



Overseas Development Institute

The Institutional Conditions for Seed Enterprise Development

Robert Tripp

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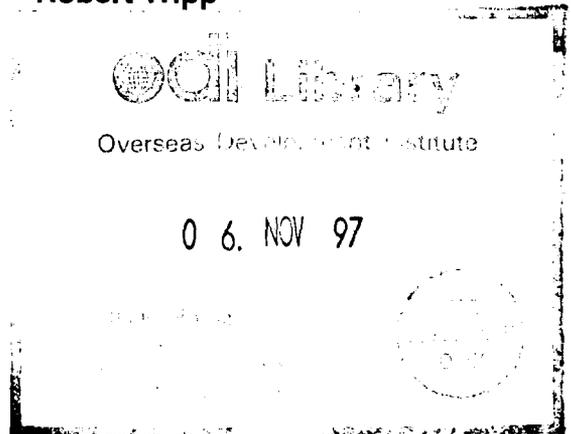
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THE INSTITUTIONAL CONDITIONS FOR SEED ENTERPRISE DEVELOPMENT

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Acronyms

FAO	Food and Agriculture Organisation
NGO	Non-governmental organisation
OPV	Open-pollinated variety
PRA	Participatory rural appraisal
PVP	Plant variety protection

Summary

Most policies and projects designed to stimulate the growth and diversity of national seed systems place their hopes on the emergence of viable seed enterprises. Such enterprises include everything from conventional commercial seed companies to community-level endeavours. Institutional factors are a key to understanding this type of seed enterprise development.

Inappropriate institutional conditions are one of the principal explanations for the relatively slow growth in national seed sectors. However, other factors must also be considered. Policy makers and project planners often have a poor understanding of the nature of seed demand. Farmers seek seed off-farm for various reasons, and the nature of this demand is important for determining the appropriate seed provision response. Another factor contributing to the slow emergence of seed enterprises is continuing government interference through support to seed parastatals, and laws and regulations that discourage private competition. But the principal focus of this paper is the institutional context of seed system development.

The analysis draws on literature from New Institutional Economics and emphasises the importance of information, and its attendant transaction costs, in understanding enterprise development. The efficient interchange of information is supported by the development of norms and trust, often associated with the concept of social capital. In addition, adequate incentives must be provided for undertaking the various tasks of seed provision.

It is important to realise that seed provision is a complex process. It can be seen as a chain that begins with plant breeding and extends through source seed production; seed multiplication; quality control; seed conditioning and storage; and distribution and marketing. Except in the case of large-scale commercial seed companies, most seed provision entails the co-ordination of several different organisations to accomplish these tasks. There is often a mix of public and private (commercial or voluntary) entities in the process, adding to the importance of co-ordinating the flow of information. The expansion of seed markets also requires attention to the development of trust and information exchange between farmers and seed providers.

Although institutional change is necessarily slow, there is much that can be done through policy and projects to encourage the growth of an institutional environment that supports seed enterprise development. A government seed policy unit should be able to assess seed demand and help direct resources and training to priority areas. Parastatal seed companies should be placed on a more competitive footing. The incentives and focus for public plant breeding require attention, and public seed

regulation should be reoriented to support seed system diversification. Projects and policies should support private and local-level seed activities, but these should be realistic about the costs and requirements of information co-ordination. Particular attention should be given to supporting the types of organisations (associations, producer groups, firms) and institutions (markets, norms, legal systems) that contribute to information exchange.

Finally, it is important to distinguish seed enterprise development from welfare-oriented seed activities. The latter activities are aimed at ameliorating the poverty that contributes to seed insecurity. These activities should help develop the conditions that eventually allow the emergence of independent seed provision.

1. Introduction

This paper examines the prospects for the growth of seed enterprises in developing countries. The analysis includes all seed provision activities beyond the farm level, from small-scale voluntary projects to large commercial seed companies. The analysis is particularly concerned with the conditions required to stimulate the growth and development of seed enterprises that serve the needs of resource-poor farmers.

Any attempt to define the environment that favours the emergence of seed enterprises will necessarily draw upon certain currents in development theory. This analysis will focus on the institutional aspects of seed enterprise development, and will make reference to the body of development literature often referred to as 'New Institutional Economics' (Nabli and Nugent, 1989). Issues of particular importance to the analysis include the nature of transaction costs and the conditions for the emergence of firms (Williamson, 1979). These issues underline the key role of information in economic development (North, 1990; Casson, 1997). The analysis will also touch on some of the social preconditions for economic growth, such as trust and norms, that are often referred to as 'social capital' (Putnam, 1993). In addition, a review of the nature of incentives will help identify the most viable options for seed enterprise development (Ostrom et al., 1993).

The paper is not a theoretical exercise but rather an attempt to delineate practical strategies for promoting seed enterprise development. Although much of the work of the New Institutional Economics is dismissive of the role of the state (Stein, 1994), the realities of national seed systems demand particular attention to the nature of public sector participation in seed enterprise development. The analysis will therefore contribute to current discussions about the responsibilities and limitations of the state in economic development (Colclough and Manor, 1991; de Janvry et al., 1995). Non-governmental organisations (NGOs) are also playing an increasingly prominent role in seed projects, and specific conclusions will be drawn that can be related to debates concerning the proper role of NGOs in agricultural development (Edwards and Hulme, 1995; Hulme and Edwards, 1997; Farrington and Bebbington, 1993).

The objective of the paper is to use insights from development theory to examine the current status of national seed systems and to identify strategies that promote seed sector development and diversification. The tone of the analysis is positive but cautious. Relatively few of the innovations for seed provision that have appeared in developing countries can yet be judged to be sustainable or effective. Donors, governments and NGOs seem intent on promoting the same programmes and making the same mistakes. There are a number of specific strategies that can encourage the emergence of seed enterprises, but such development also depends on wider

institutional changes. The paper thus provides guidelines for government policy and NGO programmes, and identifies the implications for incentives, information and social capital that must complement policy and programme intervention.

An examination of the conditions for seed enterprise development should provide conclusions that are relevant to broader concerns of agricultural development. Seed is an appropriate focus. It is a universally-required input and a major industry, worth approximately US\$50 billion in the mid-1980s (Groosman et al., 1991). Seed production is also almost unique in its breadth of participation. Farmers themselves are responsible for a major portion of seed provision. Private seed enterprise development includes everything from local entrepreneurs to multinational corporations. The state is also a major actor, playing a significant role in seed provision in Africa and Asia. In the past decade, NGOs have also become major participants in seed provision in developing countries (Cromwell and Wiggins, 1993).

The economic and organisational requirements of seed provision are well understood (Douglas, 1980; Lopez-Pereira and Filippello, 1995; Cromwell et al., 1992). But despite policy changes in many countries that provide incentives for seed enterprise development (Jaffee and Srivastava, 1994; Pray and Ramaswami, 1991), there have been relatively few advances in most national seed systems. The major instances of entrepreneurial activity have been in hybrid seeds, which offer greater commercial returns. On the other hand, a profusion of community-level seed projects still offers little firm evidence of sustainable impact (Wiggins and Cromwell, 1995). In addition, public sector plant breeding continues to be disappointed by the slow diffusion of its varieties (Virk et al., 1996; Heisey, 1990).

There are four possible explanations for the slow development of national seed systems. The first explanation is related to demand. The argument is that farmers are able to manage most of their seed requirements on-farm and have little need for formal sector seed. The demand for seed of new varieties may be limited by the inadequacy of the varieties on offer. The second explanation focuses on continuing state interference, where regulations and policies favour public seed enterprises and hinder commercial seed development. The third possible explanation focuses on the technical requirements of seed provision and holds that appropriate technology may not always be available. The fourth explanation, which occupies the majority of this paper, is that insufficient attention to the institutional environment of seed provision has rendered many policies and programmes promoting seed system development ineffective.

The paper is organised in the following way. After this introduction, the second section examines the first three alternative hypotheses, particularly those related to seed demand and state interference. Each of these hypotheses has considerable validity and deserves exploration before moving on to look at the institutional

environment. The third section provides a theoretical basis for the rest of the paper, and examines the nature of seed provision and its relation to the concerns of institutional economics. The fourth section examines the seed provision process in more detail and attempts to identify institutional factors of particular importance to seed system development. The fifth section presents a series of specific interventions that can promote seed enterprise development. The sixth section concludes by drawing implications for public sector responsibilities and NGO projects, as well as by pointing to the concomitant changes in information, incentives and social capital that must complement specific seed system interventions.

2. Explanations for inadequate seed system development

2.1 The demand for seed

There has been a demand for seed ever since the beginning of agriculture, but the formal organisation of seed provision is a relatively recent phenomenon. Organised efforts at plant breeding only began in the late eighteenth century, and it was not until the late nineteenth century that commercial plant breeding began to emerge. This was further stimulated by the rediscovery of Mendel's work on plant genetics in 1900. Farmers began to purchase seed not only because it embodied the output of scientific plant breeding, but also because seed enterprises could at times offer advantages of cleanliness, purity or convenience that were difficult with farm-saved seed. As the seed industry developed in Europe and North America, most seed production was done by commercial or co-operative entities. But plant breeding was managed by both government and private commercial enterprises. In the US, the American Seed Trade Association was formed in 1883 (Kloppenborg, 1988), but it was not until the advent of hybrid maize in the 1930s that private plant breeding began to challenge the predominance of the state experimental stations. Today, most large seed companies do their own plant breeding, although for certain crops they are still partially or wholly dependent on public research.

The outstanding challenge for seed enterprise development is the low utilisation of formal sector seed. Estimates vary, but it is generally agreed that no more than 10% of seed in developing countries comes from formal sources (Almekinders et al., 1994).¹ It is not uncommon for policy pronouncements to point to the gap between total and formal sector seed use as evidence for latent seed demand. Such 'demand' estimates have been used to help justify many donor, government or NGO seed projects that have subsequently foundered. Therefore, it is well to begin by examining the nature of seed demand in more detail.

The first point to note is that the high use of farm-saved seed for certain crops is not confined to developing countries. Pray and Ramaswami (1991) present data indicating that 50% of the cotton and barley, 60% of the oats, and 70% of the wheat planted in the US is farm-saved seed. Similar figures are available from Europe: 50% of all seed in France and Germany, and 30% in the UK, is farm saved (Ghijsen,

¹ Calculations with data presented in Pray (1990: 196) indicate that only about 7% of the seed planted in India (which has a relatively well developed seed sector) is purchased from formal sources, for instance.

1996). The difference in levels of seed enterprise development between industrialised and developing countries is therefore not explained by any absolute difference in farm-level seed management practices.

Farmers will look for seed off-farm for various reasons, and it is important to be able to identify the precise nature of seed demand before planning formal seed provision activities. Farmers may purchase seed to obtain a new variety or when they begin to grow a new crop. They may purchase seed because they are using hybrids, whose yield potential declines in recycled seed. The costs or technical requirements of on-farm seed conditioning or storage may motivate farmers to purchase seed. Finally, many farmers in developing countries are forced to look for seed off-farm because poverty denies them the opportunity to harvest and save sufficient seed for the following season. We examine each of these types of seed demand below.

New varieties

It is important to distinguish variety from seed. A variety is a specific example of plant germ plasm that is delivered through an input, seed. Once the germ plasm has been acquired by the farmer, it may be quite feasible to maintain the genetic integrity indefinitely, through seed saving, without recourse to further purchase. (The principal exceptions are hybrids, and certain open-pollinated varieties, discussed below.)

The failure to distinguish between seed and variety (and the use of the meaningless term 'seed varieties') is a cause of much confusion in seed policy. Demand for a variety is not the same as demand for seed. True, the variety is embodied in the seed, but once the farmer obtains a small quantity, he or she is able to test and at times modify it, and can often multiply and maintain it. It is not sufficiently recognised that a considerable portion of the spread of the wheat and rice varieties of Asia's Green Revolution was carried out by farmer-to-farmer seed movement rather than by formal seed provision channels (e.g. Heisey, 1990). Many other examples can be found of the effective spread of varieties through farmer networks. Farmers in Nepal were able to diffuse a variety of rice that had been included in an extension mini-kit provided to relatively few farmers (Green, 1987), and many farmers in Ghana rely on their neighbours, rather than formal seed sources, to acquire newly-released maize varieties (Tripp, 1993).

If such farmer-to-farmer diffusion of varieties is common, is there any need for formal seed provision to stimulate variety use? There are several reasons for a positive response to this question. First, although farmer seed exchange is common, it may take a considerable time to achieve extensive coverage. This is particularly true where farming communities are isolated from each other. Second, even within communities, seed exchange mechanisms may not be equitable. In Rwanda, for instance, the

diffusion of new bean varieties tends to be limited to the neighbours and close friends of the original recipients (Sperling and Loevinsohn, 1993). Finally, information provision regarding new varieties is often inadequate. Extension agents may demonstrate new varieties without being able to tell farmers where they can acquire seed, or farmers may acquire seed from outside their community that has not been tested for local adaptation. More effective diffusion of new varieties must link the provision of information with the widespread availability of small quantities of seed.

A more serious question related to varietal demand is the adequacy of the varieties on offer. There are many cases where seed projects have assumed that just because 'modern' varieties of a crop were available they would be quickly taken up by farmers. Public sector plant breeding has not always addressed the real needs of farmers, and many public varieties have been tried and rejected by farmers because they are not superior to local varieties. Despite considerable improvements in the conduct of public sector plant breeding, there is still much work to be done in encouraging a shift of plant breeding priorities towards farmers' needs and priorities (Haugerud and Collinson, 1990; Byerlee et al., 1987). Until this is accomplished, the demand for seed as a source of new varieties will be limited.

The use of hybrids

Certainly the single most significant stimulus to commercial plant breeding, and the growth of the seed industry, has been the development of hybrid technology. Although the term 'hybrid' has several meanings (Tripp, 1996), it is used here to refer to the combination of two inbred lines to produce seed that is high yielding because of hybrid vigour (heterosis). The drawback of hybrids is that subsequent generations are usually not as productive as their parents. Thus farmers must buy fresh seed each year to obtain the full potential of the hybrid.

Hybrid technology was first developed for maize, and virtually all of the maize seed sold in industrialised countries (and a growing proportion in developing countries) is hybrid. Hybridisation is theoretically possible for any crop, but among the food crops of importance to developing countries it has been most successfully exploited in maize, sorghum and pearl millet. There is as yet no use of hybrid wheat or barley anywhere in the world, but hybrid rice is rapidly becoming a reality, especially in China (Pingali, 1994).

The necessity to buy fresh hybrid seed each year is of course a significant incentive for commercial seed operations. Some observers are inclined to see a commercial conspiracy in hybrid development (Levins and Lewontin, 1985; Kloppenburg, 1988), but where hybrid varieties are used it is generally because they outperform the best open-pollinated alternatives. The cost of hybrid seed is higher than that of open-

pollinated varieties, however. There is growing anecdotal evidence of farmers recycling hybrid maize seed in response to high seed prices in environments as disparate as the highly commercialised farms of Argentina (Jaffé and van Wijk, 1995) and the subsistence-oriented small farm sector of Malawi (Smale, pers. comm.). The degree of yield depression from recycling hybrids depends on the nature of the hybrid and the level of crop management, but any significant degree of recycling will certainly affect incentives for commercial hybrid promotion. A similar situation obtains for the open-pollinated varieties (OPVs) of crops such as maize and pearl millet. With careful management, a farmer can save the seed of these varieties, but cross pollination may result in the loss of some of the variety's desirable traits. Public sector campaigns to promote maize OPVs often recommend that farmers renew their seed every third cycle, but firm support for such advice is usually lacking. Farmers growing maize on relatively isolated forest plots in Ghana rarely seek to renew their seed of OPVs, and there is as yet no clear evidence of what yield loss, if any, this engenders. In other cases, however, the effects of recycling OPVs may be more obvious. Longmire and Mohammed (1994) describe the rapid loss of the early maturity characteristic of a new maize OPV in Pakistan. In southern Mexico, farmers grow a number of maize varieties, in the same or adjacent fields. Some are landraces that have been grown for centuries, others are OPVs that have been introduced in the recent past and modified by farmers, and others are formal sector OPVs that farmers periodically renew when they observe that the variety is losing its characteristics (Bellon and Brush, 1994).

There are thus instances where some demand for formal sector seed may be expected from the periodic renewal of seed of OPVs of cross-pollinated crops, but this demand on its own will rarely sustain a seed enterprise. For seed of crops such as wheat that are essentially self-pollinated it is even less likely that farmers will renew their seed stocks for reasons of genetic purity.²

Seed management

In addition to the acquisition of a new variety or the preservation of genetic purity, there are a number of other reasons for farmers to acquire seed off-farm. Many of these are related to seed management. Seed storage may be a problem, for instance, as in the case of soybean seed in the humid tropics. Seed cleaning can be difficult; Fujisaka et al. (1993) document problems with weed seed contamination in farm-stored rice seed in the Philippines. For certain crops like potato, some environments are far more susceptible to plant disease and are hence unsuitable for seed production.

² Heisey and Brennan (1991) reviewed the literature on annual yield losses in wheat grown from farmers' seed and found estimates ranging from nil to 1.6%.

Farmers must thus purchase seed from other areas, resulting in complex indigenous trade networks for seed potato (e.g. Chhetri, 1992).

In addition, certain crops may be utilised as green vegetables or as fodder, and seed saving would require leaving a portion of the field for seed production. For some vegetables, the preparation and drying of seed is a laborious process which farmers may prefer to leave to specialists.

The extent to which seed management problems generate increasing demand for formal sector seed is uncertain. There is a tendency for policy makers to assume that farm-level seed management is inadequate and the source of significant productivity loss, but empirical evidence does not always support this claim. A number of studies have shown farmer seed management to be quite adequate (Wright et al., 1994; Sattar and Hossain, 1986). Other studies, however, show significant gains from using fresh seed.³

When farmers experience seed management problems there are at least two possible answers. One is to provide extension advice that increases their capacity for saving seed on-farm and the other is to encourage them to buy formal sector seed. This may lead to different views about agricultural policy, with advocates of farmer training pitted against those who hope to promote the development of the parastatal or commercial seed sector.⁴

The decision to purchase seed should be based on the price of the seed and its yield advantage. For most crops, seed contributes a small proportion of total costs of production. A review of literature from developing and industrialised countries shows that hybrid maize seed accounts for between 5 and 13% of the total costs of production; the figures for OPV seed would be somewhat lower.⁵ Seed cost is a more

³ Thiele (1997) reviews several studies from the Andes showing that farmers' periodic purchase of disease-free seed potato provides economic benefits. Similarly, a study comparing farmers' rice seed to formal sector seed of the same variety showed the latter had better seed and grain quality, a higher yield, and an approximately 10% economic advantage (Pongsroyetch and Lemonius, 1997).

⁴ Such conflicts are certainly not confined to developing countries. Fitzgerald (1990: 72) describes the protests of commercial seed companies in the US when the Department of Agriculture urged farmers to save their own seed during World War I.

⁵ Lopez-Pereira and Filippello (1995) present a series of scenarios for the decision to purchase maize seed. If a farmer has current maize yields of 1 t/ha and seeks a return on investment of at least 100%, a yield increase of 20% is sufficient to justify seed purchase at a 5:1 seed:grain price ratio.

important factor for crops with high seed requirements, such as groundnut or potato.⁶ For farmers who have little experience with the formal seed sector, the learning costs associated with identifying appropriate varieties and reliable sources of seed are often as important as the actual price of seed.

Poverty

Much of the demand for seed in developing countries is a consequence of poverty. Farming conditions are so tenuous for many households that the harvest does not provide adequate seed. In other cases debts may force the farmer to sell the portion of the harvest that should be kept for seed. Household food shortage close to planting time may cause saved seed to be consumed. In many areas, this type of poverty-related seed demand is chronic and widespread. Such demand is met in a variety of ways. If farmers have cash, they may be able to buy grain suitable for planting at the local market (Sperling et al., 1996). In other cases, farmers may be able to obtain seed on credit from neighbours or traders (Kelly et al., 1996). Bartering for seed is also common in some areas (Zimmerer, 1988), and sharecropping may be used to gain access to seed (Robertson, 1987; Louette and Smale, 1996). In many other cases farmers may have to forego planting the crop if they cannot find adequate seed.

This type of seed demand is unlikely to be addressed to any significant extent by conventional commercial seed enterprises. Its ultimate resolution depends on breaking the cycle of poverty through improvements in farming conditions and access to resources and technology. Small-scale seed projects may help reverse the trend, but it is unlikely that they will have any lasting impact unless they are linked to initiatives addressing broader production and institutional deficiencies.

Another source of seed demand linked to poverty is found in emergencies (civil disorder or climatic disturbances such as droughts or floods). Seed demand during emergencies may be more widespread than that associated with chronic poverty, but it is a temporary phenomenon. Considerable caution is required in addressing emergency seed demand. A recent review has shown that even in severe emergencies local seed systems are surprisingly resilient and that individual households or local markets may be able to serve as sources of seed supply (ODI Seeds and Biodiversity Programme, 1996). The same study shows that emergency programmes have often provided seed of inappropriate type or quality.

A further problem is knowing when to stop emergency seed supplies. Recent experience in several countries in southern Africa has shown that 'drought relief' seed

⁶ Thiele (1997) cites studies showing that seed contributes as much as 50–60% to costs of production for potato.

distribution is a politically attractive strategy, even when there is little evidence of the effects of drought. Such programmes promote a confusing image of seed demand and are the strongest possible disincentive to the development of local-level seed capacity.

Summary

There are many reasons for which farmers may seek seed from formal sources. But although the list of possibilities is long, it is not infinite. There are many instances where it is sensible for farmers to rely on their own seed stocks and where the promotion of seed enterprise development is unrealistic.

Of equal importance, the different types of seed demand imply different types of response. Table 1 presents a rough summary of basic types of seed demand and possible seed provision responses. The poverty category, discussed above, is disaggregated into chronic poverty and emergency. On the other hand, the examples of seed management and hybrid use are combined into one category because they elicit similar responses. The search for new varieties is the fourth demand category represented.

These categories are not absolutely separate. The distinction between drought-related emergency and chronic poverty is not always clear, for instance, and no farmer who seeks seed off-farm is indifferent to the type of variety. Nevertheless, these categories are useful in thinking about possible seed enterprises. Two of the demand categories seem to offer clear responses. If farmers are likely to seek seed every season because of hybrid use or the convenience of buying conditioned seed, then there are strong incentives for conventional commercial seed provision. At the opposite extreme, climatic catastrophes or civil disorder are events that neither farmers nor enterprises

<i>Source of demand</i>	Seed demand		<i>Response</i>
	<i>Type of demand</i>		
	<i>Effective</i>	<i>Continuous</i>	
Chronic poverty	No	Yes	?
Emergency	No	No	Government or voluntary programmes
Seed management or hybrid use	Yes	Yes	Commercial seed provision
New variety	Yes	No	?

can plan for, and some public sector (and voluntary agency) intervention is usually required.

The remaining two types of seed demand are more problematic. The chronic poverty that keeps farmers from maintaining their own seed stocks is unlikely to be resolved by commercial seed enterprises, because of the lack of effective demand. Small-scale seed projects often fall into the trap of trying to address poverty-related demand with the promotion of entrepreneurial innovations. This move away from welfare-oriented seed distribution is understandable, but the institutional support required for the establishment of sustainable seed enterprises is usually not contemplated by these seed projects. A broader attack on the poverty that leads to this demand is required in order to establish household seed management security (thus eliminating much of the demand), or to develop an effective market for formal sector seed. The appropriate response to poverty-related seed demand thus remains unclear, and is a significant challenge for seed policy and for the management of seed enterprise development.

The provision of seed to foster the diffusion of new varieties is also unlikely, by itself, to stimulate the development of seed enterprises. Only in cases of a continually changing offering of new varieties would conventional commercial seed enterprises be willing to address this type of demand. But mechanisms must be identified to help diffuse the range of useful varieties that public sector plant breeding and local-level variety selection projects are producing. This challenge must be included in the remit of seed enterprise development.

The hypothesis that slow seed enterprise expansion in developing countries is caused by lack of demand is partially correct. Seed demand is limited and specific, and seed enterprise development policy must pay more attention to the nature of seed demand and its relation to seed and varietal characteristics. But there is still considerable scope for improving seed provision. Formal seed management can help boost farm productivity, however each year many farmers face uncertainty about their source of seed and have neither knowledge of nor access to a wide range of useful varieties.

2.2 Government control of the seed sector

A second major explanation for the slow development of seed enterprises in many countries is the negative effect of government policies on national seed systems. Problems include the bias towards parastatal seed enterprises, the restrictions on the establishment of private seed companies, and the distortions of the seed regulatory system.

Parastatals

The predominant strategy for seed sector development in many countries has been support for parastatal seed enterprises. The National Seeds Corporation of India was established in 1963, followed by the emergence of 13 state-level seed corporations over the next two decades. These public seed corporations in India provide well over 100,000 tonnes of rice and wheat seed each year, as well as seed for many other crops (Turner, 1994). Most of the formal seed activity in sub-Saharan Africa has been through parastatals. The Kenya Seed Company was founded as a private company but the government acquired a controlling interest in 1980 (Rusike, 1995). One of the major exceptions to government control has been the private Seed Co-op of Zimbabwe but, until recently, agreements between the government and the co-operative effectively gave it monopoly status (*ibid.*).

Parastatal seed enterprises are under threat from both the recognised inefficiencies of government production and the movement towards privatisation engendered by structural adjustment. In Africa, many national seed companies have been closed (e.g. Ghana), sold to private interests (e.g. Malawi), or are on the selling block (e.g. Tanzania). But in those countries where parastatal seed companies still operate, they can seriously affect the incentives for private enterprise.

One of the principal problems with parastatals is their tendency to subsidise the price of seed. When parastatals were newly established, and farmers were being introduced to formal sector seed, there may have been some justification for initial subsidies. But those arguments can hardly be made today, and although current policy in most countries urges full cost recovery, there are still many opportunities for subsidy. A survey of maize seed (OPV and hybrid) prices in developing countries shows that public sector seed is significantly cheaper than commercial seed (Lopez-Pereira and Filippello, 1995). The market share of the Mexican state seed company, PRONASE, rose and fell in the 1980s according to the level of government subsidy (McMullen, 1987). A further disincentive to private seed development is the privileged role accorded to parastatal seed in government extension and rural development activities. In many cases private varieties are not included in extension demonstrations and private seed cannot be used in credit programmes.

Although parastatal seed companies still provide significant amounts of seed for crops for which there is no obvious commercial competition, there are strong arguments for turning as many seed production and marketing functions over to the private sector as possible (e.g. Jaffee and Srivastava, 1994). Precisely how that might be accomplished is one of the principal themes of this paper. As long as a parastatal is operating in a country, there will be a significant danger of bias against private seed enterprise development.

Industrial policy

Many countries have not only supported and protected seed parastatals but they have also actively discouraged the entry of private seed companies, both national and multinational.⁷ In countries such as India and Mexico these attitudes have been part of a populist political tradition that is suspicious of any possibility of foreign commercial domination (McMullen, 1987). This situation is changing rapidly, however. Modifications of Indian seed policy have contributed to the growth of an exceptionally dynamic seed sector (Pray, 1990), and Mexico now allows the operation of a wide range of private seed companies. The impact of such changes on seed sales and variety use can be significant, as Pray and Gisselquist (forthcoming) have shown in a study of the impact of liberalisation in Turkey's seed sector. But many countries still impose severe restrictions on the operation of private seed enterprises. Some of the problems involve manipulation of seed regulations (see below), while other barriers include difficulties in licensing companies or restrictions on foreign participation in the seed business.

A further concern of private seed companies in developing countries is the issue of plant variety protection (PVP). The recently concluded negotiations that led to the formation of the World Trade Organization require that member countries provide some kind of intellectual property protection for plant varieties. The protection may be through plant patenting, but will more likely be a *sui generis* ('of its own kind') system. The hope is that developing countries will become signatories to one of the UPOV (International Union for the Protection of Plant Varieties) conventions. These currently include most industrialised countries, but there are doubts whether they are appropriate for all countries (Louwaars and Ghijsen, 1996). The only study of the impact of PVP in developing countries has been done in Latin America (Jaffé and van Wijk, 1995). It concludes that the implementation of PVP has provided some incentives to local seed companies and has allowed greater access to foreign commercial germ plasm. But because hybrid technology provides adequate protection for many commercial varieties already, and it would be very costly for companies to try to enforce restrictions on seed saving for protected OPVs in the small-farm sector of most countries, it is not likely that current uncertainties related to PVP will have a large effect on commercial seed activity in developing countries.

⁷ An Indian government official is quoted as proposing a plan to discourage private seed companies. 'We will take away their contract growers by paying them 20% more for seed produced than they do, and their markets by selling seed for 20% less than the price they set' (cited in Pray, 1990).

Seed regulations

A more serious impediment to the development of commercial seed activity comes from conventional seed regulation. This includes the conduct of variety release and registration procedures as well as the operation of seed certification and seed testing regulations. Until recently, plant breeding has been exclusively in the hands of public research institutions, hence varietal performance testing and release procedures have been designed for public varieties. Many countries insist that privately developed varieties go through the same procedures. In these cases, private varieties are usually subjected to long delays and face the bias of variety release committees dominated by public officials (Tripp and Louwaars, 1997). These conditions are a significant disincentive for private plant breeding.

Even when private seed companies or voluntary seed projects use public sector varieties, they are often required to follow public seed quality control regulations which include inspection by the public seed certification service (Tripp and van der Burg, 1997). If the certification service is inadequately staffed and funded, private seed producers may not be served and hence may not be able to market their seed. Mandatory certification combined with low public sector salaries also leads to considerable rent seeking by inspectors. In some countries, companies that sell hybrids refuse to operate where mandatory certification requires that they deposit their inbred lines with the certification agency. They fear that the inbreds will not be protected and may be passed to (public or private) competitors.

Many countries are beginning to change their seed regulatory systems, allowing private varieties to bypass the state performance testing system and recognising truthfully-labelled seed that does not require certification. These changes will provide additional incentives to private seed development, but more positive support from the public regulatory system is still required. We return to discuss possible improvements to seed regulation in Section 5 of the paper.

2.3 Technical limitations

A third hypothesis to explain the slow emergence of seed enterprises in developing countries supposes a lack of appropriate technology. But this hypothesis is more difficult to defend than those related to inadequate demand or government interference. After all, farmers have been managing their own seed provision since the beginning of agriculture. The history of seed industry development in industrialised countries has featured individual farmers learning how to adapt their crop production techniques to meet the demands of the seed market. (An example from the US is presented in Appendix 1A.)

Seed provision involves much more than seed production, however, as section 4 will emphasise. The development of new varieties requires training in scientific plant breeding, and such expertise already exists in most national agricultural research institutes. There is a risk that, as the private seed sector expands, it will attract plant breeders from public institutions. If public sector agricultural research is poorly funded and managed, competition from the private sector can have a devastating effect on the public research service. But if incentive structures are appropriate, a healthy balance and a rational division of labour between public and private research can develop.

Formal seed provision also involves learning how to condition and store larger quantities of seed. This requires experience and often special equipment, but training and advice are readily available (Camargo et al., 1989; Chopra and Reusche, 1994). Successful seed enterprise development also involves attention to seed marketing (Mumby, 1994), a factor that is often overlooked in small-scale seed projects. But this is a question of organisation and institutional development.

2.4 Summary

Most seed used by farmers in developing countries comes from household stocks. Much seed provision will continue to be managed in this way, but as national agricultural systems develop and diversify there will be increasing opportunities for formal seed enterprises. Three possible impediments to this development have been described. The growth of seed enterprises is obviously limited by seed demand. But seed demand is not a constant factor, and as farmers become aware of new varieties, and as markets provide incentives for more specialised products, demand for formal sector seed should increase. Seed enterprise development can also be constrained by government policies and regulations, and progress will require a redefinition of public roles and responsibilities in the seed sector. New seed enterprises also require access to technical and managerial skills.

These three factors all help explain the relatively slow emergence of seed enterprises. But although they are legitimate hypotheses in their own right, the discussion above has shown that each has strong links to the fourth limiting factor, institutional development, which is the subject of the rest of the paper. Seed demand is related to economic diversification, the flow of information, and the development of social capital necessary for market growth. Government interference must be reduced by reshaping the incentive structure of national seed systems and the norms for government service. Finally, seed technology provision is in large part dependent on adequate training and information.

3. Institutional development and national seed systems

3.1 Seed and seed provision

Before discussing the institutional environment of seed provision it will be useful to review the special characteristics of seed and the seed provision process. Seed is a commodity that (in many cases) farmers can reproduce themselves. The possibility of seed saving gives seed some 'public good' characteristics and lowers the incentives for private development. Even in industrialised countries a considerable amount of basic research in plant breeding is managed by public entities. But the use of hybrid technology essentially eliminates the possibility of seed saving, and increasing attention to plant variety protection also serves to increase commercial incentives. In addition, farmers often purchase seed because of the convenience and quality of formal sector seed, which provides further avenues for enterprise development.

Seed embodies genetic and physical characteristics that are usually difficult for the purchaser to assess. Judgements about the performance of the variety and the quality of the seed must often wait until harvest. The development of trade in seed therefore requires particularly good information exchange and the existence of mechanisms allowing trust to develop between buyer and seller.

Demand for seed is often highly differentiated. Farmers require specific varieties and seed characteristics. In developing countries farmers often sow several varieties of one crop. The quantities of seed demanded for any particular variety, however, may be quite low and will vary considerably from season to season. Addressing this type of demand requires excellent information. In addition, farmers may live in dispersed communities, adding to the problem of information flow and seed delivery. We also have seen that seed production is more management – rather than capital – intensive (Cromwell et al., 1992). This offers opportunities for small entrepreneurs, but once again highlights the importance of information in the development of the formal seed sector.

These are some of the characteristics of seed that make it particularly susceptible to the concerns of institutional development. But we also need to introduce the process of seed provision. Seed enterprise development is often confused with seed production, but the latter is just one component of the seed provision process. This process resembles a chain, which is only as strong as its weakest link (Cromwell et al., 1992: 8). There are a number of ways of defining the stages in the seed provision process, but the following divisions will be used in this discussion:

Plant breeding and variety selection. Seed provision begins with variety development. Seed may be of a modern variety or a farmer variety, but a significant investment in plant breeding and/or variety selection is required to identify the appropriate materials for subsequent seed multiplication.

Source seed production. Several stages are usually required to move from the small amount of seed produced by the breeder to quantities sufficient for seed multiplication. There are several nomenclatures in use to describe these stages; the OECD scheme identifies breeder, pre-basic, and basic seed as stages preliminary to the production of certified seed (Cromwell et al., 1992). Even where farmer varieties are the focus of formal seed provision, decisions must be made about how source seed is to be maintained and produced.

Seed multiplication. Most discussions of seed provision focus on the organisation of seed multiplication. Although this is obviously a key stage in the process, it is only one aspect of seed provision.

Quality control. This is not really a discrete stage, but covers activities that are carried out during several other stages. It is important enough to the viability of seed provision, however, to merit separate treatment. Activities may include some type of official certification (including field visits) and seed testing after harvest. The quality control procedures practised by seed producers and merchants themselves are also important (and may be sufficient).

Seed conditioning and storage. After seed is harvested it must be dried, graded and cleaned, and the organisation of these tasks is crucial to successful seed provision. In addition, the seed of many crops must be stored for a considerable time before sale or distribution, necessitating adequate storage facilities.

Seed marketing and distribution. Appropriate mechanisms must exist for delivering seed to farmers, and may involve a complex marketing or distribution network.

Farmers. The final 'stage' in seed provision is farmers' utilisation of the seed. This is an appropriate place to recall that seed must respond to farmers' demands, whether for a particular variety or for a specific type and quality of seed.

Seed provision is a complex process. An examination of the relationship between the institutional environment and seed enterprise development must include the organisation of the individual components (the transformation costs) as well as the management of the links between the components (the transaction costs) (North, 1990: 28).

3.2 Transformation costs and incentives

Much is already known about the technical and economic aspects of seed provision.¹ Perhaps the most important issue to be resolved about the organisation of the seed provision process is the division between public and private responsibilities (Jaffee and Srivastava, 1994). But the public/private dichotomy is not nearly as clear-cut as it appears. Thirtle and Echeverria (1994) discuss the choices for agricultural research, which is currently seen as a predominantly public responsibility. They point to a series of parameters that can be used to distinguish organisational responsibilities. These include: the source of funds for an activity (including public funds, levies, private commercial or voluntary sources); the execution of activities (by a publicly owned, commercial or voluntary organisation); the importance of the profit motive; and the utilisation of the output (by the public, a restricted set of users or private demand).

These factors can be seen as part of the incentive structure that guides an activity such as seed provision. The challenge for seed enterprise development is to shift from almost exclusively public sector-related incentives towards other, private, incentives. In North's view, 'incentives are the underlying determinant of economic performance' (1990: 135). The concept of incentives is complex, however, and involves both quantifiable rewards and people's perceptions (*ibid*: 137).

Most current analysis emphasises the negative aspects of public sector incentives. Rational choice theory sees political systems as markets where actors pursue their own goals (Staniland, 1985: 36). Regulatory systems are seen as serving particular political interests rather than the public good (e.g. Stigler, 1971). Most instances of public seed production and distribution are clearly inefficient because of a lack of adequate incentives (Jaffee and Srivastava, 1994). However, certain aspects of public participation in the seed provision process can, or should, call on more effective incentives. This is true, for instance, of plant breeding and variety selection, where scientific motivations and the satisfaction of developing new and useful varieties may compete with more commercial rewards. It should not be unreasonable to expect the motivation of public service to play an important part in the seed provision process.

Commercial incentives are similarly complex. It is undoubtedly true that the profit motive is underemphasised in current seed provision, and the expansion of commercial opportunities is the single most important stimulus for seed system

¹ Among the useful references on the technical organisation of seed provision are Douglas (1980), Kelly (1989), Chopra and Reusche (1994) and Mumby (1994). Economic analyses of seed provision include Cromwell et al. (1992), Cromwell (1996) and Lopez-Pereira and Filippello (1995).

development. But other types of incentive are also important. As Ostrom et al. (1993: 8) point out, incentives

are more than just financial rewards and penalties. They are the positive and negative changes in outcomes that individuals perceive as likely to result from particular actions ... The internal values of an individual or the cultural values he or she shares with a community can act as a strong motivation.²

We need to consider as wide a range of incentives as possible for organising and performing the various components of the seed provision process.

3.3 Transaction costs

Although it has long been recognised that information is vital for economic development, it is the growth of institutional economics that has brought this subject to the fore. The concept of transaction costs is central here. Transaction costs can usefully be divided into 'search and information costs, bargaining and decision costs, policing and enforcement costs' (Dahlman, 1979: 148). An even more parsimonious definition is 'resource losses incurred due to imperfect information' (ibid.).³

It is clear that neoclassical assumptions of perfect information are not useful for understanding the direction of economic development. More attention needs to be paid to the institutions that mediate and facilitate the flow of information between actors in any market. Although excessive reliance on the concept of transaction costs may in itself be a new orthodoxy that diverts attention from the political realities of

² Among the types of incentive identified by Ostrom et al. (1993: 8) are:

- (1) opportunities for distinction, prestige, and personal power; (2) desirable physical conditions in the workplace ... ; (3) pride in workmanship, service for family or others, patriotism, or religious feeling; (4) personal comfort and satisfaction in social relationships; (5) conformity to habitual practices and attitudes; and (6) a feeling of participation in large and important events.

Even current management theory admits the importance of diverse incentives: 'Scientific managers overestimate the importance of financial rewards in motivating workers: people are much more interested in intangible things, like winning the praise of colleagues or working for an organization they admire' (Micklethwait and Wooldridge, 1996: 101).

³ Information costs and transaction costs should not be equated, however. '[L]oosely speaking ... most transaction costs are information costs. But the converse does not apply. There are important information costs which are not transaction costs. The costs of investigating a project to reduce its risk are a case in point. So too are the costs of developing a new technology through R & D' (Casson, 1997: 279).

resource allocation,⁴ it is exceptionally useful for understanding a number of weaknesses in current planning for national seed systems.

The concept of transaction costs is relevant to seed enterprise development for two reasons. First, a seed enterprise attempts to market a commodity that farmers have been able to provide for themselves. The enterprise needs to present sufficient information to its clients about the advantages of its product, and farmers need to be able to express their demands to the enterprise. Second, we have seen that seed provision is a complex process, involving several distinct operations (discussed in section 3.1). Much of transaction cost theory addresses the ways in which information flows can be facilitated within such complex production processes. We shall briefly discuss the background for each of these types of transaction cost.⁵

One of the characteristics of developing markets is the difficulty of obtaining reliable information about products offered for sale. This information asymmetry is a particular challenge when the goods are of different grades or qualities. As Akerlof (1970) points out, a considerable amount of time and effort in these situations is devoted simply to trying to ascertain the quality of the commodities in the market. This represents a significant loss of resources that could be devoted to other activities. There are a number of ways of lowering these transaction costs for consumers. Enterprises must invest in establishing their reputations through brand names, advertising, guarantees, or third party enforcement such as licensing or certification (Akerlof, 1970; Klein and Leffler, 1981).

Exchanges can be characterised by their specificity, frequency and uncertainty (Williamson, 1979). These characteristics are particularly problematic for the seed industry in developing countries, where the range of varieties offered for sale is constantly changing, farmers' seed saving practices allow them to be only occasional participants in the market, and seed quality may not be ascertainable until months after the purchase has been made. As Cromwell (1996) points out, these conditions impose significant transaction costs on both buyers and sellers of seed. Seed buyers are constrained by uncertainties regarding the characteristics and quality of seed offered for sale. Seed suppliers are constrained by their lack of knowledge of the type and frequency of seed demand. The result is a significant depression in the potential for seed trade.

⁴ 'The suspicion remains that the concept of transaction costs is simply a gloss, or at best a respecification, of what used to be known simply as market failures' (Mulberg, 1995: 141).

⁵ These two types of transaction cost parallel Moore's (1994) distinction between 'consumer markets', characterised by impersonal and perhaps unrepeated spot transactions; and 'inter-business markets', characterised by repeated transactions with business networks.

The second aspect of transaction cost theory relevant to seed enterprise development is related to the comparison between hierarchies and firms. The subject traces its origins to Coase's (1937) paper on the nature of firms, in which he argued that firms emerge in market economies in order to lower the costs of negotiating and establishing contracts among a large number of individual specialist producers. Placing a number of components of a production process within a single firm lowers the transaction costs of obtaining information about product quality and enforcing contracts. With the exception of Rusike's (1995) study on southern Africa, however, there has been little work on applying transaction cost theory to seed enterprise development.

The degree to which the formation of firms to lower transaction costs is a feasible strategy in the developing world is a complex problem for seed enterprise development. On the one hand, the model of seed companies in industrialised countries points the way toward large, integrated operations that combine most or all of the components of seed provision. Such firms are already operating in many developing countries, and their further expansion and development should be expected. But the formation of such firms requires considerable capital and organisational capacity, resources that are often in short supply in developing countries. In addition, the seed industry offers relatively few economies of scale, so small operations are quite feasible and in fact, until quite recently, were the dominant force in most industrialised country seed sectors. There is undoubtedly a need to combine as many of the components of seed provision under unified management as possible, but the development of large seed firms can not be used as a universal blueprint.

As Hart (1975) points out, firms themselves are not free of opportunism, and if they provided the answer to lowering all transaction costs then they would be the sole player in the economy. Indeed, it is interesting to note the current trend towards the 'disaggregation' of firms (Miles and Snow, 1996). Much of current management practice is concerned with concepts such as 'outsourcing', 'contracting out' and 'core competencies' (Micklethwait and Wooldridge, 1996). The relative advantages of integration within a single firm (versus the co-ordination of a hierarchy of specialists) depend on technology, the advantages of specialisation, economies of scale, and the availability of information.

3.4 Trust and social capital

Both types of transaction costs (those arising from the need to co-ordinate specialist tasks within the provision process, as well as those characterising the buyer-seller interface) are related to the issue of trust. Trust has become a fashionable subject for

institutional economics, although there is little agreement on a precise definition.⁶ The concept of trust is relevant to seed enterprise development in two ways. First, the existence of trust serves to lower transaction costs. In a world where the absence of transaction costs would be 'as strange as the physical world ... without friction' (cited in Mulberg, 1995: 154), trust serves as a 'social lubricant' (Dasgupta, 1988: 64). Second, trust is developed within an institutional context, and is furthered by the actions of societal norms, political organisation, regulation, professional standards, networks and corporate culture (Williamson, 1993). Trust can be seen as an expression of social capital whose growth and development contribute to the lowering of transaction costs. Enterprises that can operate in an environment of well-established reputations and a stable legal and regulatory system do not have to invest such a high proportion of their resources in seeking information about their partners.

The concept of social capital is important for seed enterprise development. Social capital is defined as those 'features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating co-ordinated actions' (Putnam, 1993: 167). Social capital 'comes about through changes in the relations among persons that facilitate action ... Like other forms of capital, social capital is productive, making possible the achievement of certain ends that in its absence would not be possible' (Coleman, 1988: S100, S98).

A particular feature of the organisation of seed provision in developing countries is the range of potential participants. Public sector organisations often have a role to play, particularly in plant breeding, while potential private interests include the commercial sector, co-operatives, and community or voluntary organisations. It is a particular challenge to decide how these categories of participant, often with different interests and incentives, should divide the range of tasks in seed provision. To the extent that several types of organisation must be co-ordinated, the role of social capital in lowering transaction costs is extremely important.

3.5 Seed enterprises and transaction costs

It is worth reviewing how transaction costs affect different types of seed provision. Section 4 will expand in greater detail on how seed provision involves a chain of activities, beginning with plant breeding and extending to source seed production; seed multiplication; quality control; conditioning and storage, and distribution and marketing (as briefly set out in section 3.1). Farm-level seed provision is an integrated

⁶ A recent popular treatment of the subject has assumed a very broad scope (Fukuyama, 1995), while scholarly treatments debate the degree to which the concept of trust is open to quantitative analysis (Humphrey and Schmitz, 1996; Dasgupta, 1988).

Figure 1 The integration of seed provision activities at the farm level

<i>Seed provision functions</i>	<i>(Farm level activities)</i>
Plant breeding	(Variety selection, maintenance)
Source seed	
Seed multiplication	(Crop production)
Quality control	
Conditioning and storage	(Home storage)
Distribution and marketing	(Farmer-to-farmer seed exchange)
Utilisation by farmers	

process in which all these functions are managed at the household or community level (Figure 1).

Transaction costs are low because the farmer is in charge of the entire process, from selecting the desired varietal characteristics to producing and managing the seed. Any seed exchange takes place among neighbours whose reputations are well known. Similarly, a commercial seed company addresses the problems of transaction costs by integrating most of the seed provision functions within the firm (Figure 2).

In some cases the seed company does all of its own plant breeding, while in other cases it may rely (at least partially) on other private or public sources of germ plasm. Another important transaction for most modern seed firms involves contracting private farmers to do the actual seed multiplication. In addition, some seed companies do not directly market their products, but work through independent retailers. But with these exceptions, a conventional seed company is a good example of how a firm lowers transaction costs by integrating specialist functions.

The picture is quite different when we look at attempts by governments, donors and NGOs to promote seed enterprise development. Such efforts rarely present the integrated set of activities characteristic of commercial seed companies or farm level seed provision. In most cases, the various functions of seed provision are in the hands of different organisations. Table 2 presents two typical examples, from Ghana and Nepal.

The complexity of these operations is evident, as is their susceptibility to high transaction costs. One of the primary goals of this paper is to examine how these

Figure 2 The integration of seed provision activities by a seed company

<i>Seed company responsibilities</i>	<i>Interactions with other organisations</i>
Plant breeding	-- Basic research
Source seed	
Seed multiplication	-- Contract growers
Quality control	
Conditioning and storage	
Distribution and marketing	-- Retailing
<hr/>	
Utilisation by farmers	

Table 2 The division of seed provision responsibilities in two small-scale seed projects

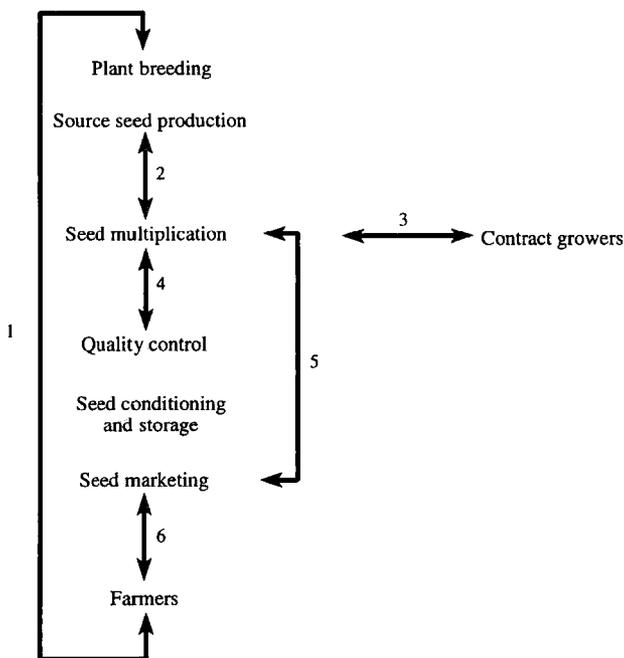
<i>Seed provision component</i>	<i>Seed producer-sellers (Ghana)¹</i>	<i>KOSEVEG project (Nepal)²</i>
Plant breeding	Crops Research Institute (public sector research)	Public sector agricultural research stations
Source seed production	Grains and Legumes Development Boards (public sector organisation)	Research stations and extension service plots
Seed multiplication	Individual seed producers	Farmer groups
Quality control	Ghana Seed Inspection Unit	Extension and research personnel
Seed conditioning and storage	Various arrangements, including use of facilities of defunct Ghana Seed Company	Farmer responsibility; some extension input
Distribution and marketing	Merchants, market sellers and small seed companies	Seed entrepreneurs association; co-operatives

Sources: ¹ Bockari-Kughei, 1994. ² Joshi, 1995.

transaction costs can be lowered, either by combining functions under single management or by establishing mechanisms that allow the more efficient exchange of information among participating organisations. Figure 3 illustrates the interactions in the seed provision process that require particular attention.

Two of these interactions (1 and 6) involve the relationship of farmers to the seed provision process. The first is related to the flow of information between public plant

Figure 3 Key interactions among components of the seed provision process



The interactions

1. Between farmers and public sector plant breeders to determine breeding priorities and promote feedback.
2. Between source seed producers and seed producers to ensure the availability of varieties that are in demand.
3. Between the seed production enterprise and the contract growers to ensure that contracts are honoured.
4. Between the quality control agency and seed producers to provide competent supervision and protect the reputation of the industry.
5. Between seed producers and retailers to ensure that seed is actively promoted.
6. Between seed dealers and farmers to ensure that a relationship of trust is developed.

breeders and farmers. It is concerned with the importance of breeders understanding farmer requirements and farmers' influence in variety development. The second is concerned with the relation between seed dealers and farmers, and underlines the importance of trust in seed markets.

The other interactions shown in the figure represent transactions within the seed provision process that must be addressed by an integrated seed company or by co-ordination among participating organisations in a seed project. They include: the exchange of information between source seed producers and seed producers to ensure that adequate source seed of desired varieties is available (2); the arrangements that a seed firm makes with its contract growers, or the management of seed producer groups (3); the interactions between seed producers and an external seed quality control agency (4); and the flow of information and development of trust between seed producers and seed merchants (5). These four interactions are not the only transactions of concern to seed provision, but they tend to be the most important. Each of these interactions (both those within the process and those that link seed provision to farmers) will be discussed in more detail in Section 4.

3.6 Summary

An analysis of the institutional environment of seed provision needs to consider both transformation costs and transaction costs. The organisation of each component of the seed provision process must be adequate. Although the technical and economic aspects of seed provision are fairly well understood, less attention has been given to the incentives for each step of the process. This is particularly important because different aspects of seed provision may be managed by public, commercial or community organisations.

Certainly the most neglected aspect of seed enterprise development is the crucial role played by information. Co-ordination among the various components of the process requires an efficient flow of technical and market information, the capacity of various organisations to establish contracts, and the development of trust among the participants in the process. The following section looks in more detail at the components of seed provision. It draws on experiences from developing and industrialised countries and pays particular attention to the management of incentives and information.

4. The components of the seed provision process

This section presents the features of each component of the seed provision process that are most relevant to the theme of seed enterprise development. The discussion includes a description of the nature of the activity, examples from both industrialised and developing countries, an examination of relevant transaction costs, and implications for the type of institutional environment required to support seed enterprise development.

4.1 Plant breeding and variety selection

The seed provision process begins with plant breeding and variety selection. There are several issues related to plant breeding that are relevant to seed enterprise development. These include the division between public and private responsibility, the organisation of adequate incentives for plant breeding, and the flow of information between farmers and public plant breeders.

Until recently, all of the crop varieties that contributed to the growth of world agriculture were developed by farmer selection. Scientific plant breeding is little more than a century old, and it has been practised by both private individuals and public organisations. The development of wheat breeding in France and the US illustrates the contrasting pathways. Wheat breeding in France was initiated by private breeders in the late nineteenth century, and they dominated the development of new varieties. It was not until 1921 that government-sponsored plant breeding was initiated in France (Lupton, 1988). In the US, on the other hand, most wheat breeding was the responsibility of state experimental stations and universities, or the Department of Agriculture.¹

The development of hybrid technology has been a significant stimulus to private plant breeding because farmers need to purchase fresh hybrid seed each year. Most hybrid development in industrialised countries is in the hands of private seed companies. The breeding of non-hybrid crop varieties is more evenly shared between public and private breeders. In the US, for example, there are approximately equal numbers of

¹ An analysis of the 128 principal wheat varieties grown in the US in 1934 shows that 100 were developed by the public sector, 23 by private individuals and only 5 by seed companies (Kloppenborg, 1988).

public and private wheat breeders (Bohn and Byerlee, 1993),² and there is healthy competition between public and private varieties (Barkley and Porter, 1996). In developing countries, breeding for most non-hybrid varieties is done by public sector institutions, but there are some exceptions, for instance in Argentina, where private wheat breeding is well developed (Jacobs and Gutierrez, 1986).

There is not likely to be any formula for finding a precise balance and mode of interaction between public and private breeding. Canada and the Netherlands, which both have productive seed potato industries, illustrate alternative strategies. In Canada, all breeding activities for potatoes are done by government institutions, while in the Netherlands only basic research is handled by the government (Young, 1990). In both developing and industrialised countries it is likely that significant investments in public plant breeding will be required for the foreseeable future.³

It is important to ensure that adequate incentives exist for both public and private plant breeding. Section 2.2 discussed the ways in which current regulations for variety release and seed certification impede the growth of private plant breeding. The establishment of a clear system for PVP would also encourage more private plant breeding, although studies in Latin America (Jaffé and van Wijk, 1995) and the US (Butler, 1996) have shown the impact of PVP on investments in plant breeding to be confined to relatively few crops.

Incentive structures for public plant breeding require even more attention. Public investment in agricultural research in most developing countries is well below the levels found in industrialised countries (Pardey et al., 1991). Salaries for public sector plant breeders in developing countries are generally low and working conditions and facilities often inadequate. When the opportunity arises, many public plant breeders leave to work in the private sector.

But financial incentives are not the only challenge for public plant breeding. Research managers and policy makers must define more clearly their relationship with the private sector. Some observers have suggested that the public sector should do only basic research and leave all applied research to the private sector, but this is not a satisfactory division of labour (Busch et al., 1991). Moves towards cost recovery for public institutions encourage public breeders to charge royalties for the germ plasm they supply to private companies. This is a reasonable strategy, but its overemphasis

² In Europe, where there is a stronger tradition of plant variety protection (PVP), the proportion of private sector wheat breeding is higher (Bohn and Byerlee, 1993).

³ Even in the case of maize in the US, which is certainly one of the strongest examples of private sector plant breeding, 50% of the maize inbred lines in use for hybrid production in the 1980s were developed by the public sector (Knudson, 1990).

can easily direct public research away from the requirements of the farmers who are not of interest to the commercial sector.

An appropriate definition of the mandate for public plant breeding will include the identification of the varieties, crops and farmers that are unlikely to attract commercial investment. Plant breeders' responsibilities will have to include not only the development of appropriate varieties but also the identification of seed provision mechanisms to ensure that the varieties are readily available to farmers. This implies co-ordination between public sector breeders and various local-level organisations that can facilitate variety selection or produce seed.

Much has been written about the lack of communication between public plant breeders and farmers in developing countries (Ashby and Sperling, 1995; Byerlee et al., 1987; Haugerud and Collinson, 1990). If public plant breeding is to contribute to seed provision for farmers who are not reached by the conventional commercial sector, more emphasis must be placed on techniques that allow a more efficient exchange of information between breeders and farmers. The low adoption levels for many public varieties (and the consequent low demand for seed) can often be traced to the absence of effective communication about the conditions and priorities of farmers.

The inadequate flow of technical information between farmers and breeders is not the only example of deficient communication. Of equal importance are the political mechanisms that allow the voices of resource-poor farmers to be heard in the public research system, and the development of a public service ethic that directs attention to the needs of the more disadvantaged members of the farming population. The potential contribution of public plant breeding to national seed system development depends crucially on institutional innovations that provide farmers with a greater voice and promote a more responsive public research service.

4.2 Source seed production

Seed producers depend on access to source seed. One or more generations of source seed of a variety must be maintained and produced each season as long as commercial seed production of the variety is contemplated. Source seed production is a distinct step in the seed provision process requiring particular skills and should not be confused with seed multiplication. Relevant institutional issues include the division between public and private responsibility, incentives for source seed production, and the flow of information to organisations that produce source seed.

Large seed companies that have their own plant breeding capacity manage and maintain their own source seed. Smaller seed companies, however, may rely on other

suppliers for source seed. Many of the small regional hybrid maize seed companies in the US depend on one company (Holden's Foundation Seeds Inc.) for plant breeding and source seed.⁴ This is an example of how specialisation can promote the diversification of a national seed system; the small companies take advantage of their knowledge of local needs and markets while the source seed supplier provides research products that the small companies could not afford to develop individually.

When commercial companies produce seed of public varieties their source seed may come from public or private organisations. In India, companies may produce their own source seed of public varieties, or may acquire it from public universities, research institutes or state seed corporations. In Latin America there are a number of examples of government research services that provide source seed of public varieties to private seed producers.⁵ In Ghana, the Crops Research Institute is responsible for plant breeding, but another organisation, the Grains and Legumes Development Board, produces source seed, which it then provides to small commercial seed producers (Bockari-Kugbei, 1994).

As in the case of plant breeding, there is no simple formula for determining how public and private responsibilities should be divided. When sufficient skills are available in a country, commercial source seed production should be promoted. For seed of public varieties that will be produced by small commercial enterprises, co-operatives or farmer groups, some public source seed production capacity will probably be required.

To the extent that public organisations retain responsibility for source seed production, they require adequate incentives for producing the quantity and quality of source seed required. Source seed production requires particular care in controlling for genetic impurities, and any problems introduced at this stage will be exacerbated during commercial seed multiplication. If the public source seed supplier depends on payments from seed producers rather than a government budget, performance is likely to be better. Public seed quality control agencies should devote more attention to

⁴ It is interesting to note that this niche for Holden's is threatened by the advent of transgenic varieties. Unless the company is able to invest in new technology, its varieties may not be able to compete with those of the larger seed companies. This in turn will affect the survival of the smaller regional seed companies (Seghal, 1996).

⁵ In Brazil, the national research institute (EMBRAPA) provides source seed for hybrids and open-pollinated maize varieties to a group of small private seed companies and co-operatives (Lopez-Pereira and Filippello, 1995). In Argentina, the national research institute (INTA) provides source seed of its maize, soybean, wheat and sunflower varieties to a co-operative (PRODUSEM) that produces and markets the seed (Jacobs and Gutierrez, 1986). CENTA, the national research institute of El Salvador, provides source seed of maize hybrids to private seed companies and co-operatives (Choto et al., 1996).

source seed producers (and less to commercial seed growers) (Tripp and van der Burg, 1997). In addition, source seed producers can work with seed growers to determine the most relevant type of generation control and level of purity required for particular settings. When small seed enterprises or co-operatives are just beginning to introduce commercial seed to farmers in an area, the strict generational control characteristic of sophisticated commercial operations (and often required by public seed companies as well) may be inappropriate (Garay et al., 1988).

Information is also a key issue in source seed production. Depending on multiplication rates and generation control requirements, it may take several seasons to produce sufficient source seed of a particular variety that can then be used for commercial multiplication. The source seed organisation thus requires very clear signals about the varieties and quantities required by seed producers. On the other hand, if seed producers have little information about new public varieties that are available, and if farmers have no effective means of expressing their demands for new varieties, seed producers will continue to request source seed of current varieties (Virk et al., 1996).

In many instances, simply acquiring a small amount of source seed of a new variety may be difficult, particularly for a small seed producer. Besides the problems of information exchange described above, a potential seed producer may need personal contacts with the source seed organisation. In many NGO-sponsored seed projects, NGO staff take the responsibility of making these connections. Converting such projects into sustainable enterprises requires attention to the institutionalisation and amplification of communication between source seed providers and seed producers.

4.3 Seed multiplication

In almost all cases seed multiplication is best done by individual farmers. This is the way that seed is produced by most commercial seed companies, who would find it very inefficient to try to maintain their own land for seed production.⁶ Some parastatal seed companies use state farms for seed production (e.g. Tanzania, Bangladesh), while others contract private farmers. Although there have been few studies, the available evidence points to the superior efficiency of contract farmers (Abeygunawardena et al., 1990).

⁶ The economics of land use is responsible for even the most advanced seed companies having to establish contracts with many individual growers. In other industries, changes in technology have affected the economics of contract production. The development of central sources of power helped convert 'putting out' in the weaving industry to a centralised factory system (Alchian and Demsetz, 1972).

Among the institutional issues of importance to seed multiplication are the organisation of contracting and the type of information and support required to provide adequate incentives for farmers to become seed producers.

Seed may be grown by individual farmers who are contracted to a company, or by the members of a co-operative or seed producers group that have some agreement for sharing responsibilities and benefits. Seed production can be a very important source of income for farmers. Payments to contract growers are the largest single expense for US maize seed companies, and total US\$300 million annually (Newlin and Kuster, 1994). Seed enterprise development thus offers the possibility of providing a productive specialisation for some farmers. The challenge is to provide incentives for seed growers.

Seed producer co-operatives have been important in a number of countries. They have played a particularly important role in the development of commercial seed production in France, for instance (McMullen, 1987). Much of the testing and seed production for public varieties in the US in the early twentieth century was done by crop producer associations (Kloppenburg, 1988). In El Salvador, the initial development of maize seed production featured small growers; co-operatives then came to the fore, and they have since been overtaken by several large local seed companies (Choto et al., 1996). The largest commercial seed producer in Zimbabwe began as a producer co-operative (Rusike, 1995). There are relatively few successful seed production co-operatives in developing countries; a seed potato co-operative in Himachal Pradesh, India appears to be one example (Baumann and Singh, 1996), and some producer co-operatives in Latin America have been able to initiate commercial seed production (Janssen et al., 1992). A number of small-scale seed projects have found it useful to organise farmers into seed producer groups (e.g. Joshi, 1995), which might evolve into co-operatives.

Although seed growing is a potentially profitable activity for farmers, it is worth examining the incentive structure. In some cases, grain producer co-operatives have initiated seed activities when their members have been unable to obtain adequate seed from other sources. In some of these instances, the co-operative evolves towards marketing seed to non-members as well. In many small-scale seed projects initiated by NGOs or donors, the objective is to make seed production a source of added income for individual growers. However, relatively few of these projects are financially viable as yet (Wiggins and Cromwell, 1995). Participating farmers may have other motivations, including access to credit, inputs or technical advice (Joshi, 1995). Even in cases where small farmers have become successful commercial contract seed growers, an initial investment in training, organisation and credit has often been necessary (Benziger, 1996). Contract seed production is certainly not always a profitable activity, especially for seed of low value crops. In Malawi, for

instance, farmers who were recruited to grow seed maize often found it was more profitable to grow a crop of tobacco (Cromwell and Zambezi, 1993).⁷

An alternative to contract seed production is for individual farmers to produce and market seed. There are of course many informal examples of this, where particular farmers in a community are recognised as reliable producers from whom their neighbours may occasionally purchase small quantities of seed (e.g. Thiele, 1997). Much of the commercial seed production in the US began in this way, with particular farmers selecting their own varieties and marketing the seed, or multiplying source seed they acquired from state universities or experimental stations (Appendix 1A) (Fitzgerald, 1990; Norskog, 1995; Kloppenburg, 1988). In most of these cases, however, seed production skills were combined with a flair for marketing, and the successful individuals soon expanded to manage contract growers of their own.

Some NGO and donor seed projects attempt to follow this model. Bal and Rajbhandary (1987) describe a 'producer-seller' project in Nepal, where individual farmers were provided with source seed, technical advice and storage facilities, and expected to produce seed and market it to their neighbours. The concept of 'artisanal' seed production has been promoted in Latin America (Lepiz et al., 1994). In Ghana, ex-contract growers for the defunct parastatal seed company have now been organised as individual seed growers, responsible for marketing their output (Bockari-Kugbei, 1994). Seed projects funded by the Inter-American Development Bank in Guatemala (Veliz, 1993) and the World Bank in Ethiopia are also based on individual 'producer-sellers'. Although this strategy lowers the transaction costs of contracting growers, it would seem to place an extraordinary burden on the seed growers to manage a number of other transaction costs, including those of source seed acquisition and marketing.⁸

If commercial seed production based on contract growers is to evolve, adequate contracting mechanisms must be in place. Farmers will only be interested in growing seed if they are assured that they will get a fair price for their harvest, and seed companies will only wish to contract growers who honour their commitments. The problems are typical of contract farming in general (Little and Watts, 1994; Porter and

⁷ Similarly, the high costs of growing sorghum seed in Zimbabwe (including mandatory government certification) mean that commercial farmers prefer to grow grain maize. This discourages commercial sorghum seed production.

⁸ It is interesting to note that the 'producer-seller' project described by Bal and Rajbhandary (1987) has since closed. Another seed project in Nepal (KOSEVEG), which establishes seed producer groups, has found it necessary to establish a separate organisation (KOSEPAN) to manage source seed acquisition, quality control, and negotiations with seed merchants (Joshi, 1995). This would seem to illustrate the importance of these transaction costs for small seed producers.

Phillips-Howard, 1997). Contract growers may be disappointed by the prices paid by the seed company, the timing of payment, or the application of obscure quality provisions that lower the producer price. Companies, on the other hand, face the risks that growers will not comply with contracts, will be tempted to sell their seed to other buyers, or will attempt to adulterate or misrepresent their product. Contracts can address many, but not all, contingencies, and the successful evolution of contract seed growing requires the development of trust between the contracting partners.⁹

Problems are particularly challenging in developing countries where neither emerging enterprises nor individual growers have experience with commercial contracting. In India, where farm size is small, both public and private seed enterprises have found it useful to contract with entire villages. This concentration saves on supervision resources and helps to ensure sufficient isolation distances, which would otherwise be difficult in the small-farm environment. In most cases, relations between these 'seed villages' and the firm are mediated by an agent (Singh et al., 1995). The performance of such agents is itself worthy of study. In other contract farming situations agents may be able to exploit their position through rent seeking (Glover, 1987). On the other hand, there are instances where seed villages have gained sufficient experience to separate themselves from the firm and initiate their own seed business.

The issue of contracting with resource-poor farmers raises the additional question of who should be the targets for projects or policies that promote contract, group or individual seed entrepreneurship. On the one hand, we have seen that the opportunity costs of seed production of low-value crops means that larger commercial farmers may not be interested. On the other hand, the skills, resources and ability to bear the risk required for seed production mean that it is not usually an activity that can be targeted at the poorest members of the farming community. Policy makers must be able to distinguish between the benefits to the (relatively few) seed *growers*, and the benefits to the much larger group of seed *users* who will have access to good quality seed. Placing too much equity emphasis on the selection of growers may jeopardise the potential to reach a large number of seed users.¹⁰

⁹ The problems are not unique to conventional contract growing. The management of obligations for members of a co-operative or seed producers group faces similar dilemmas. Joshi (1995) describes some of the problems of seed grower groups in Nepal.

¹⁰ There are some interesting exceptions to this general rule. Turton and Baumann (1996) describe how some landless women in India have been able to make a business from collecting fodder grass and processing and selling the seed. The high labour requirements, and the fact that the grasses are collected from common land, give these women a comparative advantage in this seed production activity. Another attempt to have the poorest members of the community benefit from seed production activities (with less clear comparative advantage, however) is described by Sathesh (1996).

4.4 Seed quality control

The establishment of effective quality control procedures is absolutely essential to seed enterprise development. Seed embodies both genetic and physical qualities that the buyer may not be able to assess until after the crop is in the field. When farmers buy seed they require some type of assurance regarding seed quality. Clear responsibility for seed quality control makes a major contribution to establishing the trust that promotes enterprise growth.

Seed quality control addresses two concerns. Genetic quality is controlled by monitoring the source seed used for multiplication, by visiting the seed production plots to ensure proper isolation distances and to remove off-type or diseased plants, and by inspecting the harvested seed. These activities comprise seed certification, in the strict sense. In addition, seed testing is carried out on harvested seed to monitor characteristics such as moisture content and germination percentage. The results of seed testing are often included in the report of a certification agency.

There are two general approaches to seed quality assurance. The first places much of the responsibility with the seed seller and market forces. When seed is sold in a competitive market by well-established enterprises that have reputations to protect, consumers generally have confidence in the quality of the product. The practice of 'truthful labelling' is most often used in these cases. The seed is sold with a label that describes its minimum standards. Any divergence from these can be challenged by the consumer in a court, and the company will also be punished as unhappy customers switch to competitors.

The second approach to seed quality control is independent certification. This may be done by a public or private organisation, and it may be voluntary or mandatory. In EU countries, seed certification for field crops is mandatory. The certification may be carried out by government agencies, although private companies are often licensed to do the certification. In many developing countries seed certification is also mandatory, and in the hands of a public agency. In the US, certification is voluntary and managed by private agencies. Although companies may not certify their seed, they may contract an independent laboratory to help manage their quality control operations (Handwerker, 1997).

In South Africa, voluntary seed certification is done by the seed producers association (SANSOR) with government supervision (Rusike, 1995). In New Zealand, the Ministry of Agriculture and Fisheries is responsible for voluntary certification, for which seed producers pay full costs (Hampton and Scott, 1990). Seed certification is voluntary for private companies in a number of developing countries such as India, Pakistan and Mexico.

A common thread in the history of seed enterprise development in most industrialised countries has been the necessity to address inexperience (and at times dishonesty) with some types of regulatory mechanism (Rutz, 1990; Kloppenburg, 1988). Confusion over the names and characteristics of varieties on the market can discourage farmers from purchasing seed. As the seed industry emerged in the US, one observer described its operations as '*caveat emptor* with a vengeance' and the US Department of Agriculture published lists of merchants known to sell adulterated seed (Fowler, 1994: 81). Although it may be argued that markets and consumer courts should be the final arbiters, assignment of blame for seed quality problems can be difficult. For instance, poor germination may be the fault of the seed producer, the merchant who stored the seed, or the farmer who sowed the crop. Even in the well-developed US seed market, clear-cut liability procedures for defective seed have yet to be established (Centner, 1989).

Although seed quality control seems to present a case for some kind of state regulation, the experience of government seed regulation in developing countries has not been positive (Tripp, 1997). Government seed certification agencies are usually inadequately funded, and their inability to carry out inspections or tests on time may cause serious delays. In many countries public seed certification has been directed towards monitoring parastatal seed companies. As policies change to allow the emergence of new seed enterprises, the certification agency often does not have the resources to address this diversification. Inadequate budgets also mean that in most cases seed inspection at the point of sale is neglected. This is often one of the weakest links in the chain, especially when seed is sold by inexperienced merchants in distant locations. Furthermore, the standards used by the certification agency may be too strict, and these discourage the emergence of seed provision options that meet farmers' diverse needs. Finally, mandatory public seed certification is subject to rent seeking. Inspectors may demand extra payments for their services, or politically powerful seed producers can influence the judgements of the inspectors.

Many of these inadequacies in government seed certification can be described as a problem of incentives. The government certification agency serves a small number of seed enterprises (sometimes only the seed parastatal), is funded from a limited government budget, has little direct communication with farmers, and has little motivation or opportunity to improve its service. Responsibilities for seed quality control need to be shared more broadly among the government, seed producers and farmers. Moving seed quality control in this direction will require strong markets, increased information for farmers and attention to the technical skills of new seed producers.

Many of the problems with the management of seed quality control will be ameliorated by more competition in the seed market – seed producers will pay more attention to quality control when their sales depend upon it. A co-operative in Bolivia

has found that its reputation is sufficient to sell soybean seed locally without state certification, but realises it will need to contract the certification service to help it compete in more distant markets (Rosales, 1995b). Similarly, Makus et al. (1992) discuss a case of seed potato growers in the US imposing stricter certification standards on themselves to help them capture new markets.¹¹

The development of reputations and the use of independent certification are only useful when consumers have access to adequate sources of information. In order for reputations to be useful, they must be capable of transmission to a wide audience. In Bolivia, some farmers who grow potato to sell as seed may get a better price when the sale takes place on-farm (where other farmers can observe the growing conditions) than in the local market (Thiele, 1997).¹² Similarly, the use of certification to promote sales presumes knowledge of the concepts. A study in Zambia showed that only 6% of farmers could identify all the information on a certification label, even though most of them had experience in buying certified seed (Andren et al., 1991).

In order to promote seed enterprise development, public seed certification agencies will have to be willing to provide more technical information to help emerging seed producers develop their own quality control skills. It is unrealistic to assume that endeavours such as local-level seed projects will be able to manage all of their quality control responsibilities from the beginning. But the opportunities for testing and promoting such initiatives are limited as long as public seed certification sees its role as a policeman for a limited seed sector, rather than as a catalyst for seed system diversification.

4.5 Seed conditioning and storage

The management of seed conditioning and storage are important considerations for seed enterprise development. Seed conditioning includes drying, cleaning, grading, treating and packaging the seed. Storage in a central location is usually necessary before seed is sold or sent to retailers. Institutional issues include the identification

¹¹ It is not unusual for producer associations in various industries to set and enforce high standards for their members in order to gain new customers. A wide range of businesses now contract independent quality control certification to give them an edge on their competition (Dale, 1994).

¹² In Scotland, companies that hold plant breeders' rights for certain potato varieties have attempted to control seed potato production. This has led to a number of former seed growers turning to the production of 'small ware' potatoes, supposedly destined for food use. These are actually sold (illegally) as seed to potato producers in England. This clandestine cross-border trade in non-certified seed requires exceptional trust between buyer and seller (Clunies-Ross, 1996).

of appropriate organisations to manage these tasks and the choice between ownership of and contracting for these services.

Seed conditioning and storage require considerable skill and experience. Adequate facilities and equipment must be acquired. Cromwell et al. (1992) describe the investment decisions that have to be made regarding the degree of decentralisation of seed conditioning and storage facilities necessary to accommodate dispersed seed multiplication. Commercial seed production operations concentrate contract seed growers close to the company's seed processing facilities. Appropriate techniques and equipment for small-scale seed operations are also available (Camargo et al., 1989; Lepiz et al., 1994). Many donor or NGO seed projects use donated processing and storage facilities, and plans for their maintenance and replacement are often inadequate. In these cases there are few incentives for participating farmers to do a careful job of seed conditioning or maintain the facilities.

It certainly cannot be assumed that farmers in small-scale seed projects will be able to manage seed conditioning and storage on their own. Although farmers of course manage their own seed supplies, the expanded quantities of seed in even small-scale schemes may place a considerable burden on the participating farmers. A 'producer-seller' project in Nepal had to provide metal storage bins to its farmers (Bal and Rajbhandary, 1987). Besides physical facilities, seed storage also has an opportunity cost, and many small farmers cannot afford to wait until next planting season to sell the seed they have produced.

In some cases it may be possible to promote small-scale seed production by renting or contracting for processing or storage facilities.¹³ In developing countries, the facilities of public seed companies have sometimes been used for small seed producers (Bockari-Kugbei, 1994). An adequate rental charge must be established, however. In El Salvador, several small seed producers contract for seed conditioning with larger companies (Choto et al., 1996). Such contracting adds to the transaction costs of these producers, but saves investing in equipment and facilities that might not be fully utilised.

4.6 Seed marketing

There is widespread agreement that the state should have little involvement in seed marketing (Jaffee and Srivastava, 1994). Parastatal seed producers are often linked to public agricultural input marketing organisations. There are few incentives available to such government input distributors to promote a responsive approach to

¹³ Contracting for seed cleaning is a common practice among many industrialised country farmers who save their own seed.

farmers' demands.¹⁴ For example, most of the seed produced by Zambia's parastatal ZAMSEED has been marketed through Provincial Co-operative Unions: farmers complain that seed of only a few crops is available (Andren et al., 1991), and even with maize, the seed is often not one of the preferred varieties and arrives late (Howard, 1994). The experience in Kenya, where the Kenya Seed Company markets through a range of retailers (including the Kenya Farmers Association, private traders and co-operatives) has been somewhat better (Rusike, 1995).

The evolution of a private seed marketing capacity depends on the availability of adequate information and the development of trust in the market place. Many seed system development efforts have given insufficient attention to developing the capacities of local traders. On the other hand, many small-scale seed projects seem to place too much faith in the marketing capacities of the average farmer.

Farmers' diverse and variable seed demands make seed marketing a fairly risky venture. Retailers are often uncertain about which varieties farmers will want to plant, and they do not want to end up with unsold stocks. In Zimbabwe, local shopkeepers assess farmers' demand for seed of particular varieties before placing their orders with wholesalers in town; the process is so slow that seed often arrives late or not at all (Friis-Hansen, 1992). Such problems are not limited to developing countries: uncertain seed demand has a serious effect on the size and range of retailers' stocks in the US (Houston et al., 1988).

Relationships between seed companies and retailers need to be developed. Seed producers could provide better information for dealers and farmers about the characteristics of those varieties available.¹⁵ In countries like India, where a competitive commercial seed market has developed for a number of crops, seed companies use a full range of promotional strategies to establish and maintain a network of dealers (Singh et al., 1995; Pray et al., 1991).

The development of trust between seed dealer and farmer is also essential. It is instructive that in many parts of the US large seed companies still market their

¹⁴ A telling contrast between the effectiveness of privately managed agricultural output marketing and public input marketing in India is described by Walker and Ryan (1990: 32). ICRISAT (the International Crops Research Institute for the Semi-Arid Tropics) carried out extensive farm surveys managed by enumerators who were resident in villages for long periods of time; farmers frequently asked these outsiders for help in acquiring seeds of new varieties that were not available locally, but never asked for help in selling their produce.

¹⁵ The primary role of marketing in the US seed industry is emphasised by Shimoda (1996: 8): 'The seed business is more a marketing game today than in the past ... Seed corn and cottonseed companies, in our opinion, have reached germplasm equality, which places greater emphasis on service and marketing functions to improve business.'

products through a network of local 'farmer-dealers' who sell inputs to their neighbours (Zulauf and King, 1985). It can be assumed that this system is effective because farmers are more likely to rely on the experience and reputation of one of their neighbours than on a large retail outlet when seeking advice on the appropriate type of seed.¹⁶

Indigenous seed marketing is already well established in many countries. Farmers often buy grain suitable for seed in local markets, however the importance of these markets, especially for the poor, is seldom recognised. For instance, they are a significant source of seed for bean farmers in Rwanda (Sperling et al., 1996) and wheat farmers in Bangladesh (O'Donoghue, 1995).¹⁷ In many cases market traders play more specialised roles in identifying and distributing seed and planting material. In Nepal and Peru, seed potato is usually produced in higher altitude zones and then moved to producers at lower altitudes through a network of local markets (Chhetri, 1992; Scheidegger et al., 1989). Turton and Baumann (1996) describe the complex network of trade, managed by local merchants, in the seed of fodder crops in India. One of the most remarkable examples of indigenous seed trade is that of soybean in Indonesia. Soybean production takes place in three different seasons, depending on the ecology of the zone, with stringent requirements for planting times and hence for seed availability. Grain traders are able to identify recently harvested soybean suitable for seed and move it to other areas in time for planting much more efficiently than the parastatal seed company (Van Santen and Heriyanto, 1996).

Grain merchants have disadvantages as seed sources, however. In some cases, their relations with farmers may be characterised by inequitable debt relations or interlocked markets (e.g. Olsen, 1996) that are not conducive to seed trade. Although local shopkeepers are important sources of seed in Sudan, farmers express concern about the quality and price of seed obtained in this way (Coughenour and Nazhat, 1985). Similarly, farmers in Rwanda purchase much of their bean seed in local markets but say that they do not trust market sellers (Sperling et al., 1996).

¹⁶ It is interesting to note that at least one observer is predicting that this system is likely to change with the advent of transgenic crop varieties that will require more technical information than a 'farmer-dealer' is likely to be able to provide (Seghal, 1996).

¹⁷ The resilience and complexity of grain markets as sources of seed is illustrated by the experience of a drought relief effort in northern Ethiopia (Pratten, 1997). The relief agency distributed barley seed acquired in a grain market in a neighbouring province. Most farmers who received the seed recognised that it was not a locally adapted variety, however, and bartered the donated seed in local markets (which were still functioning despite severe drought) for seed of the preferred variety. These farmers had a fairly successful harvest, while the few that sowed the donated seed had very low yields.

Part of this problem with trust is linked to traders' lack of specialist knowledge about seed management. In many cases, grain traders are not familiar with seed storage requirements. Although traders may be important sources of information about new varieties, they may not always be aware of the provenance of the grain they are selling. This becomes a particularly important issue in areas where hybrid varieties are grown, where the grain market may be the unintentional source of advanced generation hybrids whose yield potential is significantly diminished. These problems with trust and technical capacity point to the importance of providing training and information for the development of specialist seed traders and merchants.

Many small-scale seed projects have adopted the strategy of relying on farmers themselves to market seed. Projects in environments as diverse as Guatemala (Veliz, 1993), the Gambia (Cromwell and Wiggins, 1993) and Nepal (Bal and Rajbhandary, 1987) have been based on the premise that once selected farmers have been given access to source seed of new varieties, they will multiply it, use the seed on their own farms, and market the excess to their neighbours. This is an attractive idea, but it deserves closer scrutiny, particularly in relation to its assumption that most farmers are capable of marketing seed. The strategy is often based on the vague notion of 'local seed channels', the idea that seed somehow flows within farming communities. This tends to confuse several different types of transaction. Small quantities of seed are indeed often exchanged or given as gifts between farmers, and this is an important means of diffusing new varieties (e.g. Green, 1987). In such cases, farmers participating in a seed project may serve as sources for seed of new varieties, but it is unlikely that this will develop into a business. On the other hand, certain farmers are recognised as being sources of good quality seed, and they are able to sell seed to their neighbours or in local markets (see Thiele, 1997). If these farmers are the target of the seed projects, then more effort should be devoted to developing their capacities and skills, particularly in seed storage, management and marketing.

Many seed enterprises in the industrialised world can trace their origins to the efforts of an individual farmer who began to market small amounts of seed and gradually expanded their business. Such experiences can be repeated in developing countries, as long as appropriate policies support enterprise development. Seed projects can help foster this development, but they must pay more attention to identifying and supporting the entrepreneurial skills required to establish a viable seed business. (Appendix 1B describes the experience of one such entrepreneur.)

4.7 Summary

Seed provision is a complex process that involves a chain of different activities. In large-scale commercial seed enterprises, most of these activities are integrated within a single firm. In contrast, the development of small-scale seed provision will most

probably require co-ordination between various organisations taking responsibility for different functions in the seed provision process.

Different types of organisation have skills, resources and incentives that are appropriate for particular functions in seed provision. There is growing commercial participation in plant breeding, but in most cases the public sector will continue to play a strong role. Source seed production is currently dominated by the public sector, but this needs to shift towards private responsibility. Seed multiplication is most efficiently done by individual farmers or farmer organisations. Seed conditioning may require special skills or equipment, and should be managed on a private basis. Seed producers should take increasing responsibility for quality control, with participation from the public sector and farmers. Seed marketing and distribution should be a commercial activity.

Because different types of organisation (public, commercial, voluntary) may all contribute to a particular seed provision strategy, it is particularly important that mechanisms are in place that provide appropriate incentives to each type of organisation, and that allow effective communication between the participants. The following section discusses suggestions for such mechanisms.

5. The way forward

Seed enterprise development will depend on specific organisational changes that can be fostered by national policies and by externally financed seed projects. It will also depend on more profound changes to national institutions that provide appropriate incentives and develop the social capital required to support a diverse national seed system. This section provides a number of specific suggestions for activities to support the appropriate type of change.

5.1 The assessment of seed demand

Policies and projects that support seed enterprise development must be based on realistic assessments of the nature of seed demand. The discussion in section 2.1 emphasised that seed demand is often poorly understood. At the policy level, more effort is needed to co-ordinate data related to seed practices. At the project level, more emphasis should be placed on acquiring better quality information about farmers' requirements for varieties and seed.

Many countries have established seed policy committees or units. However, most of these entities have insufficient resources and expertise to provide guidance to the national seed sector. One of their greatest weaknesses is a lack of information about seed demand and use. One contribution would be simply to collate and analyse the information currently available from various agricultural censuses and from agricultural research institutes and universities. A further contribution would be to provide guidance for the way in which seed demand is assessed in the future. Not enough information is available about current variety use; agricultural censuses and other survey instruments often confuse variety and seed, and miss opportunities to obtain useful information about subjects such as farmers' sources of seed. A seed policy unit should have at its disposal a collection of past studies related to seed demand and be aware of (and be consulted for) current seed research done in the country. It should be able to use this information to provide guidance for seed projects and for general policies that support seed sector development.

Small-scale seed projects should be good sources of information about seed demand. But many of these projects neither invest in an adequate diagnosis of farmers' needs nor develop links with national seed policy. The deficiencies in developing information are perhaps surprising, given the emphasis of most NGOs on participatory rural appraisal (PRA) techniques, but much PRA is done very superficially (Christoplos, 1995; Mosse, 1995). The result is that many small-scale seed projects still multiply seed of crops or varieties that are not important to farmers,

or attempt to provide seed in situations where farmers have other more pressing needs.¹ The isolated nature of many seed projects means that their experience often contributes little to building links with seed policy. A national seed policy unit should help to co-ordinate and link the work of individual seed projects and to ensure that they address farmers' actual seed demands.

Both seed policy units and individual seed projects should devote more effort to prioritising seed demand. Considerable resources have been wasted on the assumption that formal seed provision is necessarily superior to on-farm seed management. Seed enterprises will only be viable when they are based on a thorough understanding of farmers' seed requirements.

5.2 Including seed in small business policy

Many governments have policies that encourage agricultural business development (Abbott, 1987). It is important that these policies include seed enterprises. Seed production or marketing may be seen as risky or complicated ventures, but policy makers should be reminded that these are activities that can take advantage of local skills and do not require expensive equipment or infrastructure. The seed business is an excellent example of an entrepreneurial activity that can be initiated on a small scale.

This paper has stressed that one of the principal requirements for seed enterprise development is information. A seed policy unit can provide information about seed demand and can help link seed producers to public sector plant breeding and source seed. A seed policy unit can also help direct technical information and training to emerging seed enterprises and seed producers (Benziger, 1996) and provide incentives for the formation of associations of seed producers or merchants.

The provision of information must be linked to the elimination of unreasonable licensing or other regulations that discourage the development of seed enterprises. The alternative is a parallel economy that may partially meet farmers' needs but does not provide sufficient security to engender sustainable enterprise development.²

¹ The sorghum variety that was the most important part of a church-supported seed scheme in Uganda for more than ten years was found to have low acceptability by farmers. A project report describes its 'relative susceptibility to damage by storage pests and poor taste. Apparently this variety is grown widely only when seeds are made available free of charge' (Anglican Church of Uganda, 1994).

² Restrictive regulations are often avoided by taking advantage of public sector corruption and rent-seeking behaviour. Zhou (1996) describes the development of a remarkable array of rural businesses in China, despite official restrictions. The current attitude towards

NGOs and donor projects may encourage seed enterprise development by funding pilot projects or experiments which allow a progression from externally supported activities to financially viable enterprises (Ferguson and Sauma, 1993). This strategy requires a clear trajectory which includes agreements over the division of responsibilities between external donors and participants and which moves towards independence and sustainability.

5.3 The targeting of public plant breeding

The availability of new crop varieties is an important stimulus for seed enterprise development. The general decline in public agricultural research funding and the growth of private plant breeding in developing countries call for a reconsideration of the targets and goals of public plant breeding. There is a need to identify which crops and farmers should receive the majority of public sector agricultural research funding. No firm rules can be given but, in general, public research should be devoted to crops that will not receive private research investment (such as subsistence crops and those not subject to hybrid technology) and to farmers in more marginal environments.

Once targets and goals have been identified, plant breeding strategies need to be assessed. Many resource-poor farmers have not benefited from public plant breeding and there is a search for alternative approaches. There is considerable interest in the decentralisation of plant breeding, allowing for greater farmer participation and location-specific variety development (Sperling and Loevinsohn, 1996; Eyzaguirre and Iwanaga, 1996). Such decentralisation will have to rely on farmer groups or organisations that can interact with plant breeders (Sperling and Ashby, 1997).

NGOs can play an important role here in helping to stimulate the emergence of farmer groups that can interact with plant breeders. To be most effective in this role, NGOs may have to discard a certain amount of ideological baggage regarding the nature of plant breeding. Some NGOs uncritically promote 'improved varieties', without first investigating their adequacy for farmers' conditions.³ On the other hand, there are NGOs that take a similarly single-minded approach to the merits of local varieties.⁴

government is summed up in the saying 'no winds of corruption, no rural enterprises' (ibid: 239).

³ For instance, Oxfam was one of the most enthusiastic promoters of the rice variety IR 8 in Sri Lanka in the mid-1960s which subsequently proved unsuitable for most growing conditions in the country (Anderson et al., 1991).

⁴ While there is much to be done in working with and improving local genetic resources, there is a strong current in some parts of the NGO community that discourages interactions with formal plant breeding (e.g. Mooney, 1992).

What is required in both instances is the development of better diagnostic and research skills among NGO staff.

Directing public agricultural research to address the needs of less politically powerful farmers is not easy. Private seed companies will increasingly serve the needs of commercial farmers, helping to focus the attention of public breeders on other clients. But a firm policy mandate clearly defining the responsibilities of public research is also required.⁵ Research management will also have to provide the necessary incentives. Plant breeders can be evaluated and promoted on the basis of the level of adoption of their materials by designated sectors of the farming population.

Finally, incentives are needed to ensure that public sector plant breeding is able to maintain access to a wide range of germ plasm. The trend towards seeking royalties for public sector varieties will ultimately restrict the regional and international exchange of germ plasm that has been the backbone of public sector plant breeding (Maredia and Eicher, 1995). A balance must be sought that allows public research access to compensation for its contributions to private companies, on the one hand, but does not subject public and farmer varieties to plant variety protection (Butler and Pistorius, 1996).

5.4 The delivery of seed of public varieties

While public seed systems have often been ineffective in promoting the diffusion of new public plant varieties (Heisey, 1990), it is unreasonable to expect that private seed enterprises will necessarily have the incentive to take on this task. For self-pollinated crops whose seed is easily saved, there is little expectation that farmers would purchase seed with sufficient frequency if demand were based purely on the desire to obtain a new variety. In these cases, other methods of initiating variety distribution must be attempted.

One possibility is the widespread delivery of small quantities of seed of new varieties. The seed could be sold through extension agents, farmer groups, NGOs or other organisations. The production and packaging of the seed would require some public expense, but this would be significantly less than the money currently spent on large, ineffective parastatal seed companies or ill-conceived seed projects.

⁵ The tendency for plant breeding to serve better-resourced farming areas is universal. In Illinois in the 1930s, hybrid corn development was much more advanced for the northern part of the state than for the lower yielding, often tenant-operated, farms of the south (Fitzgerald, 1990).

This strategy would be limited to crops and areas where there is little hope of stimulating private seed activity but where new varieties are available. Grisley (1993) suggests that this would be appropriate for new bean varieties in Africa and reports on the widespread diffusion of a bean variety that was distributed to farmers in Zambia (Grisley and Shamambo, 1993). Sperling et al. (1996) describe how small packets of new bean varieties were produced by the public research service in Rwanda and sold through market traders. Demand was high and the costs of the exercise compared favourably with those of conventional public seed provision.

The strategy relies on subsequent farmer-to-farmer diffusion, a subject about which relatively little is known. Much of the spread of Green Revolution wheat and rice varieties in Asia took place in this way, but they benefited from an initial injection of seed from public seed companies and high rural population densities favouring seed movement through markets and exchange. Many other more limited examples of farmer-to-farmer diffusion are known, but they are often dependent on ties of kinship, class or ethnicity.⁶ Sperling and Loevinsohn (1993) emphasise the importance of critical mass in such diffusion. Farmers in Rwanda did not begin to distribute the seed of new bean varieties that they had acquired until after several seasons' experience and multiplication on their own farms. Bad weather, illness and other calamities could threaten the farmer's supply of the variety, and if the initial quantity of seed was not large enough or widely distributed the variety could well be lost. Thus any plans for an initial distribution of seed of a new variety will require information about the necessary breadth and depth of the initial distribution to assure a widespread and sustained diffusion.

It should be emphasised that the idea of distributing seed packets is certainly not new. Kloppenburg describes the early efforts of the US Patent Office to obtain seed of new species for distribution to farmers: 'By 1861, a total of 2,474,380 packages of seed, the bulk of which contained common vegetable and flower varieties, were being distributed through congressmen to their constituents' (1988: 61). By 1910, 24 state agricultural experiment stations had programmes of seed distribution of new varieties directly to farmers. The demand for this seed led to the establishment of state crop improvement associations to help multiply and disseminate new varieties (*ibid*: 80). These crop improvement associations became a stimulus for the development of private seed producers and the basis for state seed certification organisations. Similarly, farmers' associations in late nineteenth century Japan included seed exchange societies that fostered the spread of new rice varieties (Francks, 1984).

⁶ The spread of a rice variety in Nepal was mediated largely by relatives between neighbours of the same ethnic group (Green, 1987). Analysis of the diffusion of a new bean variety in Uganda showed that farmers with larger farm sizes, and those who were less risk-averse, were more likely to engage in varietal exchange (Grisley, 1994).

This type of seed distribution should rely on public sector plant breeders, who have the greatest incentive to see their varieties in the hands of farmers. Some modest additional funding would have to be provided to help organise these programmes, but the investment would likely be more cost effective than most conventional public seed efforts. It logically places major responsibility with the plant breeding institution for the promotion of its products.⁷ Plant breeders can thus devote effort to following the spread of their varieties and learning from farmers' reactions, rather than blaming the extension service or the parastatal seed company for the dismal rate of adoption of public varieties.

5.5 Improving variety release procedures

Most farmers in developing countries have access to a very restricted range of crop varieties. The blame for this situation lies principally with restrictive variety release procedures for public varieties which discourage the development of locally adapted varieties, and the application of these and other regulations to the private sector to discourage competition.

Much needs to be done to reform variety release and registration procedures (Tripp and Louwaars, 1997). There is too much emphasis on ensuring varieties are widely adaptable before release. Variety release committees often rely on the results of widely scattered trial sites and the ranking of only a few parameters (such as yield) to make their decisions. This ignores the range of farming conditions and farmer priorities that determine varietal preference. More emphasis should be given to location-specific testing, acceptance based on adaptability rather than absolute yield superiority, and (most importantly) responsiveness to farmer demand. Variety release and registration would also be facilitated by regional agreements or harmonisation that accept testing data generated in similar environments in other countries.

If private breeders are required to submit their varieties for some type of variety testing, the release authority should have sufficient representation from the private sector. A more attractive approach would be to establish a voluntary variety testing system where both public and private varieties could be compared.

⁷ The fact that the US experience described by Kloppenburg (1988) relied to some extent on congressmen, who saw the distribution of seed packets to rural constituents as a useful political tool, suggests another source of support. Many African countries have fallen into the habit of large-scale seed distribution, supposedly as part of 'drought relief', but in fact as a misguided political sop. The seed is often late in arriving and of inappropriate varieties, which cannot enhance the reputations of the politicians who organise the distribution (Rohrbach et al., 1997). A much lower investment, and of potentially greater political pay-off, would be the distribution of small packets of new varieties.

Effective reform of variety release procedures will need to rely heavily on greater farmer participation. The discussion in section 5.3 emphasised the importance of decentralisation and farmer participation in plant breeding and variety testing. Not only can farmers and farmer groups play an important role in the development of public varieties, but they can also help organise the testing and demonstration of both public and private varieties. Crop improvement associations played an important role in testing and diffusing new varieties in the US. The University of Illinois and the Illinois Crop Improvement Association established the '10-Acre Corn Yield Contest' in 1930 where commercial growers and state experimental stations submitted their varieties, which were grown by volunteer farmers (Fitzgerald, 1990).

The yield contest offered something for everyone. The college, at almost no expense, received experimental information on the adaptability and yield of a wide variety of available corn types, information it had neither the fields nor the staff to acquire alone. The seed companies got free advertising for their corn seed, information about its merits relative to the competition, and a cheap and efficient means of testing new lines that were not yet in commercial production. And the farmers, who saved money buying seed corn from the college rather than a seed house, were able to determine which of the many corn varieties was best suited to their particular conditions (ibid: 127).

In the US, members of crop improvement associations often became growers for public varieties or commercial seed producers. A similar experience is reported in Colombia, where several farmer groups that were organised to test new crop varieties went on to organise the production and sale of seed of those varieties for which there was greatest local demand (Ashby et al., 1996). Farmer participation in variety testing not only accelerates the release of a wider range of varieties, but can also stimulate local seed production.

5.6 Establishing a sustainable capacity for source seed production

The diversification of seed production for public varieties depends on establishing a sustainable strategy for source seed production. In many countries, responsibility for source seed production is in the hands of a public organisation (research institute, university or seed enterprise) that has become accustomed to operating on a limited budget, benefiting from various subsidies, and serving perhaps a single (parastatal) client. If seed enterprise diversification is to take place, the incentive structure for the source seed organisation must change. It must become a financially viable operation as well as develop the capacity to serve a wide range of seed producers.

The technical requirements of source seed production indicate that this responsibility may initially have to stay with a public organisation. But there should be a strategy of moving source seed production into a commercial, competitive position. As seed companies develop technical skills, they will be able to take increasing responsibility

for source seed production. Some enterprises may even specialise in this, and provide source seed to smaller seed producers.

Because of the crucial importance of the quality of source seed, seed quality control agencies should place more emphasis on ensuring that adequate (but appropriate) standards are established for source seed. These agencies could help train private enterprises in source seed production and management.

5.7 Information exchange for source seed

One of the most important incentives for efficient source seed production is the establishment of adequate information exchange with seed producers. The complexity of communication between source seed providers and seed multipliers is a function of the numbers of varieties, seed multipliers and source seed producers. Seed enterprise development should promote an increase in all of these parameters, hence the importance of co-ordinating the flow of information about source seed. This is especially true because it may take more than one season to multiply sufficient source seed to meet a particular demand.

One way of improving information flow is for source seed providers to be more proactive in promoting the varieties they have available. Moving source seed production towards greater financial independence would significantly improve their ability to do so. Public plant breeders, who should have a stake in the promotion of their varieties (section 5.3), can provide advice, information and pressure.

From another angle, seed producers need to co-ordinate better their demands for source seed. In many small-scale seed projects, this co-ordination is a hidden transaction cost currently covered by project staff who use personal or professional contacts with public organisations to obtain source seed. If these projects are to be viable, the seed producers themselves must learn how to make these arrangements. It is interesting to note that in several small-scale seed projects that promote farmer groups as seed producers, effort has been devoted to forming committees (e.g. for seed potato in Peru) or a separate organisation (e.g. for vegetable seed producers in Nepal) to co-ordinate access to source seed for the individual farmer groups (Thiele, 1997; Joshi, 1995).

As the complexity of supply and demand for source seed increases, it will be worth considering the establishment of some type of forum (such as an annual meeting) at which seed producers, source seed providers and plant breeders can exchange information. Such a forum would be a low-cost means of stimulating the growth of the national seed industry.

5.8 Improving the technical and organisational capacity for seed production

The establishment of a regulatory and policy environment that supports local agribusiness development will do much to promote the emergence of seed enterprises. But there are also positive contributions that government can make in terms of the training and organisation of seed producers that will accelerate this process.

Although farmers are experienced in producing and maintaining seed for their own use, the technical demands of commercial production often require outside advice. Lepiz et al. (1994) discuss the costs of management and technical training for small-scale seed operations. Government organisations can help provide advice and training. Rowarth et al. (1993) describe how New Zealand government research staff were funded to provide technical consultancy to private seed companies and seed growers to help promote seed business growth. Benziger (1996) emphasises that government support for extension and credit was necessary to help farmers in Thailand become contract seed growers.

When seed enterprise development involves large companies and contract farmers, government can help ensure that the growers are sufficiently organised to bargain effectively with the company. This is a problem encountered in the development of any type of contract growing, and may involve the formation of grower unions or associations, or the development of other mechanisms for grower participation in enterprise decision-making (Glover, 1987; Porter and Phillips-Howard, 1997).

5.9 Better use of parastatal seed facilities

Where parastatal seed companies cannot be made more competitive they are increasingly being closed down or sold off. The Ghana Seed Company, which concentrated on open-pollinated maize seed, was never able to provide an efficient service and was closed down after ten years of subsidised existence (Bockari-Kugbe, 1994). The National Seed Company of Malawi, which provided mostly hybrid maize seed, was sold to Cargill in 1988 (Cromwell, 1996).

Closing or selling the parastatal opens the way for a competitive commercial seed market and eliminates the inevitable temptation for predatory pricing of parastatal seed. There are situations, however, where there are no short-term commercial alternatives to the service provided by the parastatal. For instance, it is likely that some state involvement will continue in wheat and rice seed provision in a number of Asian countries. In these cases, more needs to be done to put these operations on a more competitive basis. Possibilities for decentralising parastatals should also be

explored in order to make them more responsive to the needs of farmers in different regions.⁸

Policy makers should explore opportunities for taking advantage of underutilised parastatal facilities to promote seed enterprise development. For instance, some small seed growers in Ghana are currently using facilities of the defunct Ghana Seed Company for seed conditioning operations (Bockari-Kugbei, 1994). In the absence of short-term alternatives, this may be the best use of facilities acquired in the days of donor-sponsored parastatal seed expansion.

In many cases, the privatisation of parastatal seed facilities may be easier said than done. If the parastatal offers commercially attractive products, such as hybrid maize, then a rapid transfer to private management may be feasible. But the sale or rational use of parastatal seed facilities may be a problem because they are often poorly maintained or too large-scale for efficient seed production and processing. In addition, privatisation implies much more than a simple transfer of control and requires attention to a wide range of institutional strengthening (Rondinelli and Iacono, 1996).

5.10 Exploring government contracting as an alternative to parastatal seed production

In those instances where no commercial enterprises are immediately willing to cover the demand that parastatal seed companies have tried to address (such as providing seed of self-pollinated food crops to farmers in relatively isolated locations), the alternative of tendering should be explored. This offers the advantage of putting seed production on a more competitive basis, and stimulates the growth of commercial seed enterprises.

Government tendering for any product or service is subject to a number of preconditions (Hubbard, 1995). It functions best when there is an active and competitive private sector, a competent government authority that is able to define requirements and make payments, and a capacity to monitor and enforce contracts. Government contracting is subject to many of the same problems that plague the other activities of highly centralised government bureaucracies (Ostrom et al., 1993).

Government contracting for seed supply must be linked to a strategy that encourages the growth of the private seed sector, and should be based on an accurate assessment of actual seed demand. Successful tendering for seed supply should include the

⁸ Decentralisation is far from being a panacea, however. Ostrom et al. (1993) discuss some of the administrative problems associated with various types of government decentralisation.

understanding that contracts are reviewed frequently and that they are subject to scrutiny by client farmers.⁹ Farmer groups or merchant associations should play a strong role in deciding what type of seed is provided through tenders, and should be able to provide clear feedback regarding its adequacy.

5.11 Promoting seed grower co-operatives

Seed grower co-operatives have played a key role in the development of the commercial seed sector in countries as diverse as France (McMullen, 1987) and Zimbabwe (Rusike, 1995). However, there are several serious limitations to promoting co-operative seed production in developing countries. In the first place, the majority of instances of successful co-operative seed production (and there are still relatively few) have developed out of well-established producer co-operatives that find their members require a reliable source of seed. This is the case with several of the co-operatives in Latin America that have had some success as bean seed producers (Janssen et al., 1992; Rosales, 1995b). Similarly, the National Dairy Development Board in India has successfully organised its members to produce seeds of fodder crops that are difficult to obtain elsewhere (Turton and Baumann, 1996).

Trying to address seed demand by initiating a new co-operative can be a risky business. For instance, Crissman (1989) describes the top-down formation of seed potato producer associations that were registered as co-operatives in the Philippines. They were largely unsuccessful because they did not respond to the needs of their members; indeed the main incentive for joining these associations was to take advantage of subsidised credit.

The formation of seed producer co-operatives is subject to many of the problems that affect co-operative development in general. Most importantly, co-operatives must be member-driven (Braverman et al., 1991). In too many cases, co-operatives are formed on the initiative of government or donor projects, with no evidence of grass-roots support or understanding. Adequate attention is seldom given to the management skills necessary for the survival of a successful co-operative (ibid.). Co-operative development in Africa has also been hampered by excessive government control and interference, and by mixed social development and economic goals (Zesch, 1989).¹⁰

⁹ These are similar to suggestions made by Leonard (1993) in his analysis of the contracting of veterinary services.

¹⁰ It is well to remember that rural co-operatives are themselves a relatively recent phenomenon, emerging in late nineteenth century northern Europe in response to farmers' desires to improve their bargaining position with the urban commercial sector (Holmén, 1990: 18).

It is thus important to understand that seed producer co-operatives will only emerge when there is a clear demand for seed, when farmers who might provide that seed are able to organise themselves, and when those farmers have access to adequate resources and infrastructure to compete in the seed market.¹¹ Governments, NGOs and donors may provide training and advice for such co-operatives, but the major initiative must come from the farmers themselves.

5.12 Promoting the formation of seed producer associations

The members of seed producer associations may be individual farmers or seed companies. Associations are formed to advance the interests of their members and to promote the industry in general. Seed producer associations can be useful for co-ordinating interactions with public research or source seed production, organising seed quality control and strengthening members' reputations.

The formation of an association obviously requires the existence of at least several seed producers, but associations may begin on a modest scale. Reference has been made to the crop improvement associations that were formed in many states in the US in the early part of this century. They brought together farmers who were interested in testing new varieties and producing seed. They served as links with public sector research and provided support for the emergence of commercial seed operations. In Brazil, the national maize research programme helped establish an association of small seed companies (UNIMILHO) to multiply public varieties. The association helps co-ordinate access to source seed and regulates seed quality control (Lopez-Pereira and Filippello, 1995).

The state can encourage the formation of producer associations. There are a number of examples of how associations or networks of firms can help foster the growth of trust within an industry (Humphrey and Schmitz, 1996): 'With trust comes greater willingness to share orders, establishment of new divisions of labour, co-operation in marketing, etc., which lead to economies of scale and scope and competitive advantages (ibid: 36).

¹¹ An interesting example of a co-operative that has successfully moved into seed potato production is the Lahaul Potato Society in Himachal Pradesh, India (Baumann and Singh, 1996). Its members live in a high-altitude zone that has particular advantages for seed potato production. It has been successful by maintaining good contacts with government agencies (such as agricultural research) and by pursuing aggressive marketing strategies.

The type of seed producer association will of course vary from country to country. Policy makers should place special emphasis on ensuring that associations represent emerging producers and that they address the seed needs of resource-poor farmers.¹²

5.13 Reorienting seed quality control agencies

It is important that public seed quality control agencies reorient their mandates to support seed system diversification (Tripp, 1997). These agencies should stop seeing their role as a policeman for parastatal seed enterprises and put more emphasis on the provision of technical advice to support a wide range of seed enterprises.

There are a number of examples where public seed certification agencies have provided support to emerging seed enterprises. One of the most outstanding examples is in Bolivia, where regional seed councils (the seed regulatory authority) provide training to farmer groups that are beginning to produce seed (Rosales, 1995a; Garay et al., 1988). The councils are required to certify all 'formal sector' seed, but they exercise considerable discretion regarding requirements and standards. Other examples of seed regulatory agencies contributing to the development of small-scale seed enterprises can be found in the Gambia (Cromwell and Wiggins, 1993), Nepal (Joshi, 1995), and Ghana (Bockari-Kugbei, 1994).

In order to fulfil their new role as sources of technical advice and backstopping for diversified seed production, seed quality control agencies will have to learn more about farmers' seed requirements. Although public seed certification services have often claimed to be 'protecting' farmers from low quality seed, they are rarely able to identify the standards and seed types that are appropriate for farmers' conditions, nor to monitor the quality of seed that is actually sold at remote locations.

5.14 Moving seed quality control responsibilities towards seed producers and merchants

If there is to be growth in the number of seed producers, it is unreasonable to expect that public agencies will have the resources or capacity to manage seed quality control in the way they have in the past. Most public seed quality control (theoretically) involves inspections of all seed production fields and sampling of all

¹² There is a danger that seed producer associations can exclude new entrants and create effective monopolies. The Southern Rhodesia Seed Maize Association was formed in the 1930s to meet the seed needs of commercial farmers. It evolved to become the Zimbabwe Seed Co-op, which until recently had an agreement with the government that effectively restricted the entry of other maize seed companies to the Zimbabwe market (Rusike, 1995).

seed lots. With a diversification of seed producers, this strategy soon becomes unmanageable. Public seed quality control will benefit from a consideration of the separate regulatory responsibilities of setting standards, monitoring performance and enforcing compliance (Tripp and van der Burg, 1997).

Seed quality control agencies have the technical expertise to define seed quality standards, but they are often unfamiliar with the realities of farmers' production conditions. More effort needs to be devoted to defining seed quality standards that are appropriate for particular farming conditions and which are not so stringent that they discourage seed production.

Seed quality control agencies should pass many of their monitoring responsibilities to seed producers, merchants, and consumers. There are several ways in which this can be done. FAO's Quality Declared Seed scheme (FAO, 1993) gives the control agency guidance on organising random sampling of a small proportion of seed fields and marketed seed, while transferring major responsibility to seed producers and merchants. Seed enterprises can also be licensed by the state to operate their own quality control. The provision for truthfully-labelled seed is another option, where companies are responsible for labelling their seed with an accurate description of its minimum quality parameters (purity, germination, etc.). The majority of seed sold in the US is truthfully labelled, as is most of the private sector seed sold in India.

Although most monitoring responsibility can be given to producers and merchants, government must maintain some enforcement capacity. In cases of persistent violation of truthful labelling or quality declared seed regulations, the state must be able to apply sanctions. But passing more regulatory responsibility to producers and consumers means that enforcement can also be addressed by producer or merchant associations, consumer courts¹³ or the market itself, as farmers learn which enterprises are trustworthy.

The exact balance of regulatory responsibility will vary from country to country, depending on the structure of the seed industry, technical capacities and regulatory experience. The important point is that regulation should not be the sole domain of government agencies. A dynamic and responsive regulatory structure requires a balance between state, producer and consumer interests.

¹³ The experience with using courts for enforcing seed quality control is variable. In India, farmers are increasingly taking advantage of consumer courts to pursue complaints about seed quality (Turner, 1994), while in Bolivia, farmers are still reluctant to take their claims to court (Rosales, 1995a).

5.15 Closing the gap between seed producers and seed merchants

One of the weaknesses of many small-scale seed projects is a lack of attention paid to the links between seed producers and seed sellers. There are two remedies. First, more effort should be devoted to seeing that seed production and seed marketing are the responsibilities of the same person or organisation. Second, more attention should be given to the development of seed marketing skills.

We have discussed the fact that a large number of donor and NGO seed projects have adopted the strategy of developing seed 'producer-sellers', where small-scale seed producers assume responsibility for the local marketing of their product (Wiggins and Cromwell, 1995). The idea is fine in principle, and parallels the experience of many seed firms in industrialised countries that have emerged from the initiatives of individual farmers who began producing seed and selling to their neighbours. One flaw in the small-scale project strategy is the assumption that many farmers possess the requisite marketing skills. Another flaw, in some cases, is the difficulty that farmers may have in selling a commodity such as seed that has traditionally been subject to less commercial transactions within the community.¹⁴

Insufficient recognition is given to the difficulties of developing small-scale entrepreneurs, especially when their 'clients' are linked to them through social or kinship relations. The local entrepreneur is always subject to the ambivalent perceptions of his or her neighbours as 'swindler or benefactor' (Hart, 1975). The most likely result of these producer-seller projects is the emergence of a few farmers or groups with outstanding production and marketing skills. They will probably involve other farmers or groups as contract growers, and move to develop markets beyond their immediate communities.

Where seed marketing is done well beyond the boundaries of the local area, merchants have to be recruited and contracted. This is particularly difficult for small-scale projects. A donor-sponsored project in Nepal (KOSEVEG) encourages farmer group production of vegetable seed that may be marketed in distant areas of the country, or even exported. They have established a separate organisation to help represent the farmer groups and to negotiate with the Seed Entrepreneurs Association of Nepal (Joshi, 1995).

¹⁴ Describing interest in rice seed in Sierra Leone, Richards (1986: 145) concludes, 'If rice is a "currency" in which many social relations – relations of patronage and clientship – are computed, then rice varieties have assumed something of the significance of gambling chips in a game of social mobility.' Diaz et al. (1994) describe farmers' rice seed exchange in the Philippines: 'They consider exchanging seeds with friends and neighbours as a sign of "good luck" during the cropping season. Seeds are considered as a vehicle for social interaction' (ibid: 90).

Because many farmers depend on local markets for their seed, it is also worth exploring the possibilities of developing the seed marketing and management skills of local traders. An experiment in selling small quantities of bean seed was well received by market traders in Rwanda, for instance (Sperling et al., 1996). Extension agents or seed quality control agency personnel could organise training activities to help traders become more effective outlets for the products of small-scale seed projects.¹⁵

There are certain limitations to the development of local traders as seed merchants. Any such project must ensure that the traders in question are respected locally and do not manage predatory debt relations with farmers in which seed provision might simply be another element. The development of local merchants and traders for seed retailing also presumes that licensing requirements for the seed trade are straightforward and supportive of enterprise development.

5.16 Establishing efficient seed provision for welfare objectives

Earlier discussion (section 2.1) emphasised that the type of seed provision should respond to the nature of seed demand. We have discussed incentives for ensuring better distribution of public plant varieties, and we have discussed how demand for replacement seed of various types can be met by commercial, community or co-operative efforts. But when seed demand is due to chronic poverty or the results of a disaster, consideration must shift from seed enterprise development to welfare-oriented seed provision.

In the case of emergency seed provision, one or two seasons of intervention may be all that is needed to get a community back to relative seed security (ODI Seeds and Biodiversity Programme, 1996). Governments and NGOs can collaborate effectively in such endeavours, which should be based on a thorough understanding of local seed systems and farmer requirements (*ibid.*). There are a number of ways of addressing the requirements of farmers whose seed supply is inadequate because of chronic poverty, but these are beyond the scope of this paper. They include technologies to increase and stabilise farm production, improvements in household seed storage and management, and innovations such as community seed banks (Berg, 1992).

These activities should strengthen local farming systems so that seed enterprise development can eventually take place. But it is important that pressure to

¹⁵ An interesting parallel is described by Lewis et al. (1996) for aquaculture development in Bangladesh. Traders sell fingerlings to fish pond owners, but often have little technical knowledge about their product. A short course was given to a number of these traders in order to increase their capacity to give their clients useful advice.

demonstrate project sustainability does not lead to these kinds of efforts being described in the language of entrepreneurial development. They should instead be justified by an analysis of the immediate needs of the target population and a clear trajectory that shows how project interventions will lead to long-term improvements in local capacities.

This discussion of welfare-oriented seed activities highlights a distinction between the two types of beneficiaries of seed enterprise development. The farmers who emerge as key players in seed enterprise development will be few in number and will be likely to have above-average skills and resources. However, many more farmers will be able to take advantage of the seed produced and improve their productivity. It is the responsibility of policy makers to direct this development towards all resource-poor farmers who have effective seed demand. For farmers affected by chronic or acute poverty, on the other hand, welfare-oriented activities should strengthen rural institutions and farming systems so that seed enterprise development can eventually take place.

5.17 Summary

This section has presented a number of suggestions for improving the efficiency of seed provision, especially in situations where seed enterprise development requires the co-ordination of public and private organisations. Some of the suggestions involve attention to aspects of agricultural policy, including the development of capacity for assessing seed demand, the re-examination of agricultural research strategies in the light of growing private sector participation, and the inclusion of seed enterprises in business development policies. Other proposals concern the re-examination of the roles of public seed organisations, including parastatal seed enterprises and seed regulatory bodies. Public plant breeding requires particular attention, including the provision of adequate incentives to address the needs of target farmers and better links to farming communities and organisations. Mechanisms are also required that help co-ordinate the planning and implementation of source seed production. In addition, support should be provided to stimulate the emergence of individual seed producers, co-operatives, seed producer associations and seed merchants.

6. Conclusions

Section 5 discussed a series of strategies for stimulating seed enterprise development. These are summarised in Table 3, together with their implications for both organisational and institutional change. With respect to organisations, the summary highlights responsibilities for governments and for NGOs. Institutional change focuses on the growth of information, incentives and social capital. Organisational change, encouraged in some cases by government policy and by field-level projects, will be necessary to promote seed enterprise development. More basic institutional change is also required. This summary emphasises the interplay of these two elements.¹

6.1 Organisational responsibilities

The public sector role

After several decades of almost unrestrained support for the role of government in agricultural development, the pendulum has now swung in the opposite direction. The danger is that the counter-movement may be equally exaggerated. While it is clear that the government has little justification for maintaining a role in activities such as seed production or marketing, it cannot simply bow out of national seed systems.

The government must attend to reshaping public plant breeding so that its division of responsibilities with the private sector is better defined and its commitment to addressing the needs of resource-poor farmers is well understood. Regulatory reform to reorient the government's role towards support for seed system diversification is needed. Sufficient intellectual property protection must be given to private plant breeding without jeopardising the free flow of public and farmer germ plasm.

The government has an important responsibility to support mechanisms that enhance the flow of information within the seed system. This includes support for small business development and incentives for the formation of seed producer associations and farmer groups. It also includes the provision of training and technical information to organisations that are entering seed provision.

¹ It is not useful to argue about which of these is primary. Institutions determine which organisations can emerge, but 'organizations and their entrepreneurs ... are the agents of, and shape the direction of, institutional change' (North, 1990: 73).

Table 3

Pathways to seed enterprise development: organisational responsibilities and institutional implications

<i>Strategy</i>	<i>Public sector role</i>	<i>NGO role</i>	<i>Information</i>	<i>Incentives</i>	<i>Social capital</i>
1. Develop capacity to assess seed demand and to derive appropriate policies	A principal public sector responsibility, requiring a clearly designated policy entity	Advocacy for disadvantaged groups, monitoring of policy impact, provision of information on seed demand at local level	Better information about farmers' seed use and seed requirements available to seed enterprises	Development of public service ethos	Norms for government service directed toward equity objectives
2. Include seed enterprises in policy supporting small business development	Regulatory reform and other policy change to promote agribusiness	Provide training and advice for potential entrepreneurs	Promote communication networks for business and technical information for potential seed producers	Development of confidence in business environment and potential for growth	Trust and communication required for the evolution of commercial development
3. Specify targets and priorities for public plant breeding; decentralise some plant breeding	Attention to stabilising and re-invigorating public sector agricultural research	Help organise farm-level activities contributing to decentralisation of agricultural research	Better information about farmers' practices and priorities for public agencies	Better links between farmers' needs and the rationale for public research; balance demands for PVP with need to maintain interchange of germ plasm	Norms of government agricultural research directed to resource-poor farmers
4. Develop capacity to deliver small quantities of new public varieties to farmers	* Requires small investment of public funds to promote products of public research	Help distribute varieties, assess their utilisation and impact	Better delivery of information by public plant breeders	Develop better links between public plant breeders and the farmers they are meant to serve	Norms for government agricultural research directed to resource-poor farmers
5. Make variety release procedures more flexible; involve farmer groups in testing	Seed regulatory reform; promotion of farmer associations	Help organise farm-level activities contributing to decentralisation of agricultural research	Improve links between farmers and public and private plant breeders	Increased agility for variety release; increased feedback from farmers	Development of 'open playing field' for public and private plant breeding

<i>Strategy</i>	<i>Public sector role</i>	<i>NGO role</i>	<i>Information</i>	<i>Incentives</i>	<i>Social capital</i>
6. Establish sustainable capacity for source seed production; move towards more commercial operation	Seek commercial alternatives to government source seed production; if public support required place on firm financial footing	-	Technical information needed to develop source seed production capacity	Ensure either clear commercial rationale for source seed production or accountable public service	Development of conditions for specialisation and technical competence in seed provision process
7. Develop an efficient mechanism for exchanging information between seed enterprises and source seed producers	Development of 'clearing house' may require some initial government support	May be able to facilitate flow of information between small seed producers and source seed providers	A key information requirement for the development of seed systems	Offers opportunities to channel farmers' demands for varieties and to promote varieties	Helps develop network of information exchange within seed system
8. Provide technical and organisational support for the development of seed production capacity	Government can help identify sources of training and information, and support grower associations	If NGO has appropriate skills can provide training and advice	Training and information for development of seed enterprises	Allows a broader range of participants in seed system development	Government responsibility for training and fostering producer associations
9. Examine the possible redeployment of parastatal seed production and conditioning facilities	Develop plans for more effective use or privatisation of public facilities	-	-	Parastatals need to be made competitive; monopoly status must be removed	Government seen as facilitator and provider of public goods, rather than impediment to private activity
10. Explore possibilities for tendering to replace dependence on parastatal seed production	Seek private sector alternatives to parastatals	-	Government uses information on demand to direct resources to priority needs	Provides incentives for development of private seed enterprises	Develops government interaction with private sector

<i>Strategy</i>	<i>Public sector role</i>	<i>NGO role</i>	<i>Information</i>	<i>Incentives</i>	<i>Social capital</i>
11. Promote seed production by co-operatives	Government support for co-operative movement	NGOs may help establish co-operatives	Training and information required for development of viable co-operatives	Co-operatives cannot be imposed; must respond to incentives from members	Co-operatives can strengthen and diversify rural institutions
12. Promote the formation of seed producer associations	Provide advice and encouragement for formation of associations	NGOs may facilitate associations among small seed growers	Associations share technical and market information	Associations provide stability and promote industry	Associations help develop trust and industry reputation
13. Reorient the mandate of seed quality control agencies from policing towards enabling	Regulatory reform and reshaping of public seed quality control agencies	Help form links between new seed producers and quality control agency	Provide technical information, training to seed producers	Signal state support for diversification of seed systems	State recognised as providing ultimate regulatory enforcement, but most responsibility shifted to markets, courts
14. Move seed quality control responsibilities towards producers and merchants	Quality control agency to provide advice on standards, spot checks and enforcement		Farmers need multiple sources of information regarding characteristics of marketed seed	Incentives for quality control more dependent on market forces	Efficient markets and communication among farmers helps control seed quality
15. Narrow the gap between seed producers and seed merchants	Policies in support of agribusiness development	Help provide training – for entrepreneurs	Seed producers require awareness of marketing opportunities; merchants require training and information	Seed producers should be able to promote their seed or take over marketing functions; opportunities to expand portfolios of rural traders	Emerging complexity and development of seed markets
16. Establish efficient mechanisms for seed provision for welfare objectives	Clear policy for emergency seed provision and aid to most disadvantaged farmers	NGOs play role in working with communities, developing local seed provision	Accurate information required about farmers' actual seed requirements	Public and voluntary service; goals of establishing local development and self-sufficiency	Government and voluntary agencies provide support to disadvantaged groups

Finally, the government should establish a seed policy capacity that can direct resources to meet seed demands which have been identified. Seed policy should place particular emphasis on equity considerations, and should provide guidance for both enterprise development and welfare concerns.

NGO role

NGOs comprise an exceptionally broad range of organisations. The NGOs that are referred to here are the non-membership organisations that have come to play an increasingly prominent role in small-scale seed projects. The conclusions are relevant to many donor and government seed projects as well.

NGOs can play an important role in developing local organisations to participate in seed enterprise development. But in many cases, NGOs need to acquire more technical and organisational expertise. Of equal importance, many NGOs need to improve their capacity to understand farmers' seed requirements. These projects often do not address priority seed demands, and many are based on either idealised conceptions of local seed systems or unwarranted faith in the improved varieties that are available.

NGO seed activities need to explicate their goals clearly. Many NGO projects uneasily straddle welfare and enterprise development objectives (section 5.16). If a project has enterprise development goals, then it should present a clear trajectory towards financial sustainability, including attention to the arrangements for lowering the transaction costs that have been described in this paper.

NGOs also have an important role in advocacy. They can draw attention to the needs of communities or farmers whose seed requirements are neglected, and they can help measure the effectiveness and impact of current seed policy. Such a role presumes that there is effective communication between governments and NGOs, which may not always be the case.²

² Many of the seed-related activities of NGOs in the Philippines, for instance, are based on a tradition of opposition to the government. This began in the Marcos era (Miclat-Teves and Lewis, 1993). The Marcos regime was strongly identified with support for the Green Revolution (Anderson et al., 1991), and it is not surprising that rural opposition included seed system development that emphasised independence from government organisations.

6.2 Institutional change

Information

We have emphasised that the efficient flow of information is crucial to seed enterprise development. Some types of information can be provided directly by governments or NGOs, while other information flows depend on institutional growth. Governments and NGOs can provide training to help seed producers and merchants acquire the necessary technical skills to initiate or expand their activities. They can provide management training and advice for the evolving organisations that respond to seed demand. The government can also promote mechanisms, such as meetings and associations, that allow a more efficient interchange of information about farmers' seed requirements and the availability of seeds and varieties.

However, many of the information requirements for seed system development depend on broader institutional change. The growth of the market system is particularly vital. It provides the facilities for buyers and sellers to exchange information about products, requirements and reputations. There are complex and varied trajectories for market system development, linked to both the evolution of mediating organisations and the role of social capital (Platteau, 1994a, 1994b).

Much of transaction cost theory has emphasised the role of large firms in coordinating information flow in complex production processes. But changes in information technology and declines in economies of scale have begun to challenge this notion, and there is a trend toward disaggregation. This is especially relevant to seed provision, a process that requires the contributions of a series of specialists. Whether seed enterprise development is based on integrated firms or the coordination of specialist units, the provision of adequate information is essential.

Incentives

This paper has emphasised the importance of commercial incentives for seed enterprise development. One of the principal problems with public seed systems has been the lack of appropriate incentives. Seed production and distribution are most efficient when they respond to clear commercial incentives in a competitive market.

But other incentive systems are also required for seed system development. Government policy must be directed toward the more economically disadvantaged farmers, and this requires an ethos of government service that emphasises equitable development. It also requires a political system in which public servants are expected to respond to farmers' requirements. Although the majority of seed provision

responsibilities are best managed by private (commercial and voluntary) organisations, there will still be a significant need for public plant breeding. Incentive systems must be in place that motivate public plant breeders to address farmers' needs.

In addition, seed enterprise development at the local level can take advantage of the incentives of voluntary and community service. The organisation of farmer groups that can interact more closely with plant breeding and variety testing activities is another example of the importance of non-commercial incentives. Thus, seed enterprise development requires the emergence of a complex incentive structure that is able to take the greatest advantage of commercial, public service and voluntary motivations.³

Social capital

Social capital is an elusive concept because it is based on relationships rather than on concrete entities. The challenge is to see how the norms, information channels and expectations that constitute social capital evolve. Much of social capital is based on local social organisation, but social capital has a public goods character, and 'most forms of social capital are created or destroyed as by-products of other activities' (Coleman, 1988: S118). This implies that it is appropriate to consider public policies for supporting the growth of social capital. Many of the suggestions (discussed above) for improving the organisation of information provision and incentive structures would qualify as contributing to social capital.

The possibility of encouraging the evolution of social capital leads back to the question of the relative importance of organisations and institutions. The dilemma is discussed by Humphrey and Schmitz (1996) in relation to the establishment of sufficient trust within developing economies to ensure the emergence of the organisations that promote efficient commerce. The process is bound to be interactive and reflexive, and Humphrey and Schmitz emphasise the importance of identifying, and building upon, existing 'islands of trust' (ibid: 39) which can serve as examples for the wider economy. Seed provision would seem to qualify as a potential 'island

³ The complexity of incentive structures is emphasised by North's (1990) discussion of early US economic growth. He points to the

critical importance of the English heritage of institutions and ideas for the creation of the colonial economy and the relatively efficient markets that characterized that era ... The heritage was not just economic but political and intellectual as well - town meetings and self-government, colonial assemblies, and the intellectual traditions from Hobbes and Locke ... (ibid: 135).

of trust' whose growth and development would contribute to the economic and institutional evolution of the entire agricultural sector.

6.3 Summary

Seed enterprise development depends on three factors. The first is the general level of agricultural development, which determines the range and types of seed that farmers demand. The second is the realignment of government responsibilities in the seed sector, so that incentives to participate in seed system development are provided to a wider range of actors. The third factor is the availability of institutions that allow the interchange of information and the growth of social capital to support enterprise development.

The level of demand for seed from the formal sector is related to agricultural development. Farmers will be more likely to appreciate the convenience of formal sector seed when the opportunity cost of their time for on-farm seed management increases. Demand for seed quality or special varietal attributes is also likely to be linked to general economic development generating more sophisticated requirements from the agricultural sector. Thus seed demand will evolve, responding to changes in technology and markets. Seed enterprise development cannot run ahead of this evolving demand, but can contribute to the growth of agriculture that makes it possible.

Seed enterprise development will only be possible when the government cedes many of its prerogatives in seed provision and promotes an incentive structure that supports private initiative. But the profit motive is not the only incentive necessary for equitable seed system development. Public agricultural research and plant breeding need to be reinvigorated and directed towards the needs of the majority of farmers. And community and voluntary initiatives will also make important contributions to seed development.

One of the characteristics of much seed provision is the need to link commercial, public and voluntary elements. Government policies and specific projects are needed to strengthen participating organisations. But policies and projects are bound by broader institutional limitations to information exchange and the evolution of trust. Seed enterprise development can only take place when there is an appropriate institutional environment.

Seed is both a vehicle and a beneficiary of institutional development. It is part of the fabric of farming communities. Seed carries information about farmer experience, scientific research and market demands. Seed transactions require an environment of trust, and each successful exchange enhances the reputations of the participants. An

expanding number of seed transactions demands more complex organisations to mediate the exchanges. Increasing the diversity and quality of seed transactions contributes to agricultural development, which in turn supports the institutional growth that motivates further rural innovation.

Appendix 1. Two experiences from US seed enterprise development¹

A. Learning to be a seed producer: the story of John Polansky

'In the fall of 1940 I went to Waterloo, Nebraska, for a field day, which proved to be a great learning experience for me. I ... learned there were private lines and public ones developed by public breeders and that these could be bought and anyone could produce hybrid seed, of course, with certain guidelines.

'I got in contact with Kansas State University and they filled me in on what the requirements were to grow certified hybrid seed. So, I set out on the project of producing hybrid seed.

'In 1944 I decided to grow certified hybrid seed corn. I ordered my seed from Holden in Iowa. If I remember right, it was 45 cents per thousand kernels. The seed line was Wf9 x 38-11 and the pollinator was HY x L317. My seed production field was four acres on bottom land next to a creek, giving excellent isolation.

'In planting the seed field the problem was how do you plant six rows of the seed line and two pollinator rows. I solved this by putting the seed line in the two row lister, plant six rows, stop, take the drive chain off, blank list two rows, put the chain back on and plant six rows, etc. Then I went back and filled in the blank rows with male corn. We had a good corn year and Wf9 x 38-11 was a beautiful seed line.

'The biggest problem I had growing this seed was to detassel it. It came right at the time that I had to go with the threshing crew in order to get my small grain threshed. In the morning I would do my chores, harness and hitch my team to the hayrack, drive down to the field and tie the team to a tree. I would pull tassels until about 7 o'clock and then drive to our neighbours and start loading bundles. I would also have some time in the evening to pull tassels.

'I picked my precious seed and that winter shelled and processed the seed. Believing that seed corn should be shelled gently, my mother and I shelled this seed by hand. It was something to do in the evenings. I would bring in two or three tubs of ears and we would shell it and have the cobs to fuel the kitchen range the next day.

¹ Source: Norskog, 1995: 145-7, 60-61.

'I moved my seed project to Belleville, where I rented for ten dollars a month, the main floor of an old bank building. I had 150 bushels of corn to grade. I purchased a double drum Morecorn Grader from Corn States Hybrid Service at a cost of \$100. It took one hour to grade five bushels. I spent a lot of time grading, treating and sacking the seed. To treat the seed I made boxes that fit under the grader and treated each grade, stirred it with a hoe and scooped it into sacks. I then used wire ties to close the sacks. I also stored and delivered 435 bushels of Cornhusker Hybrid Seed and several bushels of white hybrid seed produced by Lauber of Geneva, Nebraska.

'I sold my certified seed for \$5 for rounds and \$7.50 for flats. The whole project netted me about \$1,000. Not much by today's prices but in those days you could buy a two plow tractor or a Chevy or Ford car for less than \$1,000.'

B. Developing a seed business: Henry Field's Seed and Nursery Company

Henry Arms Field was born in 1871 in rural Iowa. By age eight the young businessman was walking two miles to town with a basket in each arm to sell garden produce door-to-door. Within two years he had a thriving trade in seed potatoes, pansies and strawberry plants.

Henry further learned many of the 'ins-and-outs' of the seed business at age fifteen while working that winter at the Livingston Seed Company in Des Moines. At the age of twenty-one, Henry ... established a truck farm at Sleepy Hollow near Shenandoah. While Henry's crops sold well and were the envy of his neighbours, those who bought his produce were often more interested in obtaining some of his seed. Before long Henry was spending all of his free time making up seed packets, and in the winter he would travel the countryside selling his seed to farmers, face to face.

In 1899 Henry converted a room of his house into an office and made his barn into a seedhouse. About that time he decided to expand his operation, and using a hand-powered press, he printed a catalogue. He turned out several thousand copies of a four-page flyer. 'I was the whole thing,' he would say later, 'from catalogue to delivery wagon.' Henry Field's mail order nursery business had begun.

In 1902 Henry built a new seedhouse in Shenandoah for \$500, a huge amount of money at that time. The building, which seemed too big to ever fill, posed a considerable financial risk for the young seedsman. In 1907, however, a new larger building had to be built and the company was incorporated as Henry Field's Seed & Nursery Company.

In order to reach more people, Henry began to publish *Seed Sense*, a monthly magazine that had combined the elements of a family letter, a round robin, an almanac and a catalogue. 'Henry himself' (which is how his customers referred to him) personally penned some of the articles, but most of the magazine consisted of letters written to Henry by customers.

By the mid-1920s Henry Field's seed business provided nearly one third of Shenandoah's postal business. His catalogues and stores also began to include items such as radio tubes, tires, clothes, harnesses and coffee. His company ranked among the largest seed businesses in the nation.

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