variable demands for seed at the local level would have advantages.

Security of supply

Farmers want to know that seed will be available when they need it. Judgements on when and what to plant are often made at the last minute. The rains may be early (or late), a first planting may have been lost to drought or pests, or a field or the equipment to prepare it may have become available at the last minute. Although it is often best to plant as early as possible, there are many unavoidable factors that cause delays, and farmers will be unlikely to tolerate the late arrival of seed as an additional burden. But this is often the situation in formal seed provision schemes, such as parastatals, with bureaucratic procedures for the allocation of vehicles and few incentives to encourage punctuality.

There are limits to the ability of any seed system to respond to the variable demands brought about by last-minute planting decisions, but proximity of supply is undoubtedly an advantage. In the Punjab of Pakistan, where most farmers obtain seed of new wheat varieties from other farmers rather than the seed depot, over half obtained seed in their own village, and more than 80% travelled no more than 5 km in search of seed (Tetlay et al, 1990).

Anything that can be done to favour more local level seed production will result in a saving for farmers. Transport costs are a major component of total seed production costs; cutting out the long-distance transport of seed from production site to distribution points would thus substantially reduce costs.

The formality of the seed system

Another area where conventional smallholder seed production schemes could be changed concerns the typically strict adherence to seed 'regulatory frameworks'. By this we mean the set of seed laws, regulations, norms and standards that govern variety release and seed certification. We have already seen that the range of characteristics that farmers use in choosing varieties argues strongly for farmer participation in the varietal testing and release process. But laws and regulations that establish strict limits on the nature and quality of seed to be sold may also impose unneeded restrictions on farmer-based seed schemes. Households in CDR areas do not want or need seed to meet all the standards that International Seed Testing Association (ISTA) based certification systems provide; whilst the physical purity of seed and good germination percentages are valued, characteristics such as uniform seed size are often irrelevant.

Except in certain environments where seed-borne diseases or off-season storage is a particular problem, the physical quality of seed sourced from small farmer seed systems is usually adequate. Gore (1987) reports that trials for farmer varieties collected in Zimbabwe show germination percentages of above 94 per cent for maize and 'higher than expected' for sorghum and millet. Genetic quality is also usually adequate, because a considerable amount of in-field roguing and post-harvest selection takes place. For self-pollinated crops, Heisey and Brennan (1991) report average yield losses from own-saved seed ranging from nil to 1.6 per cent per cropping season. Farmers' indigenous seed care skills and technologies thus appear to produce seed of equal or better quality to that produced by the formal seed sector (Osborn, 1990; CIAT, 1991; Janssen et al, 1992; Sperling and Scheidegger, 1992).

At the same time, households are unwilling to pay for the additional cost of packed seed (packing seed is an integral component of formal sector seed certification schemes). Households will happily use seed from crops they have seen growing on neighbours' land, substituting 'neighbour certification' (Scheidegger et al, 1989) for formal seed certification (Singh, 1990), which unfortunately does not always guarantee high seed quality in any case.

Strict formal regulations on the type of seed offered for sale are meant to protect farmers, but if farmers have no access to either the legal system or to information on the exact source of the seed they are offered for sale, and if lack of resources at the state level means that the rules are either abandoned or followed strictly for a limited production of seed, farmers are not well served. There are now a number of examples of attempts to make the regulatory frameworks more flexible, ranging from mechanisms to allow farmers to have access to varieties before release (SADCC, nd) to proposals for more realistic alternatives to seed certification (FAO, 1993).

Seed distribution

Another advantage of integrating seed production with distribution through schemes that build on existing traditional seed systems is that small farmer seed producers have access to a wide range of distribution modalities. They are often prepared to provide seed using exchange mechanisms other than cash. These include bartering for other commodities, labouring in return for seed, swopping seed of one variety for another, and gift giving based on social obligations. In many areas cash purchases or the use of credit are limited to the better-resourced households and the need to pay cash is cited frequently as a disincentive to the use of formal sector seed schemes (Friis-Hansen, 1988; ARPT, 1991; Cromwell and Zambezi, 1993). Thus non-cash alternatives are an important means of giving a wide range of socio-economic groups access to seed.

This is not to say that local seed distribution mechanisms function perfectly. Examples range from the wide search for new rice varieties in Sierra Leone described by Richards (1985) to the parochial characteristics of maize seed supply and varietal knowledge described by Friis-Hansen (1988) in Tanzania. But there is no doubt that when there are appropriate incentives, local level seed production can function and can expand to include complex networks that cover wide areas (Siemonsma and Linnemann, 1988; Scheidegger et al, 1989).

Social equity and gender issues

Modifying conventional smallholder seed production schemes in the ways outlined above will not necessarily enable wider community participation in the income from seed production. Seed production requires time, land and knowledge – none of which are likely to be in the hands of the poorest.

The social equity of traditional seed systems needs to be monitored carefully. The limited work that has been done suggests that this is influenced by the existing degree of social differentiation within communities and the nature of patron–client relations. In some communities it may be more discriminatory than so far assumed (Cromwell, 1990; Sperling, 1993). For example, access to seed may be limited to certain ethnic or social groups; or access mechanisms may perpetuate poverty through, for example, requiring large quantities of seed to be returned in payment for in-kind seed loans. In some areas, however, structures are more equitable. Muslim communities in Sudan and Mali have been documented as operating a seed tithe which is planted out in community seed plots (NEF, 1988; Renton, 1988).

It is important to consider the specific seed needs of women farmers. In many areas, female-headed households form a significant proportion of the community. Typically, relative to other households, they are short of labour and of cash and can therefore make only limited use of seed provided by formal sector schemes. Women within male-headed households are usually responsible for ensuring the domestic food needs of the household and they are particularly concerned with the storage, processing, cooking and organoleptic qualities of cultivars used by the household. However, these requirements are often relatively neglected by formal sector plant breeders who interface primarily with the male members of farming communities. It is important to ensure that alternative farmer-based seed production and distribution systems do not unduly transfer attention and resources away from women.

However, making the changes described in the previous section should help to reduce seed costs, thus closing the gap between seed supply and demand for seed that was outlined in Figure 1 and allowing small farmers in CDR areas better access to a wider range of quality seed at affordable prices. There is no moral hazard involved in obtaining seed through traditional seed systems, because households usually know the person supplying seed to them and often will have seen the crop from which the seed is supplied growing before harvest. Equally importantly, households are able to obtain seed of their preferred cultivars, which they know to be adapted to their particular production conditions. Individuals and households supplying seed charge lower prices because they do not face the additional transport, seed certification and information-sourcing costs of the formal sector seed suppliers (Singh, 1990; Cromwell and Zambezi, 1993; Sperling, 1993).

The role of external organisations

Too often, small farmers are already using low-cost systems of seed production, storage and distribution which produce good results but formal sector researchers and extension workers 'do not know about these practices and insist upon more sophisticated and costly methods' (de Queiroz in CIAT, 1982). They borrow unnecessarily from the organisational structures and quality standards of the formal sector, thereby incurring high costs and making it difficult for conventional smallholder seed production schemes to achieve economic viability in the long run.

For those agencies seeking to become involved in small farmer seed schemes, there is considerable scope for building on existing traditional structures for producing and distributing seed within the community rather than setting up new conventionally-organised smallholder schemes. This is often more likely to ensure the sustainability of the initiative in the long run.

However, some modifications may be needed to ensure that seed reaches social groups without access to traditional community seed distribution mechanisms, such as certain ethnic groups, women farmers and poorer households. For example, a limited quantity of seed may be targeted on these groups by being distributed through other local development agencies working with them, such as church groups or health projects.

Linkages with institutions supplying extension services, complementary inputs, etc are essential. It is important for external organisations to provide support for strengthening such linkages, which are often weak in CDR areas.

A much longer time span of support is needed than many agencies currently anticipate. Alternative farmer-based seed schemes may take at least ten years to develop to a degree where they are sustainable without outside support, even in favourable circumstances (Verbrught in CIAT, 1982).

Finally, organisations working with farmer-based seed schemes must recognise the significant influence on the economics of seed demand and supply of national-level policy decisions. Of particular importance are those relating to seed legislation, seed and grain pricing policy, and plant breeding – the extent that the needs of farmers in CDR areas are catered for.

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Forage seed production systems in Ethiopia

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Introduction

Livestock production is very important to the Ethiopian economy. Improving animal nutrition using sown forage species is an important step in supporting and improving livestock productivity.

The Fourth Livestock Development Project (FLDP) of the Ministry of Agriculture (MoA) has promoted a number of forage development strategies which have already gained wide acceptance both within MoA and in other organizations. The major thrust is towards more intensive feeding management through shifting livestock from uncontrolled and environmentally destructive systems into more intensive management systems. This can greatly improve livestock production and also facilitate more sustainable cropping and lower-cost erosion control.

The major forage development strategies are:-

1. Development of forage strips or alleys.
2. Establishment of backyard forage plots.
3. Improvement of stock-exclusion areas.
4. Undersowing of legumes into annual crops.
5. Sowing of perennial forage legumes under perennial tree crops.
6. Oversowing legumes onto uncontrolled grazing areas.
7. Establishment of perennial mixed grass/legume pasture, primarily for dairying.

It is not feasible to meet the seed requirements of these strategies through importation. The success of the forage development programme depends upon the establishment of a local seed production capacity for the supply of large volumes of seed.

Previous work on seed production in Ethiopia

Pasture and forage seed production began in the 1970s. The Arsi Rural Development Project (ARDP) was the first organisation to be involved in seed production, the major species of concern being fodder crops. The Institute of Agricultural Research (IAR) was also involved in seed production. However, the primary target was to meet the requirements of its research programme and to distribute to some other government organisations. The Soil and Water Conservation Department of the Ministry of Agriculture has also initiated seed production of grasses and legumes in nurseries. The International Livestock Centre for Africa (ILCA) primarily concentrated on screening species for forage potential and producing small amounts of seed for experimental purposes. Recently, ILCA has been producing larger quantities of seeds of promising accessions to provide starter seed for national forage seed production efforts.

Current forage seed production systems in Ethiopia

Contract seed production

The most successful method of producing at least pasture legume seed has been to contract village farmers to grow the seed for sale. The area cultivated by an individual farmer rarely exceeds 0.2 hectares, although some producers grow up to 5 hectares. The Fourth Livestock Development Project of the Ministry of Agriculture introduced the seed contract system of forage seed production in 1987–88. The aim was to produce high-quality seed locally at a lower price and in greater quantities in centrally controlled seed production systems. The system involves producing seed under contract with individual farmers and co-operatives. The seed contract is attractive to most farmers and cooperatives. This results in large seed production per unit area and more seed at lower costs per kilogram produced than from daily paid labour on large farms.

The seed contract is a legally binding agreement between the Project and the farmer cooperative. Both the Project and the producer must make a certain commitment under the seed contract.

The Project must:

- Provide seed for initial sowing.
- Provide close supervision and technical backup for the seed plots.
- Purchase the seed for cash at an agreed price at a specified time.

The producer must:

- Produce high-quality seed.
- Grow the seed in an area of the farm specified by the responsible technical staff.
- Manage the crop.
- Clean the seed after harvest and deliver it at a specified time.

Contract prices are based on estimated yield, production costs, specific project requirements and the cost of imported seed. Contracts are arranged before the crop is grown, and project staff ensure that land is prepared for planting. Regular visits are made to ensure that crops are properly managed and seeds are harvested in a timely way.

Besides the suitability of environment, the success and efficiency of the programme was found to be dependent on the enthusiasm of farmers, availability of land and labour and level of farmers' income. Although it is desirable to spread the programme over a wide range of geographical locations and environmental conditions to ensure growing conditions suitable for a wide range of species, it is important to cluster production sites to facilitate supervision and seed collection.

Pasture seed production is unlikely to compete with production of other crops since the total area allotted to specialised seed plots will rarely exceed 500 hectares in the foreseeable future. This amount is negligible compared with the cultivated crop land.

Opportunistic seed collection

Seed is also harvested on an opportunistic basis from forage plots and areas established primarily for other purposes. Apart from the contract scheme, FLDP purchases any seed collected from forage development sites. Herbaceous legume, tree legume and grass seeds are opportunistically harvested from ranches, stock-exclusion areas, road sides, forage strips and undersown sites.

Promotion of forage seed production

Legumes constitute the dominant species in the current forage seed contract production programme because of difficulties in managing and harvesting grass seeds. The major species under seed production are *Leucaena*, *Sesbania*, Tagasaste, Lablab, Vetch, Cowpea, Stylo (Seca & Verano), *Desmodium*, Siratro and *Axillaris*. Annual species (Vetch, Cowpea) and fodder trees currently account for the great majority of production. The project's capacity for seed production at present is 100–120 tonnes per year. Accurate statistics on production are difficult to obtain and available information suffices only for a crude estimation of seed yields.

Seed quality is difficult to define because of the absence of seed quality testing facilities. Purity and germination are very important and will be addressed once construction of the seed store and laboratory is completed.

The farm community has been selected as the extension unit because of its convenient size, suitability to obtain credit and the presence of a development agent, who is responsible for forage seed production.

Some of the advantages of this extension approach are:

- The extension approach is used to make farmers retain their own seed for subsequent sowing, such as for undersowing maize and sorghum with vetch and cowpea, and contract seed production.
- FLDP's seed production efforts, by involving smallholder farmers through the contract scheme, have demonstrated the potential of local seed production. About 90% of the requirements for forage seeds are currently met by local production.
- Involvement of farmers in backyard nursery seedling production has assisted in reducing dependency on governmental and non-governmental nurseries and also acquainted farmers with the growing and survival behaviour of the fodder trees.
- The extension approach is also useful to make farmers expand their area under forages. This improves farmers' involvement in dairying, animal fattening and small ruminant production.
- The extension packages and materials produced on forage development, dairy production, small-scale fattening and forage-seed production have raised the interest and participation amongst development workers and farmers at all levels.

Farmers' knowledge and practices in smallholder seed production, with special reference to a case study in Central America

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Abstract

The importance and dominant role of farmer-managed local or informal seed supply systems in developing countries and the dynamic way in which they develop is described. Examples of farmers' knowledge and practices are given. Results are presented of a case study in Central America which illustrates the integration of local systems within their agro-ecological and socio-economic contexts. As these systems are a vital and integral part of the complete farming systems into which they fit, they should not be studied in isolation. The need for better use of local knowledge is stressed. It is concluded that local and formal systems have a complementary value and that seed technologists and farmers should join their efforts in a participatory approach. The question is not whether both parties should cooperate, but how this cooperation can be made more productive.

Introduction

Throuthout history, farmers' communities have developed cultivated plants. Natural selection and human interference have led to a wide range of crops and varieties which are adapted to all kinds of ecological and cultural conditions. As part of their overall farming system, farmers have developed seed supply systems for maintening and developing seeds and planting materials. These systems have been called 'traditional', 'local' or 'informal' systems, as they are often seen as opposite to 'modern' or 'formal' seed supply systems. Although totaly 'informal' and totally 'formal' seed supply systems do exist, in most cases seed supply systems contain elements of both. In most developing countries, especially in marginal areas and areas with variable ecological conditions, seed supply systems contain more elements of the 'informal'. In 'modern' agriculture 'formal' seed supply systems are dominant.

The importance of farmer-managed seed production systems has been largely underestimated by breeders and seed technologists. Consequently these systems have not recieved sufficient research attention. Information on the subject is scarce and is more likely to be found in anthropological and sociographic literature. However, interest in these systems is growing, partly because the high expectations of 'improved' varieties and 'modern' technology have not been realised.

One of the studies aimed at giving a better understanding of farmer-managed seed supply systems was undertaken by the Development Research Institute, IVO, Tilburg, The Netherlands, in cooperation with the Agricultural University Wageningen, The Netherlands, with financial support from The Netherlands Minister for Development Cooperation. After a study on seed industry development in India, Kenya and Thailand (Groosman et al, 1991), a study on local seed supply systems and food security was carried out between 1991 and 1993 in Nicaragua, Honduras and Costa Rica, in cooperation with local institutions. As a part of the study a bibliography on local seed supply systems was composed (IVO et al, 1992), the final report on the study has been published (Wierema et al, 1993) and a review paper has been accepted for publication (Almekinders et al, 1994). This article is principally based on the results of the review paper and the case study of the IVO project.

Importance of farmer-managed seed supply systems

Seed sources

The main seed sources for farmers are: own production; neighbouring farmers and friends or relatives; the local market; local government or development projects; and the formal seed sector. In developing countries most of the seeds or planting material for most crops, particularly food crops, are produced by farmers themselves. The main advantages of this are that the seed quality is known, the seed is readily available and it is cheap. According to Delouche (1982), at least 80% of the seed of the main food crops is produced by the farmers themselves, a figure that is confirmed in other reports. Muhammed et al (1985) found that home-grown seed was predominantly used in the Machakos area of Kenya (Table 1).

Delouche's figure of 80% refers not only to seed of locally developed varieties, but sometimes includes the seed of modern varieties which were introduced from elsewhere and multiplied by the farmers. This is particularly important for self-pollinating crops such as rice and wheat. Seeds from improved varieties of cross-pollinating crops, such as maize and sorghum (including seed from hybrids) are often used by farmers for their own local multiplication and selection.

Table 1. *Seed sources as percentage of total seed use in Machakos area, Kenya, short rains 1983.*

Seed Source Crop	Own seed	Commercial	Neighbours	Local market
Maize	83	12	1	4
Sorghum	77	8	8	5
Beans	89	2	2	7
Cowpeas	80	2	8	10
Pigeon peas	81	1	2	15

Source: Muhammed et al, 1985

In many developing countries the adoption of improved varieties of some food crops is significant, particularly in uniform and high-potential areas. However the annual share of the formal seed sector in the total seed supply is very limited. According to Almekinders et al (1994), it rarely exceeds 10% in most staple crops, with hybrid seed supply for maize and sorghum being the main exceptions. Estimates of the use of certified seed of a number of food crops in some African countries are given in table 2 (DANAGRO, 1988).

Variety development in local systems

There are several indications that farmers' communities have some capable breeder/selectors, often women, who are involved in a more or less permanent process of selection. They select varieties which are best fitted to the specific agro-ecological conditions of their different fields and to the socio-economic conditions of their farm. In an attempt to cover possible seasonal hazards (drought, excess water, infestations of pests and diseases, etc.) they also plant different varieties within a mixture. In order to cover many situations, a large number of varieties is needed. For this reason, farmers permanently try out and incorporate new plant material into their production system. This means that newly introduced varieties, even from the formal sector, may become 'local' after some time, particularly in the case of cross pollinating crops.

Table 2. *Use of certified seed in per cent of total area sown in a selection of African countries.*

Crop	Maize	Sorghum	Wheat	Rice	Common Bean	Ground-nut
Country						
Angola	15	0	50	0	–	0
Botswana	66	100	–	–	0	<1
Lesotho	75	5	38	–	4	–
Malawi	10	5	19	12	4	0
Mozambique	10	5	13	0	–	–
Swaziland	98	21	80	100	2	0
Tanzania	14	9	15	1	<1	0
Zambia	70	0	97	0	12	<1
Zimbabwe	83	25	97	0	0	<1

Source: Adapted from DANAGRO, 1988

Farmers' criteria

Farmers usually farmers judge a variety according to their own criteria. Although yield is always important, small farmers tend to prefer yield stability to maximum yield, in line with their policy of risk avoidance. Apart from selection criteria like resistance to pest and diseases, which are generaly important, other specific criteria may be included, such as growth period, suitability to intercropping, taste, shape, colour, secondary uses, etc. To ensure that important criteria are not overlooked, farmers' judgements must be incorporated into any outside selection work.

Seed production, storage and diffusion

In retaining seed for the next season, most farmers apply some selection. However, the intensity of the selection appears to vary greatly. Seed can be selected before or after harvest, and is sometimes produced in plots which get special treatment.

Farmers have developed a variety of storage practices, such as in the smoke of the kitchen, in ashes, in sealed containers or in calabashes. Observations also indicate that the non-genetic quality of farmers' seed is often as good as seed from the formal sector. There are a number of systems for diffusion of introduced or locally developed varieties based on traditional social networks. Some illustrative examples were described by Cromwell (1990).

Examples of farmers' knowledge and practices in local seed supply systems

There are numerous examples indicating farmers' expertise in seed production systems, and their knowledge of production conditions and cultivar characteristics.

Vink (1946), working in Indonesia, made some illustrative observations on farmers' practices.

"Often one hears the tale that the local farmer does not do any selection in his seed or planting material. This is stated in many official reports. However, this is incorrect. Farmers easily recognise fruit trees of good quality and try to get planting material from them. In good rice production areas people take good care of purity, cleanness and health of the seed, especially when one deals with varieties which easily change genetically, because they are sensitive to cross pollination. Often a few women in a village are known for their capability in selecting plants for seed before the harvest starts. The selected ears are put aside and stored more carefully than the rest of the harvest, e.g. in the smoke of the fire."

A second citation relates to adaptability of new varieties.

"In many regions the farmers are continuously looking for better varieties and in general the extension service is very successful with introduction of varieties which have proved to be good. Gradually the farmer adopts them, and if he does not adopt a new variety, one can be sure that something is wrong with it, which means that the extensionist has to search that out."

Box (1984) found that cassava farmers in the Dominican Republic had a stock of many more varieties than they actually used for production, in fact an informal germplasm collection. He found that the farmers used their collection to select varieties which were suitable for fields where soil fertility was decreasing and where they were facing root rot problems.

Cock (1986) called Colombian cassava farmers very good plant breeders because of the way they had adapted their varieties to the local conditions. He found that they had developed a good system for testing and diffusing new varieties. In the northern coast area of Colombia farmers had completely adapted their spectrum of

varieties because of changed conditions. He suggested supplying farmers with the rough material from breeding work and leaving further selection and diffusion to them.

A good example of traditional regional collaboration is reported by Linnemann and Siemonsma (1987). In certain villages in East Java, Indonesia, mung bean fits very well into the cropping pattern. However, it can only be grown once a year, at the end of the rainy season. As the seed of the mung bean can only be stored for a very limited period, seeds must be bought for every planting. Some villages in an area with a different climate have specialised in seed production and supply mung bean seed throughout the year.

Berg (1993) noted how he discovered local plant breeding activities in southern Sudan by accident. A germplasm collection team had understood that in a certain village they had been granted permission to take some heads of sorghum. However, there had been a misunderstanding, because on picking the sorghum a woman came up, shouting after them. They found that the women was responsible for selecting the supply of seeds. She would select the best sorghum heads from the field before the harvest could start. Removing seeds before she had made her selection was forbidden. The team had violated that prohibition. Through the incident it became clear that there was a strong culture of plant breeding, that the breeders were women and that the selection was done in the field immediately before harvest. However, further information revealed that the process was more complicated. The final selection was also based on observation during the growing season, in which all farmers could be involved.

Almekinders (pers. observation) found that farmers in the zone of Rio Tinto, Honduras, were growing a maize hybrid, Dekalb, in the valley and local varieties on hill sides which were not suitable for Dekalb. However, the farmers also selected within the offspring of the hybrid, which was the result of crossing with the local varieties. These selections were grown on the lower hill sides. The farmers maintained the purity of the local varieties for growing on the higher hill sides.

In The Netherlands there is a long tradition of informal potato breeding by farmers and other people who practice breeding as a hobby. The famous Dutch potato variety 'Bintje' was bred by a schoolmaster at the beginning of this century. At present at least 200 hobby potato breeders are active and play an important role in potato breeding. Most recognised varieties have been through their hands. However, the number of people involved in crossing is decreasing. It is becoming more common for crossing to be done by professional breeders. Hobby breeders then do the early selection work for four to five years. The selection is finalised by the professional breeders.

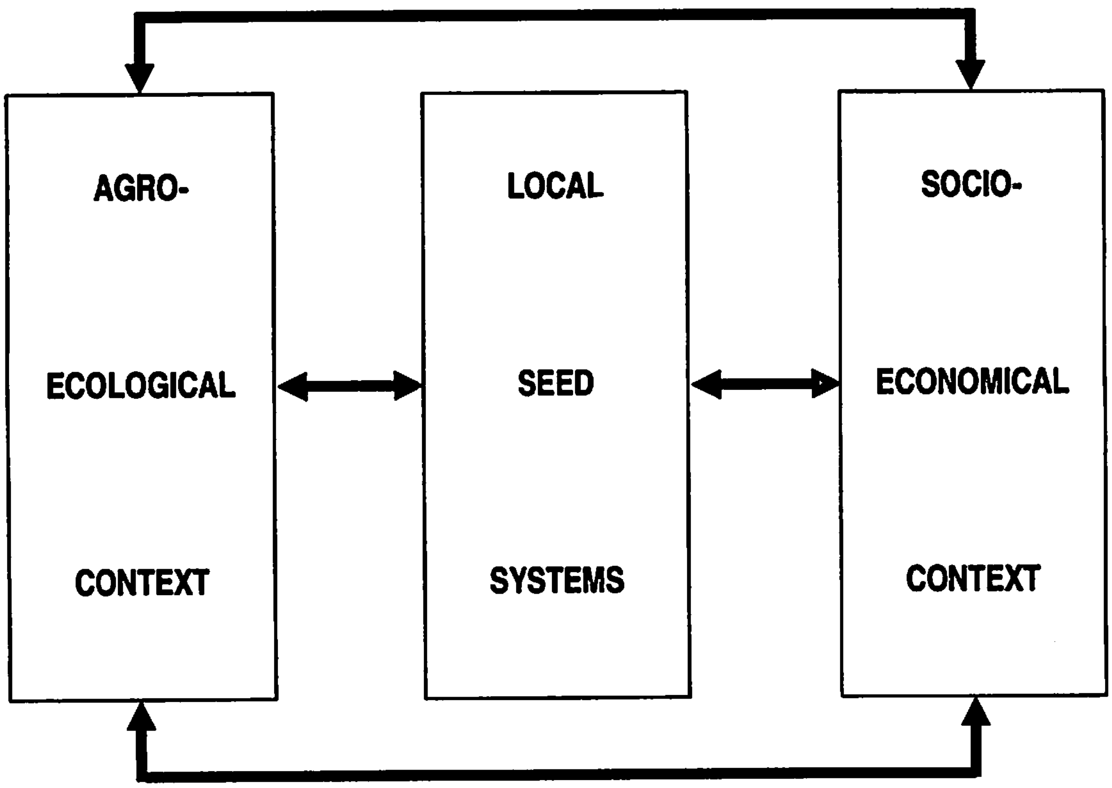
In East Java, Indonesia, a cassava production system was initiated by a farmer named Mukibat (de Bruijn and Dharmaputra, 1974). In the Mukibat system, tree-cassava (*Manihot glaziovii*) is grafted onto ordinary cassava, which leads to very high yields from backyard production in certain areas.

The above observations and anecdotes could be extended by many more examples. De Boef et al (1993) presents many examples of farmers' extensive and sometimes complex knowledge of plant selection and seed production. They provide a clear indication that farmers are aware of and care about genetic and non-genetic seed quality and prove that farmers are capable of maintaining and improving genetic material. The clear involvement of farmers in local seed production systems leads to the conclusion that any selection programme should make as much use as possible of the local farmers' knowledge. Sperling et al (1993) found that direct involvement of farmers in the selection process can lead to better breeding results.

Case study on local seed production in Central America

The main purpose of the IVO study (Wierema et al, 1993) was to collect more knowledge about local seed supply systems and their relation to farmers' food security strategies. The study was carried out in Costa Rica, Nicaragua and Honduras. During the study, 157 smalholders growing maize and common beans were interviewed. They represented 10 zones with varying agro-ecological and socio-economic conditions over the three countries. The suitability of the seed supply system was considered in the light of a total agro-ecological and socio-economical context, including their interactions (Figure 1).

Figure 1. *Local seed systems and their contexts*



The questionnaire covered all aspects of the agro-technical and socio-economic conditions, such as type and number of varieties, seed sources, cropping techniques, degree of mechanisation, farm size, family composition, role of women, labour availability, etc.

In the study, three types of varieties and three types of technologies were considered.

Varieties

a) Local. Varieties which have been part of the local system for more than 10 years and where the origin is not known.

b) Improved. Varieties which originate from a non-local special breeding or selection programmes.

c) Modern. Varieties which originate from more sophisticated breeding programmes, e.g. hybrids.

Technology

a) Local. Technology which has been common in the area for a long time and which predominantly belongs to cultural traditions.

b) Improved. Local technology of seed production has been improved by a number of innovations from outside sources.

c) Modern. Sophisticated modern technology is used in the seed production process.

Six different types of seed supply system were defined (Figure 2). As the survey did not include farmers using modern technology, only four types of system were distinguished in this study. Table 3 presents an overview of the seed systems for maize and beans in the three countries. Table 4 gives the average percentage of farmers using the four systems in the three countries. The results of the survey show that the farmers are clearly intermediate between a pure local system and a modern system. The farmers use a mixture of local and improved varieties and local and improved technology, which is a logical result of a rational process of decision making. Farmers accept what fits with their system and do not accept elements which do not.

Figure 2. *Systems of seed supply*

Type of technology	Origin of variety		
	Local	Improved	Modern
Local	Closed local system	Open local system 2	
Improved	Open local system 1	Improved system	
Modern	Open local system 3	Modern system	

The varieties used by the farmers are shown in Table 5 and the source of seeds in Table 6. The types of variety used and the degree to which improved varieties are used varied between the countries and locations and differed for maize and beans. Farmers show a clear preference for using seed they produce themselves. However, farmers with little land sold or consumed their seed more often than did farmers with larger farms. Although the formal seed sector had a considerable impact on the introduction of varieties, the regular purchase of seed from the formal sector was limited.

Table 3. *Types of seed systems in the three countries, based on numbers of varieties.*

Country Seed system	Costa Rica	Honduras	Nicaragua	Total
Maize:				
Closed local	14	25	22	61
Open local	26	19	25	70
Improved	11	10	18	39
Total	51	54	65	170
Common beans:				
Closed local	18	34	33	85
Open local	48	42	21	111
Improved	33	18	42	93
Total	99	94	96	289

Source: Wierema et al, 1993

Table 4. *Types of seed systems for maize and beans (total=100%)*

<table>
<tr><td rowspan="2">Type of technology</td><td colspan="3">Origin of variety</td></tr>
<tr><td>Local</td><td>Improved</td><td>Modern</td></tr>
<tr><td>Local</td><td>Closed local
Maize: 36% Beans: 29%</td><td colspan="2">Open local 2
Maize:16% Beans: 24%</td></tr>
<tr><td>Improved</td><td>Open local 1
Maize: 25% Beans:15%</td><td colspan="2">Improved
Maize:23% Beans:32%</td></tr>
</table>

Source: Adapted from Wierema et al, 1993

The results of the case study generally confirmed much of the information obtained from the literature study. The results indicate that seed systems are heterogeneous and dynamic. The nature of the systems is congruent with the possibilities and limitations of the agro-ecological and socio-economic contexts. Farmers who are closer to subsistence level grow more local varieties because of the need for yield stability than farmers who have more economic possibilities.

Farmers were using similar production technology for local and introduced varieties. Crossing between open pollinated and hybrid maize was found to be common practice. Hybridisation between local and introduced varieties to combine desired characteristics is apparent. The varieties Rocamex and Sintético Tuxpeño are illustrative examples of introduced maize varieties in Nicaragua and Honduras, which were transformed by farmers into local cultivars.

Table 5. *The use of local and improved maize and common bean varieties by farmers (% of interviewed farmers per country) in Costa Rica, Nicaragua and Honduras.*

Country Variety used	Costa Rica	Honduras	Nicaragua	Average
Maize:				
Local	65	34	52	50
Local and improved	12	28	21	20
Improved	22	38	27	29
Common beans:				
Local	21	44	27	31
Local and improved	48	10	42	33
Improved	31	46	31	36

Source: Adapted from Wierema et al, 1993

Table 6. *Seed source of maize and beans plots (% of total number of cases) in 1991 in Costa Rica, Nicaragua and Honduras.*

Country Seed source	Costa Rica	Honduras	Nicaragua	Average
Maize:				
Farmers' own seed	79	75	81	78
Other local sources	19	13	12	15
Formal sources	2	13	6	7
Common beans:				
Farmers' own seed	58	79	72	70
Other local sources	21	15	14	17
Formal sources	21	6	13	13

Source: Adapted from Wierema et al, 1993

Discussion

The findings of this case study confirmed results from other research, and also clearly placed the local seed systems into their agro-ecological and socio-economic contexts (Figure 1). Seed systems should not be looked upon in isolation, as they are a part of complete farming and household systems. The conceptualisation of local seed systems by combining the type of the varieties and the type of technology used (Figure 2) gives more insight into their dynamics. There are all kinds of intermediate situations between purely 'local' and purely 'modern' varieties and technologies. This leads to a large range of seed systems, in line with the heterogeneity found in the field.

This case study shows that type of varieties and technology which fit in a local situation depend on the local farming systems. The best way to understand the system is to cooperate with the farmers. Local and external knowledge and/or technology can therefore be combined in a complementary way and lead to satisfactory development. Indeed, local crop development and plant breeding are complementary activities (Hardon and de Boef, 1993).

Conclusions

There is no doubt that local seed systems play an important role in smallholder agriculture in developing countries. Local farmers have a wealth of knowledge on their seed systems, often more than is admitted by people from outside. There are many indications that those systems are dynamic and heterogeneous and that they are very much adapted to local agro-ecological and socio-economic contexts. They are a vital and integral part of the farming systems into which they fit.

If farming systems or elements of them change, seed supply systems will be immediately effected. For that reason a seed system should not be studied as a separate entity. The seed activities are often so well integrated that an apparent improved variety or technology may not be the best option for the farmer when considering the total farming system, where a multitude of resources and production and consumption purposes have to be optimised. This could explain why farmers do not often accept new varieties or technology.

Seed systems are location specific and also vary greatly within farmers' communities. Even within one production system the seed system may vary for different crops and for different cultivars. Cultivar maintenance and seed production and selection are intertwined activities which are integrated in the production system for the household and the market.

An informal or local seed supply system contains the same elements as a formal system. These include collecting germplasm, crossing, selection and testing of the suitability of the material at different locations, multiplication, storage, cleaning and maintenance, and finally the stage of diffusion. Farmers do all of this in their own way. Improvements can be made, but it is not always easy to determine where improvements will be most effective.

The nature and dynamics of the local systems need further study, which will probably decrease prejudices about them. However, this does not mean that optimal development can be reached by using only local material and technology. Outside knowledge and material can have a complementary value for local systems. Seed technologists and farmers should not work in isolation, but rather collaborate in a participatory approach.

It seems logical that the efforts for development should start at the level of the farmers. Farmers are permanently trying to develop their systems and integrate new elements in them. They are therefore in the best position to judge the suitability of new technologies or new varieties for their situation. When studying improvements for developing systems it is important to have a full understanding of the initial system. In developing new varieties or technology, intensive contact with the final users is indispensable for good results.

This case study has shown that the question is not *whether* to take information on local seed systems and farmers' knowledge and practices into account, but *how* it can be done most effectively.

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Integrated seed supply: a flexible approach

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Summary

Formal seed systems, as promoted in numerous development projects and national policies, supply only a small portion of the total amount of seed planted by farmers and of a limited range of crops only. Local seed systems, which have been responsible for plant domestication and the development of land-races, are not sustainable under rapidly changing conditions and disasters. Integration of both systems is a technically interesting option. Linkages with on-farm research, gender groups and genetic conservation activities are needed. Methods for institutionalisation of integrated seed supply as a system of continuous seed improvement remain to be investigated.

Introduction

Seed is an essential element in agricultural production. The term 'seed' includes here both generative and vegetative parts of plants that are used for multiplication. The comprehensive system of plant breeding, certified seed production and marketing, which has been developed in the industrial world, is referred to as the formal system. Others use the words conventional (Camargo et al, 1989) or organised (Chopra and Reusche, 1991) seed supply. This is a vertically organised chain of activities leading to the use of certified seed of approved varieties and hybrids. There are basically two focal points in these systems: the commercial and the developmental (Louwaars, 1990). When seed production is principally a commercial undertaking, it is the market that drives the chain. In cases where developmental aspects prevail, seed production is in most instances undertaken in order to increase crop production by the use of 'improved' varieties, i.e. the breeding activity drives the seed supply chain.

Seed supply in developing countries has received considerable attention in agricultural development strategies since the 1960s. A wide range of seed projects has been launched since then. These projects have been built on the conception that every country can have a seed supply system which can be developed in a linear model in the way Douglas (1980) described. It is a simplification of reality to assume that these formal seed systems could be served by one blueprint development model in different countries. This is also true for seed supply within each country for a wide range of crops.

This widespread attention to the formation of formal seed supply systems in developing countries has resulted in a virtual denial of the existence of local seed supply systems. These consist of farmer selection, on-farm seed production and local diffusion. These activities are equivalent to breeding, production and marketing in the formal system. Since the farmer is primarily interested in the regular production of seed for his next planting and because selection and diffusion are not always equally important, the local seed systems can be considered horizontal. These systems are also referred to as 'traditional' (Camargo et al, 1989), informal, or farmer-managed seed systems (Cromwell et al, 1992).

There is never one seed system in any country, but seed supply is built on a number of dynamic processes of formal and local variety development and maintenance, and local and formal seed production and diffusion. These processes may vary in time and space. The importance of the formal sector is often grossly overestimated.

From a farmer's point of view, seeds of optimum quality should be available at the right time and at an acceptable price. The reliability of future supply can be an additional consideration. There are four components of seed quality; physiological, physical, sanitary and genetic. The first is related to germination capacity and vigour. Physical seed quality refers to the percentage of non-seed materials in a seed lot. Seed transmitted diseases affect the sanitary quality. Genetic quality refers to the value of the variety for cultivation and use, and is sometimes also related with the genetic homogeneity of a seed lot. Evaluation of different supply systems should thus consider these quality and availability aspects. This paper intends to analyze the formal and local seed supply systems with regard to their strengths and weaknesses, and will introduce strategies of integrated seed supply, which could address the required flexibility. This paper is based on a study prepared for the Wageningen Agricultural University and the International Agricultural College, Deventer, The Netherlands (Louwaars, 1994).

Formal seed supply systems and their limitations

The economy of scale of seed processing, research and production supervision in formal seed systems result in rather centralised large scale formal seed supply units. This arrangement allows for a strict control on physical, physiological and often also sanitary seed quality and on genetic identity. Whether the focus is on commercial or developmental aspects of seed supply, some level of economic returns have to be attained in order to reach an acceptable level of sustainability of the system.

Quality aspects

An important reason why the formal sector often fails to supply the majority of smallholder farmers is its inability to produce sufficiently adapted varieties (genetic quality of the seed). Breeders in the formal system, both in private and in public organisations, have to select for wide adaptation of their varieties. Breeding of specifically adapted varieties would result in a wide range of varieties of which seed production is highly inefficient. Very poor contact between the 'scientific' breeders and their target groups often results in a total misconception of the needs of the latter, and in varieties that are not adopted by them. A clear example is the long-time concentration of Malawian maize breeders on highly productive dent types, while the majority of farmers preferred the flint maize because of food storage problems (Kydd, 1989). Numerous other examples of breeders' misconception have been documented and phrases like "the unwillingness of farmers to part with the old seed in exchange for improved seed" (Kanie Merfee, 1985) are still widely used.

Even when farmers' needs are well understood, it can be very difficult to design an appropriate breeding programme. Ceccarelli et al (1992) present some of the pitfalls of the selection of modern varieties for marginal conditions. Small farmers' preference for yield optimisation (stability) instead of maximisation has resulted in genetically variable land-races in the past. Improvement of these landraces through conventional breeding methodologies is very difficult and formal seed production and certification of the resulting genetically heterogeneous varieties virtually impossible. Guaranteed seed quality through legislation and formal seed certification and quality control can be very effective to promote the production of high quality seed. It may, however, also adversely affect effective seed supply when bureaucratic variety release and seed quality control procedures are adopted. Seed legislation which is meant to protect the farmers can thus complicate farming.

Availability

The large investments in equipment and the necessary costs for research, marketing and managerial overheads necessarily raise the seed price well above the price of consumption grain. This factor is in general at least 1.8 times for self pollinated seeds (e.g. cereals, legumes) and up to 20 times for hybrids (e.g. maize). In the case of high value vegetable and flower seeds this ratio can be much higher. High cost of good quality seed can be acceptable when the returns for the farmer are high. Such high returns can generally only be expected in agro-ecologically high potential areas with good infrastructure and combined with good farming practices. Seeds for mainly home consumed crops such as cassava and local vegetables are hardly ever bought from the formal sector. The cost involved in supplying a fragmented market generally results in a poor or total absence of seed supply to remote and resource-poor farmers and supply of 'small' crop seeds such as vegetables and local food crops like pigeon pea and cassava. This is especially true for crops where farmers can easily produce their own seed, such as self pollinated cereals and legumes.

Other supply factors include the timeliness and reliability of supply. This guarantee is especially vital in the supply of hybrid seeds but it is also important for other seeds. When farmers intend to purchase seeds they may not keep a security stock of home-produced seed, and when farmers rely on purchased seed for some time they may have lost important knowledge about how to produce and store seeds of these crops. Many - especially public - seed enterprises lack the necessary logistical expertise to guarantee the supply of good quality seed at the right time in all areas. Moreover public sector administrative procedures seriously hamper financial viability and thus sustainability of such formal seed systems.

Some major problems in formal seed supply in the public sector can be overcome or reduced by privatisation. Improved business management and more effective planning and logistics by private sector organisations can improve the reliability of supply and, especially in a non-monopolistic market, also seed quality. The scope of private seed companies is limited to supply of the most profitable seed crops to the commercially most interesting farmers. The consequence is often a reduction of the product mix and the range of farmers supplied.

Local seed supply systems and their limitations

Local seed systems are the predominant source of seed of the majority of crop seeds in developing countries. In most cases, less than 10% of the total quantity used by farmers are supplied by the formal sector (Almekinders et al, in press). Local seed selection has been the basis of domestication of wild and weedy species and the subsequent development of a wide range of land-races within crop species with high levels of adaptation to local agro-ecological and socio-economic conditions. There are numerous examples of high levels of local knowledge with regard to varieties and seed selection (Boster, 1984; Richards, 1986; Zimmerer, 1991). These apparent qualities of local seed supply mechanisms, combined with the experienced inability of the formal seed sector to supply large segments of the farming community has the risk of romanticising these local seed supply systems.

Quality aspects

The genetic seed quality referred to above is not always optimal for crop cultivation. Quickly changing needs of farmers due to intensification of agriculture or to soil depletion cannot always be catered for by the slow process of local and natural selection within genetically heterogeneous populations or by casual introduction of new material and local experimentation of new materials. Diffusion of new genetic material through the local seed systems can be extremely efficient as was shown by Maurya (1989), but the speed and the range of diffusion can be limited by a number of socio-economic parameters, such as ethnicity (Green, 1987).

Farmers' practices can also lead to unintended selection for characters that are not preferred. Shallot growers in Bangladesh tend to plant small sets because the price of the product is high during the planting season. Tomato growers may tend to extract seeds from off-type fruits that cannot be sold in the market. When the size of the dry set and the fruit shape are genetically determined, farmers are definitely selecting in the wrong direction.

Other seed qualities are often poorly taken care of. Poor storage conditions resulting in low seed purity and germination can hinder crop production especially in non-traditional crops (e.g. maize in lowland tropical areas), despite sometimes astonishing local methods (Gwinner et al, 1991). Very limited knowledge of (seed transmitted) diseases can lead to accumulation of pathogens. A common practice in vegetable bean production is the use of the last pods of a crop to extract seeds. This increases the danger of transmission of diseases that have accumulated in the crop during the growing season.

Availability

One of the major advantages of local seed supply is the high level of availability of seed to a wide range of farmers who cannot afford to purchase certified seeds. There are some important limitations however; the most important being the absence of an anti-cyclic production mode and the lack of a back-up system in case of disasters. Local seed supply is generally high after glut-production seasons and low grain prices, and is generally low in cases of hunger when grain prices are high, especially in crops where the plant parts used for seed can also be consumed, such as cereals and *legumes*. The formal seed sector can spread such risks by producing seed in different regions and by offering a premium seed price to growers. In local seed supply systems, acute seed shortages are likely to happen more often.

Natural and man-made disasters such as civil strife can very seriously disrupt local seed supply both with regard to quantity and (genetic) quality. When large numbers of people are displaced or when cultivation is impossible for more than one season, seed supply can be seriously disrupted. When large areas are affected the sheer survival of the irreplaceable adapted land-races is at risk in conjunction with the disappearance of social structures and their local knowledge systems.

Integrated approaches

Formal seed systems, although valuable to supply seeds of a number of crops to certain groups of farmers in developing countries, are unable to reach large numbers of farmers. Their lack of sustainability mainly derives from economic parameters. Local seed systems, which prove very valuable to supply large quantities of seed, appear to neglect some quality aspects. Despite their long time existence, their effectiveness and eventually sustainability may be threatened by rapid changes in the agro-ecological or socio-economical conditions. Integration of both systems may yield the most effective and most sustainable way to secure the supply of optimum quality seeds of all crops to all farmers.

Integration can mean the improvement of either the formal or local system by introducing some positive aspects of the other. In cases where physiological seed quality is a problem, improved seed harvesting and storage methodologies may be introduced while leaving all other aspects of seed supply intact. Where physical seed quality is a major problem, the use of small scale seed cleaners may be promoted. Where genetic quality of seeds is a bottleneck, new varieties may be introduced into the local experimentation and diffusion system. Various models for accelerated variety diffusion exist, such as random distribution of samples (Grisley and Shamambo, 1993), directed distribution of production kits (Douglas, 1980), sale of samples (Mansheviale and Bock, 1989) and different levels of on-farm demonstrations and on-farm research (Kisakye, 1990; Janssen et al, 1991). Where suitable varieties cannot be bred by conventional methods, adapted breeding strategies can be developed to enhance selection efficiency by adapting the selection environment (Ceccarelli et al, 1992) or the selection procedure. Where availability of seeds is the major problem - in cases where this is not related to any of the above - seed security centres may be established. Cromwell et al (1993) describe some experiences with such centres. Another approach is to promote seed production by farmer cooperatives in a semi-formal manner, as described by Garay et al (1989). This is done by directed subsidies or tax relief for starting seed enterprises and temporary relaxation of certification standards.

The possible solutions to specific problems may require a number of activities, ranging from surveys, priority analysis, technology development and diffusion of technologies, which have been described by Tripp and Woolley (1989) for on-farm research. Since there is evidence that in many cases women are responsible for seed selection and storage (Berg, 1993; Tapia and de la Torre, 1993) a strong gender aspect has to be included. The site and crop specific analysis of the strengths and weaknesses of existing seed supply makes blueprint methodologies and blanket recommendations, such as used in the formal sector, irrelevant. For most seed quality problems, basic technologies already exist. They may have to be adapted to local conditions only. For variety development for the remote and resource-poor farmer on the other hand, methodologies are still to be evaluated. This means that in most cases the importance of surveys, farmer participation in local adaptation of technologies and diffusion of technologies have to be stressed. This requires an important input of the social sciences in seed supply development.

The variety of possible technical improvements corresponds with a wide range of possible ways to transfer knowledge and/or materials to farmers (and vice-versa). General extension messages can be used to improve, for example, storage methods. Another option is to train selected farmers on improved seed production. They could either transfer the technology to other farmers or they could become specialised (local) seed producers. These farmers could also be a suitable alley for variety introduction, especially when they are the same persons who are involved in on-farm research. Directing the assistance to already existing groups of farmers may result in the seed production cooperatives described earlier.

Integrated seed supply systems: linkages

Although various isolated activities exist within national research or development programmes and non-governmental organisations, a comprehensive integrated seed supply system has not been developed in any country. Integrated seed supply can be incorporated in on-farm research programmes where important research-extension linkages are maintained. A major disadvantage is that the formal seed sector is not involved and that these are very research-oriented units. Another option could be the national seed committee (NSC). In many countries these were established to prepare national seed policies, to supervise national seed production, trade and quality control, and to link research, seed production and extension services. They could also promote, coordinate and monitor integrated seed supply, whether undertaken by the public sector, NGOs or private companies. An important aspect is that such committees are also responsible for regularly reviewing and adapting the national seed legislation, which is a necessary prerequisite for any integrated seed supply activity in most countries.

Whichever institution is chosen, a national knowledge centre has to be built on seed technology and supply that can promote and coordinate such activities. These centres can only be effective when the flow of ideas and experimental results among the participating countries is maintained. International centres can play an important role in this regional cooperation through networking. They can also be instrumental in coordinating research into insufficiently developed sectors of national seed supply, such as participative breeding, development of local farmer/seed specialists, and local seed security in stress prone areas. They can also play an important role in developing a specific interest in seeds with social scientists.

It is interesting to note that recent "in situ" approaches of conservation of genetic resources arrive at very similar techniques whereby genetic diversity is maintained and utilised in farmers' fields through strengthening the local seed supply systems (Cooper et al, 1992; de Boef et al, 1993) Despite the apparently different objective (conservation instead of sustainable production) there is a tremendous scope for cooperation.

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Seed systems for small farmers: vignettes from Latin America

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Abstract

Few small farmers have access to or use seeds of improved germplasm. This paper seeks to identify seed initiatives underway in the Latin American region and define some implications. A brief summary of current projects, including their documentation, is presented by commodity group.

There is a need for both more information to be collected from case study analysis and research on seed systems. The IARCs have a definite role to play to complement their germplasm development efforts and participate in technology transfer and institutional building/bridging. In the actual project environment, IARCs can play a complementary-facilitator role to other institutions. Areas of particular concern with forage projects include the implications of novel species, real demand for seed, congruence between forage and seed objectives, environmental requirements of priority species, seed production within farming/cropping systems and the nature of the project environment, including the need for promoting market demand.

Introduction

The vast majority of small farmers in Latin America do not use or have access to seed of improved germplasm. This raises questions and is a huge challenge to agricultural research and development.

Seed systems that are more relevant to the needs and realities of small farmers have only recently being developed. Attitudes, however, are changing on how to best use both technology and resources for the benefit of small farmers (Camargo et al, 1989; Bal and Douglas, 1992; Cromwell et al, 1993; Garay, 1993; Ferguson and Sauma, 1994). Such efforts should contribute to more efficient development assistance in the future.

This exploratory paper, aims to identify some current initiatives along with some limitations and implications within the context of multi-institutional research and development projects and IARCs in Latin America.

Project initiatives by commodity

This section aims only to identify some of the initiatives conducted or in progress. There is some bias in my own awareness and contacts towards initiatives involving the IARCs and the tropics, so omissions will be greatest on regional or local projects in temperate zones.

A summary of projects/initiatives is presented in Table 1 along with relevant references, where available.

A. Beans

In Rwanda, Burundi and Zaire the CIAT Bean Program with NARS, has a strong effort on the introduction of climbing beans. Considerable work has been done on understanding how new varieties are diffused and the formation of community based seed systems.

Table 1. *Summary of Small Farmer Seed Projects in Latin America*

PROJECT/PROGRAM		PARTICIPANTS				ACTIVITIES/OUTPUTS	REFERENCES
		National		International			
No	Country/ Region	NARD	Other	CG	Donor		
				BEANS			
1.	RWANDA,					– Diffusion of new climbing varieties	Sperling, Scheidegger
	Great Lakes	ISAR	Various	CIAT	SAC	– Multiplication of basic seed	and Burucha (1992
						– Research on SS for SF	
2	COLOMBIA						
	San Gil	ICA	Coagro-San Gil Ltd		Kellogg	– Increased availability of seed	
	Pescador, Cauca	ICA	Ashortop	CIAT-IPRA	Kellogg	– Participatory research (especially varietal evaluation)	Roa et al (1991)
						– Formation of small seed enterprise	
						– Increased availability of seed	
	General	ICA		CIAT		– Research on SS	Janssen et al (1992)
3	GUATEMALA	DIGESA	Coop Santa	CIAT		– Increased availability of seed	Baltensweller (1991)
			Gertrudis			– Increased availability of seed	Garay, pers comm
						– Formation of small seed enterprise	
						– Research on SS for SF	
4	PERU						
	Chota	INIA		CIAT		– Increased availability of seed	
						– Adoption of new variety	
5	BOLIVIA	Univ. Rsem	Prod. Assn	CIAT		– "Mairana" Project	Garay, pers comm
			(Asoprof)			– Increased availability of seed	
6	PANAMA	Coop Caisan				– Increased availability of seed	Garay, pers comm

PROJECT/PROGRAM No	Country/ Region	PARTICIPANTS National NARD	National Other	International CG	International Donor	ACTIVITIES/OUTPUTS	REFERENCES
				CASSAVA			
1	COLOMBIA						
	Zone, Arauca	ICA	Coagroarauca Ltd			– Increased availability of vegetative material	
	Costa Atlantica	DRI ICA	Fundiagro	CIAT		– Improved seed technology	
						– Organisation of farmer Coops	Lopéz (1994a and 1994b)
2	CUBA,						
		MAG					Garcia and Rodriguez (1994)
3	ECUADOR	INIAP	UAPPY FUNDEAGRO				Hinestrosa et al (1994)
				MAIZE			
1	ECUADOR						
	Porto Viejo	INIAP	UAPPY	CIMMYT (Cali)		– Production of commercial seed	Pandey, pers comm
2	PERU Cholta	INIA	FUNDEAGRO Rondas	CIMMYT		– Production of commercial seed	Pandey, pers comm
3	PARAGUAY	MAG-DISE		CIMMYT (Cali)		– Production of commercial seed	Pandey, pers comm
4	Central America and Caribbean						
		NARD'S Various		CIMMYT Regional Maize Program	SAC	– Production of commercial seed of improved varieties – Green manures, conventional tillage – Networking	Listman (1994)

PROJECT/PROGRAM		PARTICIPANTS					
		National		International			
No	Country/ Region	NARD	Other	CG	Donor	ACTIVITIES/OUTPUTS	REFERENCES
				POTATOES			
1	ECUADOR						
			Fundagro	CIP			
2	PERU						
		INIA	CIP	COTESU		– Project "SEINPA"	Garay, pers comm
		INIA	Coop			– "Arariwa project"	
3	BOLIVIA						
			SEPA			– Production basic seed	
		Nat Seed Board	Farmer Orgáns Euroconsult		Dutch Govt.	– Increased seed availability, incl traditional varieties	Garay, pers comm
				RICE			
1.	COLOMBIA Meta		Servisemillas Ltd	CIAT		Project proposal – Community based seed production	Winslow, pers comm
2	BOLIVIA	CIAT ORS	Local Coop			"Colonia Berlin" – Increased availability of seed	Garay, pers comm
3	ECUADOR Rio Daule	INIAP	Coop CESA		COTESU		Balarezo and Pazmino (1992)

PROJECT/PROGRAM		PARTICIPANTS				ACTIVITIES/OUTPUTS	REFERENCES
		National		International			
No	Country/ Region	NARD	Other	CG	Donor		
						FORAGES	
1	PANAMA,	IDIAP		CIAT		– Multiplication of basic seed – On farm evaluation of forages B. dictyoneura A. pintoi	
2	HONDURAS,	SRN		CIAT	IDRC	– Multiplication of basic seed – On farm evaluation of forages *B. dictyoneura* *A. pintoi* *S. guianensis*	
3	PERU Pucallpa	IVITA INIA	FUNDEAGRO Seed farmers	CIAT	IDRC	– Multiplication of basic seed – Commercial production by and for small farmers – Research on SS for SF *B. dictyoneura, B. decumbens* *S. guianensis, C. macrocarpum*	Vela et al (1991); Ferguson et al (1994)
4	COSTA RICA		SERCIASA Ltd Seed farmers			– Commercial production by and for small farmers *B. dictyoneura* *A. pintoi*	Sylvester-Bradley and Ferguson (1994)

PROJECT/PROGRAM		PARTICIPANTS				ACTIVITIES/OUTPUTS	REFERENCES
		National		International			
No	Country/ Region	NARD	Other	CG	Donor		
5	BOLIVIA						
	Yapacani	SEFO Ltd					
		Seed farmers	CIAT	COTESU		– Commercial production y marketing – Research on SS for SF *A. pintoi* *P. phaseoloides* *D. ovalifolium*	Ferguson and Sauma (1994)

In Latin America there is a wide range of initiatives, generally linked to variety improvement programs, of both NARs and CIAT. In the last five years there has been a number of local seed projects, usually focusing on supporting a group of farmers to produce and market seed of varieties whose local superiority has been established in on farm trials. The CIAT-IPRA-Kellogg project began work on farmer managed seed systems only after demonstrating superiority of certain varieties via participatory research. In Guatemala, DIGESA took the initiative to assist a local cooperative produce and market seed. Similar such initiatives are beginning elsewhere but documentation is limited. There is a real need for some systematic study of these initiatives. Problems encountered include wide seasonal swings in demand and prices, linkages to marketing channels and credit, lack of project continuity and linkages for support. Donors who have provided support are Kellogg and SAC.

B. Cassava

The CIAT cassava Program has developed a wealth of propagation technology, emphasising freedom from disease, vigor and storage issues. Along with NARS, they have been active in the multiplication of basic seed of new cultivars and the promotion of seed production by grower cooperatives. Such initiatives are most advanced on the north coast of Colombia and in Cuba. Progress has been most rapid when associated with the release of superior clones. Attention has also been given to improving quality of planting material of traditional varieties.

C. Maize

CIMMYT provides support in various ways to increase seed availability to small farmers as a critical complement to varietal improvement. Regional programmes channel technical and financial support to national and regional initiatives and this work has donor support from SAC. With ever changing roles and capacities of NARS and their relationship with conventional national seed enterprises, there is an increasing need for support to more regional and local projects and enterprises.

D. Potatoes

CIP has an extensive involvement in seed activities, again in support of varietal improvement. With donor support from COTESU, projects are current in several countries, eg SEINPA project in Peru. Nuclei of seed farmers conduct multiplication with support from various national and local groups. Seed farmers are assisted to progressively organise themselves on the local and regional level. In Bolivia and Ecuador, also, several projects are active with external donor support.

E. Rice

Rice seed has tended to be produced and marketed by medium to large sized seed enterprises well linked to the release of new varieties by NARS for the mechanised, irrigated sector. In recent years, some varieties have been released for the specific needs of small farmers located in marginal areas of savannas, hillsides and humid forest regions. Efforts are needed to develop more community orientated seed enterprises with appropriate external support.

F. Forages

Forages have a much lower and diffuse profile than major food crops, both within national research programs and the private seed sector. When we add the particular perspective of seed for small farmers, the picture becomes even more complex and the large forage seed industry of Brazil has to be put aside. Few small farmers in Latin America today have access to or actually use forage seeds. However, many have propagated grasses by vegetative means, and the availability and marketing of grass seed of *Brachiaria* species is increasing.

Five initiatives in five different countries are listed in Table 1. These reflect three stages of institutional evolution. Firstly, in Panama and Honduras, young multiplication projects within NARS generate basic seed of new cultivars, plus support research projects for on-farm evaluation of new forages. Secondly, in Peru, an NGO, FUNDEAGRO, manages a seed supply project that includes forages and rice (Ferguson et al, 1994). Thirdly, in Costa Rica and Bolivia, seed enterprises exist where seed is produced by small farmers with share farming or contract agreements with these seed enterprises (Sylvester-Bradley and Ferguson, 1994). SEFO Ltd. represents a successful case of a seed enterprise oriented to small farmers which became economically viable only after a subsidised juvenile phase.

Research on forage seed crop management and seed systems for small farmers is confined mainly to CIAT's Tropical Forages Program and its collaborators.

The overall status of seed supply and seed supply systems in tropical Latin America is summarised by Ferguson (1994b and c), based on the 1992 Workshop of the Advisory Committee of RIEPT. Additionally, this publication demonstrates the beneficial and synergistic effects of a regional network (RIEPT) involving NARS and an IARC. Donors who have provided financial support to forage seed development are IDRC (to CIAT for RIEPT) and COTESU (to SEFO).

Conclusions

While there are many initiatives underway involving farmer organised/community based approaches to small farmer seed systems, their documentation and analysis is limited. There is a need for comparative case study analysis and research of trends and outcomes of these seed systems.

All IARCs in the region are active in seed projects, but only CIP and CIAT have seed specialists as senior staff. Funding is mainly from Special Projects and SAC, COTESU, and IDRC have been supportive donors.

While institutional participation in community based seed systems must be broad and essentially local/regional, the IARCs definitely have a role to play. Their role may include advocacy to seek funding, advocacy for seed consciousness project design and management, technical assistance, procurement of seed stocks and a facilitator role to assure the incorporation of relevant support linkages. Part of the relative advantage of the IARCs is their ability to provide new genetic alternatives, e.g. new varieties with wider adaptation to acid soils and novel forage species.

In the case of forage seed projects, the following issues need consideration:

a. Improved genetic materials are likely to include novel species relatively unknown to farmers and most national researchers. This is in total contrast to the case of new varieties of traditional species (maize, cassava, beans, etc). This argues very strongly for IARC participation to promote both a technology transfer process and the release of a new material, where organisation of a supply of basic seed and pioneer seed production is critical. Researchers tend to underestimate these challenges.

b. While seed availability of new materials is always a limitation, levels of real (economic) demand from farmers can be so low that seed production and marketing can be constrained by limitations on the demand side. This is especially the case with legumes (Ferguson, 1994a).

c. There is a need for congruence and balance between participatory research on forage evaluation, the promotion of the utility and benefit of forages to farmers and seed production and marketing. Such congruence can be approached either by multiple objectives within the one project or complementary "sister" linked projects.

d. Consideration must be given to the environmental requirements for flowering, seed set and seed recovery of the priority species. It may not always be possible to produce seed in the same region of use as a forage. Conversely, priority species should only be those free of such complications. This issue is a frequent weakness of forage seed projects.

e. Seed production must be promoted within the context of the farming and cropping system of the participant seed farmers. This implies alternative/multiple use of the forage and seed fields, intercropping, plus share farming or contract arrangements with the project nucleus or seed enterprise and the provision of technical assistance from a compatible cultural source.

f. The complex forage seed project environment requires both close interaction between donor and executor along with dynamic management, seeking synergy between participants and adaption to changing circumstances.

g. Seed projects must promote the application of market forces. This includes having clients pay for seed used and avoiding over-subsidising their participation. A rotating fund is a key mechanism for promoting both seed production and marketing, but also for sharing risks between pioneer seed farmers and the project.

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