CGPRT NO. 32

Integrating Seed Systems for Annual Food Crops

Proceedings of a Workshop Held in Malang, Indonesia October 24-27, 1995

The CGPRT Centre

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Edited by
H. van Amstel, J.W.T. Bottema
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Foreword

These proceedings are devoted to seed of annual food and industrial (CGPRT) crops. The reason for organizing the conference is that in many countries similar problems are experienced in production of good quality seed and the timely distribution of it to the large number of users in the countryside. The problems are most clearly observed in the food and industrial crops of which consumption does not increase significantly with income growth, but which are nevertheless very important as food and raw material for industry. In such a situation, the state has good reason to assist farmers through production and distribution of seed.

The articles relate experiences in seed production and distribution in several countries and parts of the world, and a detailed analysis of the seed market in Indonesia. A number of contributions cover the concept and aspects of integrated seed systems. Integrated seed systems are thought to be the proper instrument for improving seed quality and availability and for securing efficiency of public intervention.

A word of explanation may be needed with regard to terminology used in the contributions presented here. At the request of the organizers, a number of the contributors have explored various aspects of integrated seed systems. Some authors distinguish formal from informal seed systems. The meaning of formal and informal varies; it may refer to public/government intervention and participation versus private (or even traditional) trade in seed; the word formal can also mean verified adherence to public standards of seed, as set by the authorities. In analyzing the actual availability, quality and use of seed, most authors use the concept of "market", rather than the "system" concept.

The results of the in-depth research in Indonesia are very interesting: it seems that public seed agencies depend on local supply and distribution channels. The major requirement is availability of seed. One observes interesting similarities with seed sourcing in Europe: the proportion of purchased seed for annual food and industrial crops in Indonesia is interestingly often higher than the same in Europe, where this was recently estimated at around 50% for wheat and maize. Contrary to the situation in Europe, local seed supply hangs together with multi-seasonality and inter-seasonality, and local variety in land use, which are long term, structural characteristics of agriculture in the monsoon and sub-tropical climatic zones in Asia. Some of the structural findings may, therefore, be generalized in these zones, and induce further research. The findings and explorations show that substantial inquiry is needed on variety choice and quality of seed as related to actual uses of harvested produce, the role of inter-regional trade, and the role of the state agencies involved in variety generation, seed production and distribution.

We believe that these proceedings are a good reflection of on-going efforts by public and private agents in improving seed supply, and we trust that this work, together with other studies, will provide a sound basis for future efforts.

Haruo Inagaki   Hans Van Amstel

Preamble

Seed is an essential element of any crop production system. For most plant species, it is the means by which crops are regenerated. It is also the vehicle through which genetic improvement is introduced and crop performance can be maintained.

Informal seed system

Until recent times farmers were basically self sufficient for seed. Apart from occasional calamities and infrequent seed exchange with other farmers, they produced their own seed by selecting part of their harvest to plant their next crop. By selecting seeds and seed parents, they were also involved in crop improvement. The domestication of many wild species, and the existence of a large number of traditional varieties testifies to the ability of ancient farmers to model crops to their specific requirements. There is ample evidence that they did so by selecting desirable individuals as parents for the next generation (Allard 1960). This traditional or informal seed (supply) system still functions in all or most developing countries. It is characterized by:

- Lack of functional specialization. Few if any farmers depend for their farm income on seed production, and farmers mostly are self sufficient for their own requirements;
- New varieties spread primarily through diffusion (farmer-to-farmer). As far as seed is traded at all, this is done by local traders not specializing in this commodity;
- Varieties developed by farmers or just multiplied by them are never pure (homogeneous). It is not always clear whether this heterogeneity is maintained deliberately. However, this character does provide crops with the necessary yield stability and in time and space that is of primary importance to many smallholders; in the course of repeated reproduction, varieties can change, adapting to changes in the environment or to changes in farmers' selection criteria.

Until early in the nineteenth century such simple seed systems were the only ones in existence. However, since then a new development took place in Europe and the U.S.A. in conjunction with the development of modern agriculture. A number of farmers started to select individual plants, mainly cereals and potatoes, to produce pure line varieties with superior performance. They also undertook multiplication of their selections and started small, local seed companies.

Development of the formal seed system in Europe and the U.S.A.

By the end of the 19th century breeding and seed production began to develop as a specialized enterprise, separate from farming. Seed trading developed accordingly, soon followed by nationally organized seed quality control and seed trade. At the same time, breeders started to demand remuneration for the use of their varieties in seed production, and local protection of their exclusive right to this use.

Thus, gradually a framework of national seed laws and regulations developed that determined the structure and functioning of the national seed industry. This formal seed (supply) system has the following characteristics:

- The relatively few varieties multiplied for trading are homogeneous, and trade regulations require that their characteristics are kept constant over many reproduction cycles. These varieties generally are not as well buffered against a fluctuating environment as traditional varieties are, but they are more responsive to favorable growth conditions.
- Farmers depend relatively strongly on external seed supply instead of using their crop as the source of seed for their next planting.
- Breeding, seed production and seed trade are institutionalized and seed trade is subjected to national seed laws and regulations.

The modern private seed industry, operating in the formal seed system, is entirely profit oriented. The industry is strongly market oriented, and generally the varieties it develops meet the farmers' requirements.

There are second thoughts about the relation between the seed industry and farmers, however. For example, there are serious doubts whether, for some crops at least, the development of expensive hybrids is really in the farmers' interest. The interests of seed producers and farmers do not always run parallel. The high genetic purity of modern varieties is not pursued for the direct benefit of the farmer, nor are the present high seed quality standards likely to bring him any profit. These cost increasing quality standards rather came about as the joint result of seed certification and plant breeders' rights schemes (Allard 1960). The recent attempts by seed companies to deny the "farmers' privilege" i.e. farmers being allowed to produce seed from their own crop without paying royalties to the owner of the variety, point at another conflict of interest between farmers and the seed industry.

Development of national seed industries in the Third World

The Green Revolution was based on the introduction of high yielding external input responsive varieties, in particular of wheat and rice. In the seventies and eighties large donor funded national seed programmes were set up to produce the large quantities of seed needed to introduce the new varieties. These seed programmes established a public formal seed sector, to some extend modeled on that of the modern seed industry in developed countries. The current model in developing countries, if one is allowed to generalize, is adapted to conditions vastly different from those in the developed countries. Nearly without exception, the newly established national seed companies in developing countries are state enterprises with a strongly centralized organization and large scale, centralized production units. Lack of competition, lack of sufficient skilled management, bureaucratic procedures and control all contribute to excessively high unit costs of the seed produced, often as high as three times the grain price in the case of most crops (Amstel and Gatel 1985). Since farmers are usually not prepared to pay more than twice the grain price (Chopra and Reusche 1991), there are pressures on governments to support the national seed programmes and their sales targets, usually fixed at an unrealistic high level.

To exacerbate this problem, actual demand for seed from the public seed companies turns out to be far less that forecasted by project studies. A major reason for this would appear to be that government employees and farmers hold different opinions on the benefits of improved varieties and the use of certified seed. This is true for many, self-pollinating food crops, in particular where these crops are grown under sub-optional conditions.

During the last decade, governments have come under pressure to practice stricter budget control and to abandon many subsidies, including those for seed. After the fashion of the time, donors and recipient governments now emphasize privatization of the national seed industry as a panacea to reduce seed costs and increase the circulation of certified seed. Although commercial seed companies will undoubtedly accomplish the first, they may be less successful in accomplishing the second. Being profit oriented, commercial seed companies can not attempt to supply the entire market and usually show little interest in the development of varieties and seed supply seed of food crops. It is likely that public participation in the seed sector will still be required to supply to the least profitable market segment. This means that, if one manages to successfully privatize part of the seed business, the remaining part will depend even more strongly than before on public support.

Integrated seed systems

There is now a growing awareness that the formal system as such (the legally prescribed adherence to defined quality standards) may not be able to solve the problem of availability of quality seed. In a broad effort to modernize agriculture, many governments realize that the formal system depends on the potential of the traditional, informal seed systems. These are well adapted to the local seed requirements for annual food crops produced under variable conditions. The current seed supply relies on simple technology and low costs and can provide seed at a low price, with a low entrepreneurial risk. The current systems may need to be strengthened, and links with centralized seed certification may be established. It has become clear that the formal seed system needs to be linked to the current seed supply systems in order to function optimally.

The development of such integrated seed systems requires adaptation of technology, a flexible seed legislation and regulation, wise enforcement, and institutional capacity. Farmers should be recognized as essential and active partners in seed system development.

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We thank Dr. Suyamto, Director RILET for hosting the workshop, and his staff of the excellent logistic support and the organization of the social and cultural programmes. Our gratitude also to: Mr. Amrin Kahar, Director General of DGFDCH, for delivering the keynote address, and to the members of the Steering Committee and the Organizing Committee, in particular to Dr. Yustika Baharsyah and Dr. Syarifuddin Karama of PERAGI, and to Dr. Soemarno. Last but not least, we wish also to thank Mr. Haruo Inagaki, Director of ESCAP CGPRT Centre for his interest and for his cooperation in publishing the proceedings of the workshop.

Conclusions of the International Workshop on Integrated Seed Systems for Low-Input Agriculture, RILET, Malang, Indonesia 24 - 27 October 1995

Introduction

The workshop was organized by the Palawija Seed Production and Marketing Project, financed by a grant from the European Union and implemented under the Directorate General for Food Crops and Horticulture, in cooperation with the Research Institute for Legumes and Tuber Crops (RILET) and the Agronomic Society of Indonesia (PERAGI).

The 56 participants (Appendix 3: List of Participants) in the workshop came from Indonesia (39) and from abroad (17). Their professional experience covered seed projects, research, private and public seed industry, and government. A total of 20 papers (Appendix 2: Programme) was presented during the first two days of the workshop, covering main issues and experiences in seed system development. Nine of the papers covered the Indonesian seed sector. On the third day, topical group discussions yielded a number of specific recommendations, which, on the final day, were presented and discussed in a plenary meeting. During the final plenary meeting, the workshop summarized its main conclusions in nine general recommendations.

The central focus of the workshop on the role of farmers as seed users and seed producers was illustrated by a discussion on seed supply with a forum of Indonesian farmers and seed growers. As a practical demonstration, the participants were shown a trial grown from seed samples collected from farmers at the time of planting. These plots had been evaluated by both farmers and field inspectors of the Seed Quality and Certification Service.

Background

Seed projects and programmes, as implemented until recently, usually aimed at introducing/developing a uniform seed system based on that which has developed over time in industrialized countries. This system was first introduced successfully in many developing countries during the Green Revolution. Its purpose was to rapidly introduce and spread new HYV developed to respond to new technology packages introduced at the same time. Where production environments could be optimized to fully exploit the yield potential of these HYV, this formal seed system proved successful. For several crops in suitable areas, a sustainable seed industry developed that could maintain the yield superiority of the HYV through regular seed renewal with genetically pure seed of these varieties. However for other crops, in particular those that are self pollinating of which seed can be easily produced by the farmers themselves, this formal seed system was often not so successful. The lack of sustainability was most pronounced in farming systems with less than optimal production environments. Not only were few of the HYV taken up by the farmers, but seed renewal rates were, and are still, very low.

During the last decade, awareness has grown in many countries that for the crops and environments mentioned, alternative local seed systems are required and in many cases already exist. The current drive for privatization of the national seed sector, induced by government budget constraints, is now lending a strong impetus to introduce or strengthen such local seed systems which often promise to be more sustainable than the formal one. Limited experience obtained so far with linking local and formal systems shows that this often increases the performance of both types of systems.

During its implementation, the Palawija Seed Production and Marketing Project was confronted with the problem of sustainability of the formal seed system, in particular with reference to soybean seed. The project therefore organized a workshop, with resource people from different countries and with different professional expertise, in order to clarify the need to develop adapted local seed systems and their linkages with the formal seed system. The Indonesian seed situation for palawija crops seemed to be a useful model demonstrating a wide array of existing problems and options. As its own contribution to the workshop, the Project prepared a number of reports, based on its recent field studies, that highlight these examples.

The outputs of the Workshop were recommendations for preparing guidelines to formulate national seed policies and strategies for the development of these integrated seed systems. Policy makers could then translate these guidelines into practical applications adapted to the specific situation in their own country.

Concepts

To aid conceptual clarity, some of the terms used in the recommendations of the Workshop are explained as follows:

Seed system: the total of physical, organizational and institutional components, their actions and interactions, that determine seed supply and use, in quantitative and qualitative terms.

Formal seed system: this is usually defined for an entire country and includes all the public and private commercial seed enterprises which contribute to the seed system. When fully developed, the formal system is highly structured, subject to legislation and to regulation, including control of varietal identity and the quality of traded seed. Varieties used in this system are usually the result of breeding programmes and have passed through formal testing procedures before being released for multiplication and marketing. In most developing countries, this system was introduced and developed by the government, with the financial assistance and guidance of externally-funded seed projects.

Local seed systems: these are traditional seed systems that developed naturally over time in response to farmers' demands for seed from sources other than their own farm. Recently, local seed systems have received support and encouragement from NGOs and development projects concerned with issues such as traditional farming systems, community participation in research and genetic conservation. Traditional local systems are characterized by a low level of organization and institutional development. They lack formal quality control and are not subject to seed trade regulation. Seed is multiplied without any generation control. Other than from their own farm, farmers usually obtain seed from neighbours or from local traders known to them. Recently developed local seed systems often are more structured and organized. They may have some features in common with the formal seed system and may depend on it for one or more inputs or operations. In the latter case, they may be partly subject to government regulation.

Integrated seed systems: this refers to the concept of linking formal and informal seed systems, in which one or more components of one system also service another system.

Low-input agriculture: this term is used here rather loosely to indicate farming systems with a sub-optimal production environment for a specific crop. (It is not used as an indication of resource use per land and production unit.) These environments are defined by agroecological and climatological constraints, or by farmers' management choices based on the cost/benefit ratios of labour or other inputs.

Recommendations

Research and development

1. Development requirements differ between crops and regions within countries, as well as between countries. Due consideration should be given to these differences. Integrated seed system development therefore needs to take account of the specific circumstances and the problems to be solved in each situation. Government policies and strategies to develop integrated seed systems should be based on factual information from the target areas and analysis of farmers' requirements, also taking account of wider economic benefits and sustainability. Such information may be gathered through surveys and routine monitoring. The Palawija Seed Production and Marketing Project presented a number of papers demonstrating this approach.
2. The diversity of farming systems found in many marginal environments may require a relatively large number of locally adapted varieties to meet farmers' requirements. The implications of this for variety evaluation and maintenance should be studied with regard to organizational and institutional aspects. The sub-optimal production environments often found in such areas may also require alternative breeding strategies and a clear setting of objectives based on the requirements of farmers and consumer/processors.
3. Farmer participation in breeding and selection programmes may increase effectiveness and in some situations reduce costs. The technical feasibility of such an approach has been demonstrated in some well documented cases, but needs to be tested further in different locations and farming systems.

Privatization and profitability

1. Where privatization of seed supply is the overall objective of the government, it must be realized that for certain crops (easy-to-save seed), variety development and supply of certified seed may not be profitable. Therefore, governments should ensure that production costs should be as low as possible by avoiding regulations that do not have a demonstrable effect on farmers' seed demand or on national income.
2. Small local seed business and community based seed schemes may provide an alternative seed supply channel. However, initially they may need assistance to develop. Under such conditions in particular, non-governmental organizations may be useful as cooperating partners. However, their activities may be limited in time and financial sustainability.

3. Governments must recognize that for some crops in particular environments, no sustainable formal seed system can be maintained. If equity or other considerations require government subsidies, these often should be better used for variety development, rather than for subsidizing production and use of commercial seed. Should governments nevertheless decide to subsidize these downstream activities, farmers as end-users, rather than seed enterprises, should be the beneficiaries. This is to discourage inefficiency in the seed supply system. In addition, subsidies should be direct rather than indirect.

Seed policy and seed trade regulation

1. Government seed policies should be formulated, such as to facilitate development of a diversified integrated national seed system which meets farmers' demand for seed (quality, quantity and price). Regulations that do not demonstrably increase equity or national economic benefits should be avoided or abolished as they hamper seed industry development and farmers' access to seed. Seed legislation should not restrict the development and functioning of widely different seed systems in a country. Thus, government seed policies and legislation should be adapted to the requirements of the target group instead of vice-versa. This usually applies also to regulations of seed supply organizations.
2. National seed legislation and regulations should not impede variety development by legally restricting the availability of non-released varieties or breeding material that may be suitable for growing in specific environments.
3. National seed policies should be formulated to promote legally unrestricted access to early generation breeding material and germplasm from the public sector for variety development by farmers and seed enterprises. This is of particular importance to ensure the interest of farmers in specific areas, and to maintain sufficient genetic diversity in the farming systems.

Aspects of Seed Systems

Policies and Strategies for Seed System Development

N. P. Louwaars[*]

Introduction

Seed is a vital input in crop production. Ever since seed was considered an important vehicle to extend intensified production techniques in developing countries, the supply system has received considerable attention. These formal systems, designed along the lines of western organization patterns of seed supply, have replaced the age-old local seed supply systems in particular regions and crops. Limitations of these systems have led to the development of the concept of integrated seed supply.

This paper presents a broad outline of the concepts behind these three systems, and analyzes the main focal points from where integrated seed supply is presently being encouraged, namely sustainability, equity and diversity.

Different ways to work in an integrated manner are described and the need for integration of seed systems at the highest aggregation levels (National Seed Board) and supranational bodies is discussed.

Characterization of systems

The two basic seed supply systems are broadly defined as:

Formal seed supply: the chain of activities from breeding to marketing/distribution, run by specialized `seedsmen' and supported by well defined rules and procedures, that supplies seeds to farmers with some level of quality guarantee. These systems are rather uniform in time and space. The formal system has been described in detail by Thomson (1979) and Welving (1984).

Local seed supply: activities within the farming community that aim at ensuring the availability of seed for the next planting. These systems are heterogeneous in space and flexible in time. Local seed supply systems have been summarized and discussed by Almekinders et al. 1994.

A major factor distinguishing formal and local seed supplies is that the former is vertically organized, whereas the latter system can be considered horizontal. In formal seed supply, activities follow each other. This system is rightfully compared with a chain. The main links are plant breeding, seed multiplication and seed distribution. Since a chain is as strong as its weakest link, these links have to be developed in harmony with each other. There is no point in producing seed without a developed distribution system; an efficient seed production and marketing system cannot survive without the supply of breeder's seed and new varieties.

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An important distinction can be made within formal seed systems. In commercial seed systems prevailing in OECD countries, the market defines the breeding objectives, the research budget and the seed production planning, while the 'market pull' drives the chain. In many developing countries, it is the existing breeding infrastructure that is looking for ways to get its results to farmers; the chain is driven by the research push. The seed multiplication process itself is just a necessary intermediary in both approaches. These two approaches are the basis of the dichotomy between commercial and developmental aspects of seed policies (Louwaars 1990) and they illustrate the difficulty of transferring a research-based formal breeding system into a commercial system, which is one of the available privatization options (Turner 1995).

Local seed supply consists of basically the same components: selection, production and diffusion, but contrary to the vertically organized formal systems, organized in a horizontal manner. Seed production is the focal point here, because seed is the basis for crop production. Selection and diffusion are not necessarily given the same emphasis in every seed production cycle. The horizontal pattern of local seed supply systems seems to imply that they are most suitable.

The main factors that have triggered a renewed interest in local seed systems are the following:

- the level of economic sustainability of the formal system, which becomes apparent in many countries during the transition from development oriented to market oriented seed supply in a privatization process, leading to a narrowing of the product mix with respect to crops.
- the effects of the choice of seed supply system with regard to the social differentiation of the farmers served, and on differences in influence in plant production within local groups (gender);
- the ability of different seed supply systems to respond to the existing agrodiversity, and the effects of the system on in situ conservation of genetic diversity.

Economic sustainability

Sustainability is a key word in any development discussion. It is becoming a major issue in the discussions on seed supply as well. Formal seed systems can be very sustainable providing that a number of mainly economic or political parameters fit. When farmers are inclined to buy seed at a cost covering price on a regular basis, and when the formal seed system is able to supply the required quantities of seed of acceptable quality, the regular demand will sustain a commercial formal seed supply.

The main quality aspect is in many cases of a genetic origin: value for cultivation and use and genetic homogeneity. This is by far the most important factor in a recent survey among bean farmers in the great lakes region of central Africa (Sperling 1994). In other situations, other seed quality factors play a major role: physiological quality (e.g. soybean), sanitary quality (e.g. cassava, potato) or analytical purity (e.g. grasses). When genetic factors are important, formal seed supply of cross fertilized crops is more easily sustained than supply of autogamous crops, for which new varieties have to be offered regularly to maintain a market. The hybrid seed market is very specific in this respect. Other crop specific factors pertaining to viability of formal seed supply are economic in origin: seeding rate (in combination with multiplication factor), and the level of market orientation of production being the most important.

Commercial formal seed supply systems can thus be very sustainable, which is proven by major sectors of the seed industry in Europe and the USA and by successful seed companies in developing countries supplying vegetable and hybrid field crop seeds.

Development oriented formal seed systems can only be sustainable as long as political factors allow subsidies to support a generally loss making exercise. Such political support could come from macro-economic analysis (subsidy to increase national production and reduce importation) or equity, i.e. subsidies to allow less endowed farmers to reap the benefits of modern plant breeding. International pressures to reduce public expenditure, however, show the vulnerability of this type of sustainability.

Local seed systems are generally considered sustainable because they have operated throughout the 10,000 years before formal seed supply systems emerged in the late 19th century. Unfortunately, there is a great deal of romanticism in this view. Local seed supply systems are slow in responding to changes in ecological or social conditions. A local landrace cannot be adapted to the introduction of chemical fertilizers in only a few generations without the introduction of new genes. Similarly, the genetic variation within landraces may not be large enough to cope with declining soil fertility levels due to pressures on the land. The challenge for developing alternative seed systems is thus to optimize system sustainability.

Equity

The formal seed supply is necessarily centralized to benefit from a necessary scale of operation. Modern plant breeding requires significant human and financial resources that cannot be diluted over too many sites. Seed quality control needs a limited geographical spread and minimum field sizes in order to operate efficiently; seed conditioning needs a certain scale of operation. The result is twofold: increased price inflicted by the distribution channel and uniformity of the product. Both aspects result in a bias towards particular groups of farmers.

Plant breeders in the formal sector, whether public servants or commercial, generally manage their limited resources in such a way that as many farmers as possible benefit from their work, or to optimize their effect on the national agricultural output. This means that work is concentrated on the average agro-ecological condition, leading to varieties that are adapted as widely as possible. The other result is that research is directed to those areas where gains are most easily made, i.e. the high potential areas and the high input farming systems. The variety release systems in many countries also favour these strategies: only the few varieties that perform well in a large number of test sites (only the widely adapted) are released and their breeders rewarded. The variety release system generally also requires a high degree of homogeneity of new varieties. This is based on the assumption, that the good traits bred into a variety have to be maximized, i.e. that all plants in a variety have to have that optimum genotype. Increased output and yield stability through genetically heterogeneous varieties, such as multilines, are difficult to handle in a seed certification system. The formal seed production sector benefits from this strategy, because handling large numbers of varieties with limited markets increases costs.

Concentration on high input agriculture is inherent to the formal sector. The centralized nature of the sector increases costs that can only be borne by commercial farmers who can rely on the increased yields due to the use of this improved seed. These are farmers, operating in benign ecological conditions, can control a large part of production insecurities, such as drought (irrigation), pests and diseases (chemical control) and depleted soils (fertilizers).

The resulting social difference in seed use (Friis Hansen 1995) leads to the observation that public support in a formal seed system, either through direct subsidies or through, for example, maintenance of a public research program or a free seed certification program favours the well-to-do fanners.

An equity factor that has not been researched in detail is gender in seed system development. Women have a very important role in local seed supply. Selection is often a woman's task (Berg 1993; Tapia and de la Tone 1993), as are the seed cleaning, processing and storage operations. Women thus determine to a large extent which types within a landrace are selected. This has considerable impact on the farming system as a whole. This can be illustrated very well with potato seed selection in Peru, where different user groups are identified (Zimmerer 1991). The person who selects the seed tubers determines which part of the crop will be used for cooking, storage, etc. With the formal seed supply systems, seed becomes a man's job. Except for plant breeding and laboratory seed testing where women are relatively well represented, the supply side of the seed chain is dominated by men. Since the (often male) head of the household manages cash transactions, the role of women also decreases at the demand side in the shift from local to formal seed supply. This shift thus means a significant shift in the control of agricultural production from women to men. Fernandez (1994) adds to the discussion on equity in relation to seeds the dependence of farmers on external solutions designed to solve their local problems. It thus appears that the formal sector increases inequality within the farming community.

Diversity

The genetic composition of crops develops in relation to the other major factors in the agro-ecosystem: the abiotic and biotic environment and the management of resources by the farmer (Harlan 1992). The interactions among these factors at different system levels are presented in the concept of agro-diversity (Struik et al. 1995; Almekinder et al. 1995).
In high external input agriculture, the environment is controlled to a large extent and farming practices are relatively uniform as a result of extension messages that relate to the use of these inputs. Also, the need to address the external results in standardization of the product and the production process.

Modern and homogeneous varieties may be well suited to these conditions, and the formal seed supply sector is in principle well adapted to serve this sector. In low external input agriculture, variation cannot be overruled. Variation is managed instead, involving high levels of knowledge about the different fields, crops and crop associations in a farm. Genetic variation, backed by such extensive local knowledge (Boef et al. 1993) is an important tool to influence productivity and output stability through population buffering, for example to withstand pathogens (Altieri and Liebman 1986; Bird et al. 1990) and temporal or spatial variation in the environment (Ceccarelli et al. 1991). Local seed systems support the levels of genetic diversity necessary for an optimal use of the limited resources.

This does not mean, however, that the particular sectors of the formal system may not be valuable for such farmers. Modern plant breeding can develop resistance to biotic or abiotic stresses that can be useful for particular farmers, either as modern varieties or incorporated into local mixtures. Such research can, for example, reduce the effects on yield and yield stability of the changing agro-ecological conditions mentioned above. Large scale introduction of uniform varieties in areas where they increase variation in yield over time, however, reduces the economic stability of the farming system.

Apart from the value for farming especially in areas with a heterogeneous distribution of stresses, genetic variation in locally used landraces is an important source of genes for modern plant breeding (Harlan 1992). Local seed supply systems may thus significantly contribute to the conservation of crop genetic resources in farmers' fields. Genetic conservation in gene banks has saved a lot of genetic variation (genes and gene complexes) from extinction. It is now more and more accepted that such methods of germplasm conservation are not able to solve the global problem of disappearance of crop genetic diversity. In situ germplasm conservation has received considerable attention recently (Brush 1991; Cooper et al. 1992; Friis-Hansen 1993). The discussion about the long-term sustainability of such in situ methods is, however, continuing (Zeven forthcoming). Thus, sustaining and supporting local seed supply systems is one of the major components of in situ conservation of crop genetic resources.

Integrated approaches

The above discussion illustrates that the formal system cannot effectively support all farmers operating in socio-economically and agro-ecologically diverse worlds. This is a reason why discussions on local seed supply concentrate on marginal (and thus diverse) areas (Amstel 1994). For some crops, there appears to be no reason to opt against the vertical seed supply system, e.g. in the Kenyan highlands where small farmers also benefit from hybrid maize. For other crops, even in the same farming system, this option is not viable, e.g. beans. The reason is that field bean is a self pollinated crop seed with a high seed rate, and home consumed to a large extent.

Complete dependence on local seed supply systems for such important crops for local food security and quality of the diet means a standstill or even a reduction in productivity. This is one good reason to develop integrated approaches for seed supply. Such integrated approaches have to seek a balance between the vertically organized and thus vulnerable, but potentially dynamic formal seed system, and the diverse but insufficiently plastic local systems. Integration can mean the improvement of either formal or local systems by introducing positive aspects of the other. The concept of integrated seed supply has been introduced by Louwaars (1994 a,b).

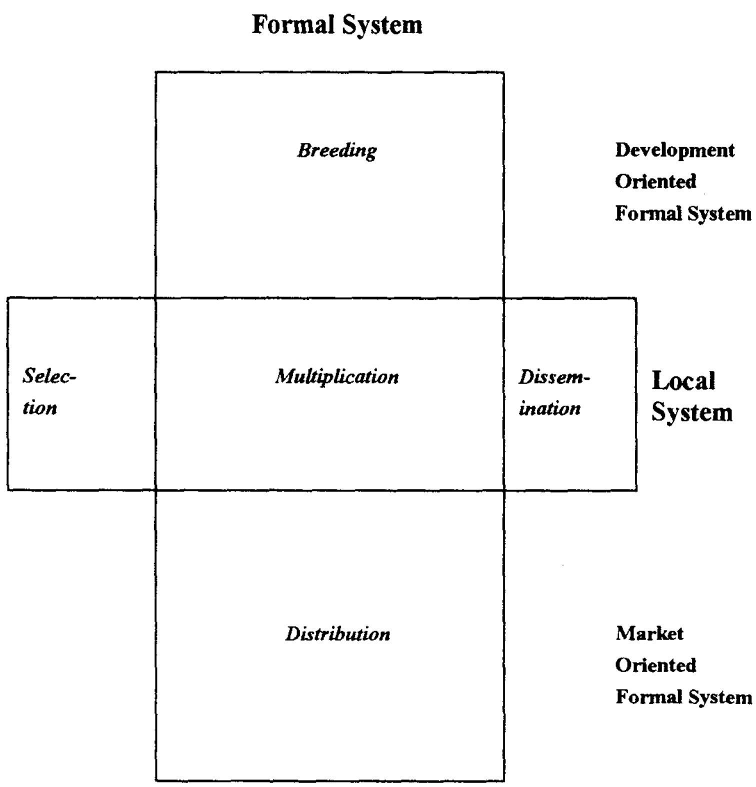
Integration can be pursued at farm, community and national levels, and could thus become an integrated seed supply system. The basis for such approaches is a careful analysis of the existing seed supply situation. The method developed by Oyewole (1995) may be used as a basis for such analysis. This means in any case a decentralized operation involving many different actors. In all three major aspects of seed supply (Figure 1), improvements of the existing situation may be possible. Such analysis may show that genetic advances may improve a local situation (breeding), or that other seed quality aspects are a limiting factor (production), or that availability of seeds may be a threat to crop production (distribution).

Breeding

Where genetic quality of seeds is a bottleneck and farmers do not have access to potentially valuable varieties bred by the formal system, new varieties may be introduced into the local experimentation and diffusion system. Various models for accelerated variety diffusion exist, such as random distribution of samples (Grisley and Shamambo 1993), directed distribution of production kits (Douglas 1980), sale of samples (Mansheviale and Bock 1989), and different levels of on-farm demonstrations and on-farm research (Janssen et al. 1991). Where suitable varieties cannot be bred by conventional methods, adapted breeding strategies can be developed to enhance selection efficiency by adapting the selection environment (Ceccarelli et al. 1991) or the selection procedure (Sperling et al. 1994). In a recent IDRC/IPGRI/FAO/CGN workshop on participatory plant breeding, hosted by the Dutch Genebank in Wageningen, a number of constraints to institutionalizing such participatory approaches were listed (IPGRI forthcoming):

- breeders are regarded according to the number of varieties that are officially released, thus discouraging the early release of breeding material to farmers in a participatory approach;
- many National Agricultural Research Systems (NARS) are concentrating on testing material from international institutes, and seem to need separate funding for including local germplasm (landraces) in their screening and crossing programs;
- variety release systems fail to recognize heterogeneous or specifically adapted varieties that are accepted by farmers, but fail to pass official tests;
- local seed production is not recognized as part of the national seed system;
- there is a general lack of information on germplasm collections; farmers knowledge is in most cases not included.

Figure 1 Representation of the organization pattern of formal and local seed supply systems.



The challenges faced in this field of participatory plant breeding are methodology development, training of international (CGIAR), national (NARS) and local (farmers) breeders, and the building of necessary partnerships among universities (North and South), NARS, and local organizations (NGOs).

An example of a far reaching philosophy of participatory research in this field is the Community Biodiversity Development and Conservation Program (CBDC). This international development and research program recognizes local landrace development as a system with comparative advantages under certain conditions, and seeks ways to strengthen these local seed systems in order to conserve biodiversity in situ. In this program, a number of NGOs and formal organizations cooperate in three regions: Latin America, Africa and Southeast Asia (Table 1). The field projects are formulated and managed at the local level with coordination and support from the regional program leader. The program is thus totally demand-driven, and bases its projects on making full use of the knowledge and skills of those farmers who are managing genetic diversity for their complex farming systems. Institutional research may be used to complement this knowledge rather than over-ruling or replacing it. The CBDC program is regarded as an important test case for formal/NGO cooperation.

Region	Organization	Crops/problem areas
Southeast Asia		
Malaysia	PACOS*	rice and other crops
Philippines	SEARICE *#	rice and other crops
Thailand	Nan Agr. Association	rice and other crops
Vietnam	Can To University	rice and other crops
Africa		
Ethiopia	PGRC/E #	various crops
Kenya	CIKSAP*	indigenous vegetables
Sierra Leone	Rice Res. Station Rokupr	rice and other crops
Zimbabwe	COMMUTECH *	small grains
Latin America		
Brazil	AS-PTA*	maize and beans
Chile	CET *#	various crops
Colombia	IMCA	various crops/species
Peru	CIED *	various crops
Global		
Canada	RAFI*	policy research
Netherlands	CGN-CPRO/DLO	technical research
Norway	NORAGRIC	technical research
Spain	GRAIN*	policy research

* NGO

= regional coordinator; global coordinator is CET-Chile

Production/quality aspects

In cases where physiological seed quality is a problem in the local seed supply system, improved seed harvesting and storage methodologies may be introduced while leaving all other aspects of seed supply intact. This can be done through general extension messages or through training of a limited number of key individuals in each community. An example of the former is the introduction of 'Wise Joseph Sacks' by the Grain Foundation, a US-based NGO.

These laminated polyethylene sacks can be sealed and thus avoid the uptake of moisture by seeds during storage in a humid season.

The latter option means the promotion of the development of local seed specialists, which may eventually become small scale commercial seed suppliers. An overview of benefits and risks of this approach was presented by Sikora (1995). An alternative is the promotion of cooperative seed production in a semi-formal manner, described by Garay et al. (1989). Such local seed specialists or cooperatives may also be a good vehicle to extend formal knowledge to local communities in case of other seed quality limitations, such as analytical seed quality (small scale seed cleaners) or sanitary seed quality (knowledge on plant diseases/use of seed dressing).

In some cases, the local system can also contribute to the operation of the formal seed system. An example is the use of herbs to avoid sprouting of potatoes, and local knowledge about insecticidal properties of plants, e.g. neem and many others (Gwinner et al. 1991). These cases should not be regarded a lucky coincidence, but a serious contribution of local knowledge to the modern scientific knowledge system. Other cases will be elaborated upon in other contributions to this workshop.

Constraints of developing such integrated methods can be the following :

- seed technologists are generally not trained to cooperate with social scientists; the participatory approaches and methods related to community development are alien to them;
- such activities to reduce the dependence on seed from outside the community can be regarded a threat to the commercialization of the formal seed sector; the sector may oppose public support in developing and executing such methods;
- national laws generally do not allow such levels of organized seed supply without the interference of seed quality control procedures.

Marketing

Where availability of seeds is the major problem - in cases where this is not related to any of the above - seed security centers may be established. Cromwell et al. (1993) describe some experiences with such centres, which can reduce the major limitation to system sustainability of local seed systems in marginal areas. Such seed security centres can store sufficient quantities of locally adapted seeds under relatively well controlled storage conditions in order to withstand ecological disasters. Such centres are insurance against individual shortages through any kind of misfortune, and against the need to import unadapted material through relief agencies in case of large scale ecological disaster.

The discussion on seed security in relation to local/integrated seed supply has intensified after the recent civil war in Rwanda and has attracted a lot of interest from the international research community (Louwaars forthcoming).

Integrated seed supply systems

The variety of crops, problems in seed supply among crops, within crops and between social classes, and between regions, makes it impossible to design a blueprint for a seed supply system. The wish to design and execute such a blueprint (Douglas 1980) has resulted in the multitude of formal seed projects in developing countries during the past 30 years. The present weaknesses in the projects can be considered a sign that the idea of an effective global blueprint is ineffective.

There is an urgent need though to link the multitude of often isolated activities in the field of integrated seed supply undertaken by public and non-government organizations. The isolated position of most of these activities and the variety of underlying objectives (efficiency, biodiversity, equity) make it difficult to coordinate or to learn from each other's experiences. A comprehensive integrated seed supply system has not been developed in any country as a result.

These different objectives may give rise to totally different activities in the field of seed supply. When new and uniform varieties clearly have an advantage compared to landraces (e.g. with respect to an important disease), their introduction will be supported when the objective is based on economic parameters, but their introduction may be inhibited by groups that support the conservation of genetic resources in situ. A similar dilemma can be expected when quick cooking bean varieties can be introduced, i.e. to cut down ecological degradation through reduced use of firewood and to diminish the workload of women at the cost of biodiversity. There will always be situations where all the above mentioned sustainability factors cannot be served at once.

There should be a central unit with the task of dealing with such dilemmas and monitoring activities. Only then we can talk about an integrated seed supply system. This could be the task of a national seed board. In many countries these were established to prepare national seed policies, to supervise national seed production, trade and quality control, and to link research, seed production and extension services. The board could, however, also promote and monitor integrated seed supply, whether undertaken by the public sector, NGOs or private companies. It should however not try to coordinate these activities, since this could put the cooperation of NGOs at risk. An important aspect is that national seed boards are also responsible for regularly reviewing and adapting national seed legislation, which is a necessary prerequisite for any integrated seed supply activity in most countries. Such laws often outlaw any sale of un-labeled (or un-certified seed) and any marketing of varieties that have not been officially released. A major problem may be that in such committees different ministries are represented that have little commitment to rural development.

A national knowledge centre for seed technology and seed supply should be available that can promote and support such activities. Such centres can only be effective when a flow of ideas and experimental results between countries is maintained. International research centres could play an important role in this supra-national cooperation through networking. They can also be instrumental in soliciting funds and coordinating research into insufficiently developed sectors of national seed supply, such as participative breeding, development of local farmer/seed specialists, and local seed security in stress prone areas. The centres can also play an important role in developing a specific interest in seeds with social scientists and promote social-technical cooperation. Also, international NGOs could take the initiative, for example in the field of methodology development, for working with local groups in seed supply and in international communication and training. They could also venture into cooperation arrangements with national and supra-national formal institutions, as illustrated above in the case of CBDC.

The basis for all these activities is that local knowledge and local seed systems are fully accepted as competent and complementary partners of the scientific knowledge system.

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Problems of Privatizing the Seed Supply in Self-Pollinated Grain Crops

Michael Turners[*]

Introduction

Efforts to improve seed supply in developing countries have been in progress for approximately 25 years. They have taken place mostly through the medium of development projects which were concerned specifically with seeds or in which seeds were a component among other activities such as research or extension. In the early stages, these projects established the physical facilities for producing good quality seed, notably processing plants, stores and seed testing laboratories. At the same time, they also developed the necessary human resources through staff training at all levels. While projects emphasized capital investment in hardware, they also conferred a certain system of seed supply and regulation (the software) which was based on that found in developed countries with mature seed industries. Experience has shown that in many developing countries this system is too demanding or costly to implement.

Finance was provided by external development agencies on a bilateral or multilateral basis and because of the nature of such funding, these projects were invariably implemented through an arm of government in the recipient (host) country. This was not necessarily the ministry of agriculture itself, quite often a parastatal seed company was the focus of the project, but it was still closely tied to government in terms of policy and funding. In this way, national seed programs emerged, often of considerable size, but with the government still playing a dominant role and with little flexibility for truly commercial operation.

While the nature of project funding has been a major influence on this pattern of development, the host governments themselves were also concerned to retain a key role in seed supply as a means of strategic intervention in agriculture. Furthermore, in most developing countries, the private sector showed little interest in participating in the organized supply of quality seed, except by providing retail sales outlets. This reluctance may be attributed to the dominance of the market by government (there was no space in the market), although in some countries the private sector was actively discouraged as a result of socialist policies. However, in most cases, the private sector simply did not find seeds a very attractive area for investment. As a product, seeds have a number of features which make them difficult to market and the potential customers (small farmers) lack the cash resources to purchase on a regular basis. This is a fundamental problem which will be addressed later in this paper.

For the past ten years or so, there has been a change in the climate of development with calls for more participation by the private sector and a reduced role for government. Those pressures have intensified in the past five years and there is now a routine expectation by funding agencies of private sector involvement wherever possible. In the case of seeds, this seems sensible since they are a physical product and would naturally fit into a commercial production/supply system. Indeed, that

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was the original reason why parastatal seed companies were established - since government accounting procedures cannot easily cope with trading operations.

An alternative influence in recent years has been the interest in seeds by non-governmental organizations who work at the community level. These efforts have usually been quite separate from the official seed program and have been concerned with issues of seed security, particularly in difficult environments, or with the conservation of local germplasm in the context of traditional farming systems.

The brief history set out above is well-known. Many national seed programs are now in a transition phase; there are calls for privatization of the seed supply but also problems in achieving that objective. There is also discussion about the future role of government. Should it simply create the policy environment within which the private sector can develop or will the government be obliged to maintain a direct involvement in those activities which are unattractive to the private sector. The purpose of this paper is to examine these problems and to suggest approaches which may assist this process generally, and can be applied specifically to assist the improvement of the seed supply system in Indonesia.

Analysis of the seed market

Before considering the opportunities for shifting the balance towards the private sector, it is helpful to analyze the seed market in rather more detail. The total seed requirement of a country is the quantity of seed used each year by farmers to establish their arable crops. This figure is normally calculated by multiplying the total area of each crop by the average sowing rate, taking account of known variations according to season or sowing practice. For example the seed requirement for rice varies greatly depending on whether the crop is broadcast or transplanted.

The figure calculated for the total seed requirement is interesting but of little direct value in market planning since in most countries only a small proportion of that total is actually provided by an organized production system. We now call this supply channel the formal seed sector. The remainder of the seed requirement is supplied by informal means, mostly by seed saved on farm or exchanged/traded within the community or surrounding area.

The recognition of these two supply mechanisms is helpful in development terms since they may require quite different forms of support. While most early projects were aimed at establishing the formal sector (which did not exist previously), the limits of that sector are now well recognized and there is no expectation that it can, or should, take over the entire seed supply. Even in countries with a highly-developed agriculture, the informal seed sector may still make a significant contribution, particularly through farm-saved seed.

Seed supplied through the formal seed sector is characterized by planned production, some form of mechanized processing, named varieties marketed in identified packages and (usually) a system of quality assurance to the buyer. As a result, there is a clear distinction between seed and grain. In contrast, the informal sector does not have these elements of organization and good quality grain may simply be offered as seed as the next sowing season approaches.

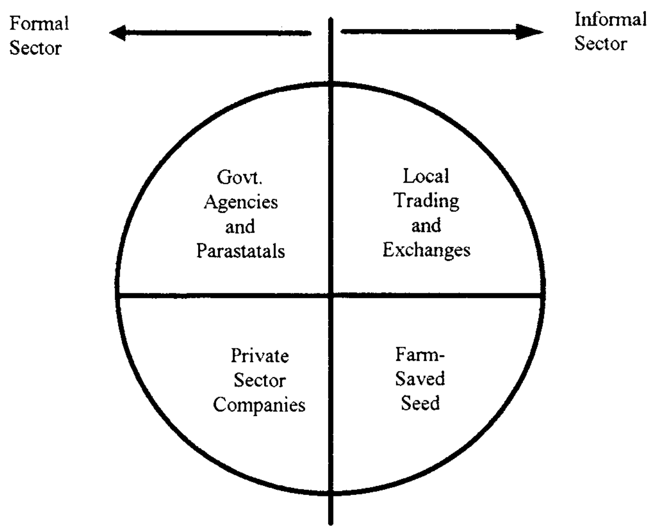
The total seed market in a country is finite and relatively stable; it will change only slowly due to increases in cultivated land area, cropping intensity or new production practices. It follows therefore that any increase in the formal sector supply will be at the expense of the informal sector. However, this does not necessarily imply competition, rather that certain types of supplier on the interface may become more formalized in their approach and practices.

The boundary between the formal and informal sectors is of course not clearly defined. For example, a trader who regularly buys seed from certain farmers for selling in his shop, but without any systematic planning or quality control, could be considered in either sector. If the were to actively seek some form of quality assurance or improved packaging to enhance his product, he may then effectively enter the formal sector. Thus, while the precise definition of these sectors is difficult, a general division of the seed supply system according the level of organization and institutional involvement seems quite clear. This interface is also interesting in the context of this paper since recruiting such local operators into the formal sector by upgrading some of their practices may be a significant way to increase the role of the private sector.

Some further partition can be made within these two sectors. The major division within the formal sector is between public sector organizations and private companies, since they may have very different objectives and financial arrangements. Within the informal sector also, one can consider a division between seed which is saved directly on the farm and that which is obtained through local trading and exchange within the community, for which there may be a distinct market, particularly before the sowing season.

These broad divisions of the seed requirement or market are represented in Figure 1. This diagram indicates the key parameters for describing the seed industries of different countries and how the total seed requirement is supplied. It is also helpful in defining the subject of the paper, which is to consider how the proportion of seed handled by the private sector, in the widest sense, may be increased.

Figure 1 Major divisions within the national seed supply system.



It is necessary to mention the strong influence that different crops may have on the seed supply system, since this also creates divisions within the seed market. The cost of seeds varies greatly between species reflecting characteristics such as seed size, sowing rate, the type of variety (whether hybrids exist) and the final value of the crop produced. We recognize that the seeds most attractive to the private sector are those of high value, low volume and which cannot easily be produced by farmers themselves, e.g. many hybrid vegetables. Such seeds have been taken care of by private companies for many years in virtually all countries. Industrial crops, such as cotton, are also a special case because seed supply can be linked into the wider relationship which exists between the farmer and the processor.

To summarize. the total seed market may divided into different sectors or components on the basis of the type of supplier and the type of crop. However, the purpose of this paper is to consider only those crops which are most problematic in terms of private sector seed supply i.e. those wich are easy to produce and store on the farm. In practice, these are the self-pollinating cereal and legume crops where the normal product is a grain and where farmers are reluctant to spend their limited cash resources to buy in seed which is often similar to that which they can save themselves or obtain locally within the community.

One final point of clarification; it is often assumed that the informal sector is only concerned with traditional varieties which the formal sector does not supply, but that is a serious misconception. Many farmers who wish to use improved varieties, of say rice and wheat, may obtain their seed requirements perfectly well through informal channels while still obtaining the benefits of genetic improvement.

Definition of privatization

It is necessary to define what is meant by privatization. This is conveniently done in terms of the diagram presented in Figure 1. For the purposes of this paper, privatization can be regarded as an increase in the volume of formal (organized) seed supply which is handled by the private sector. The key elements of organized seed supply are:

- planned production and marketing,
- use of named varieties from a known seed source,
- sold in identified packages with quality standards indicated,
- by a commercial entity which has a continuing involvement in seed supply.

Such an entity must have access to secure storage, will probably have some simple processing equipment and should have some means of testing the quality of the seed it sells. It does not have to be a company because a cooperative, a farmers' association or a large farmer could certainly meet these criteria. Included here are enterprises in which there is a physical focus for the work and some staff associated with it on a regular basis, so that the enterprise is able to acquire and retain experience from year to year.

For the purposes of this paper, village seed banks and extension programs intended to farmers save their own seed will be excluded. These are useful approaches to assist the informal sector and potentially very valuable, but not truly part of privatization.

Mechanisms of privatization

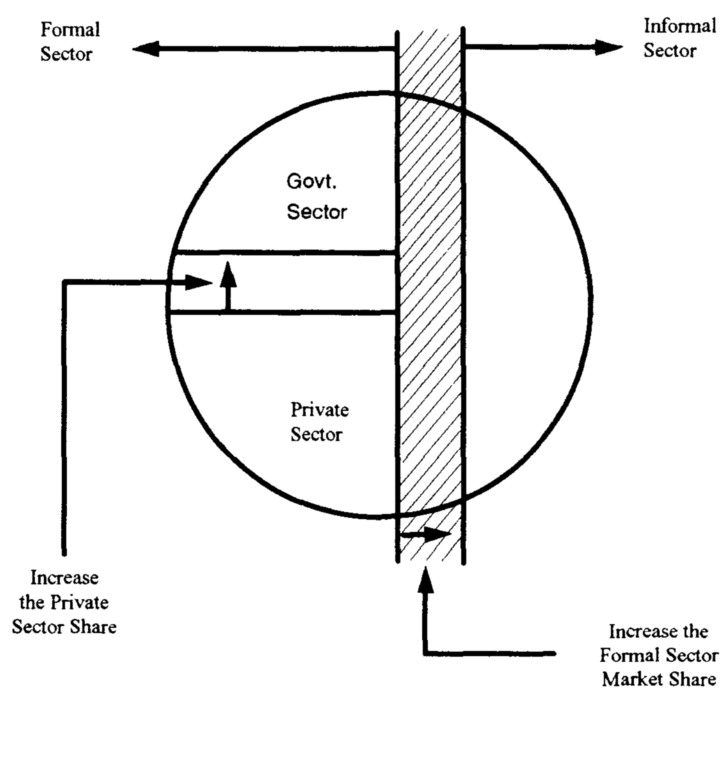
In developed countries, the term privatization came into general use in the context of returning state-owned enterprises, especially public utilities to private shareholders. It was a policy pursued vigorously by the UK government at that time and it has subsequently been adopted in many other countries. The actual mechanisms of privatization my include offering the share capital of the company for sale to the public, inviting bids to purchase the company or allowing the existing management to raise the capital necessary to buy the company. Whatever the mechanism, the end result is that the company moves out of government control and financial constraints, thus gaining much greater managerial flexibility. At the same time, its objects will probably also change from providing a service to generating profits for shareholders. This is a fundamental change of priorities which may create political debate and conflicts, which we are experiencing in the UK at the present time. It is also highly relevant to the transition now facing many government seed enterprises which were created primarily as a service but are now being required to meet new criteria based on efficiency and profit.

In developing countries, especially those that had centrally-planned economies, there were many parastatal enterprises covering all major sectors of the economy and often employing very large numbers of staff. The sale of such organizations to the private sector is unlikely to attract interest from the private sector because of their size, unprofitability and management problems.

In the case of seed companies, the same problems are likely to arise especially where project funding has established large or complex processing operations. Projects were seldom established with truly commercial objectives in mind and thus they cannot be easily privatized by intact transfer to a new private owner. In many cases, these investments were of doubtful value; they were often under-used, even within the government system, and they are of little interest to private entrepreneurs. They were justified by highly questionable economic analysis intended to satisfy the lending criteria and political objectives of donors. However, we may still need to consider how such facilities can be made available to the private sector.

The diagram presented in Figure 2 identifies two general mechanisms of privatization. Either existing activities and facilities of public sector undertakings are transferred to the private sector (essentially a redistribution), or new enterprises are encouraged to enter the seed market. I believe this latter approach will be the more fruitful and I shall consider in a later section how to encourage and assist that process. These new enterprises may take over some existing market share from public sector suppliers, but hopefully they would also increase the total market for quality seed through their promotional and distribution activities.

Figure 2 Methods for increasing the private sector contribution to total seed supply.



Special problems associated with low-value crops

The purpose of this paper is to focus on the difficult crops which are relatively unattractive to the private sector. It is useful to consider in a little more detail the actual nature of these problems and why farmers are reluctant to buy these seeds. As is so often the case in seed technology, this is the result of an interplay between technical and economic factors, the most important of which are as follows:

- Seeds of cereals and legumes are available within the community as grain and all farmers are therefore aware of the grain price, which is nowadays usually a free-market price. That provides their point of reference in assessing the price and value of seed.
- Typically these seeds are quite large and are used at high sowing rates so the cost of transport soon becomes a significant element in the total cost. Even movement over say 50 km to and from a processing centre may add a significant cost. It follows that the benefit obtained from such transport and processing must exceed the cost, but in many cases this is difficult to demonstrate.
- These seeds are normally relatively easy to store because they are part of the traditional agriculture of the region. Rice is a good example, being tolerant of humid tropical conditions which are unfavourable for seed storage. In contrast, wheat, which has been introduced into some tropical regions, is much more difficult for farmers to store safely.
- In self-pollinated crops, genetic deterioration is slow between generations and farmers may see little difference in crops grown from certified seed, unless their own stocks have become seriously contaminated.

For all these reasons, farmers will critically assess the costs of buying in seeds and the benefits they may expect to obtain. This is a separate issue from the choice of variety. A farmer may use an improved variety but may keep it within the farm/household for many years without feeling the need to renew the stock. There is no doubt that a good fanner can do this quite satisfactorily for many seasons. It is equally true that the seed stock may be ruined at any time by contamination, pest attack or poor storage conditions. This is why it is impossible to generalize about the recommended replacement rate for seed, that is how often the farmer should purchase a new stock, and what additional yield advantage may be expected from using certified seed.

It cannot be emphasized too strongly that the points listed above are basic facts about seed production and marketing in these self-pollinated crops. It is often said that the farmers do not buy improved seed because they do not understand its benefits. I believe that this is usually an attempt to justify more expenditure on extension activities but this is simply an excuse.

While cereals are the most important crops in this category, the special problems of grain legumes should also be mentioned since the various beans and peas are important sources of protein in rural communities, and of course groundnut is a major oilseed in many countries. In general, the legumes suffer all the same problems listed above, but with some special features of their own. For example, the large-seeded beans are very prone to mechanical damage during handling or transport and some are also very prone to insect attack. These are problems which apply in any supply system. formal or informal. Soybean is notoriously prone to physiological deterioration in storage and may demand special production, storage and distribution techniques to ensure a reasonable seed quality. Groundnut is one of the most difficult crops of all to handle in an organized system, due to its large seed bulk, high sowing rate and susceptibility to damage once it is removed from the shell.

How to increase the demand for seed supplied by the private sector?

When seed production is undertaken by government organizations, there are usually subsidies which mean that the sale price of seed does not reflect the true production cost. However, that clearly cannot apply to private companies which must cover all their costs in the sale price and are therefore concerned with the efficiency of all their activities. Quality control, likewise, is often provided as a free or subsidized service by an official agency. The future of such services, and especially their financing on a regular basis, is being increasingly scrutinized by governments.

If we accept that in the future the seed market will not be distorted by subsidies, then it must be driven by real demands from the farmers. The real costs of production will have to be covered by the sale price and farmers will purchase seed only if they expect the benefits to exceed the cost. Despite the well-known strengths of the private sector in marketing, it is doubtful whether aggressive promotion will have a substantial effect on demand if the benefits claimed are not actually realized in practice by farmers. In other words, pressure whether by government agents or commercial salesmen will (thankfully) have little effect on naturally cautious farmers. The purchase of seed will have to be justified on its true merit and value to the farmer.

There are only two general approaches by which regular seed purchase can be encouraged in these crops - by reducing the production cost to a minimum and by ensuring the highest possible quality. We know that seed quality has many components but the most important are the potential to achieve good crop establishment, which is mostly a function of germination, and the genetic characteristics/purity of the variety. Ultimately these are issues of technology, economics and management. We know how to produce seed of high quality; the question is can this be done on a large scale and at a moderate cost?

Regular purchase was referred to above - but what does that mean? There is no expectation that farmers will buy seed of these staple crops every year. The significant point is that farmers see sufficient benefit from purchased (certified?) seed to replace their stock from time to time. The problem however is that such purchases are, by definition, unpredictable. After a poor harvest, there may be a shortage of grain and many fanners may hope to buy seed. If the harvest has been good and there is plenty of high quality grain left in store, they may expect to use some of that for sowing. Again this opportunity to convert grain to seed has a fundamental impact on the market.

Another reason why farmers purchase seed from the formal sector is to obtain a stock of a promising new variety. This can create a significant demand for a short time as the more innovative and richer farmers purchase. However, once the variety has diffused into the local system, and its usefulness has been confirmed by farmers, such a new variety can be obtained through the informal sector channels.

Interestingly, this novelty trade is a quite significant influence in the UK cereal seed market since breeders make most money out of new varieties and are therefore anxious to have a new variety to launch into the market each year. This shows that the regular release of new varieties from dynamic plant breeding programs can be a powerful stimulus to the commercial seed trade. However, in situations where plant breeding in these self-pollinated crops is entirely a government activity, as is the case in most developing countries, it is a less significant factor in seed marketing.

How to reduce the costs and improve the efficiency of production?

In considering production costs, it is possible to generalize and to use experience from quite different countries because the essential elements and costs of seed production in these self-pollinating crops are similar in virtually all situations. They are as follows:

- producing the seed - usually through contract growers,
- careful handling, drying and storage after harvest,
- transport to a processing centre,
- mechanical processing to improve quality,
- laboratory testing to check quality,
- storage costs and losses,
- packaging to provide a sealed, identified unit for sale,
- distribution to sales points,
- sales - usually through agents who receive a commission.

These are all direct costs which are necessarily incurred in producing seed of known quality. In addition, there will be some overheads costs such as:

- management/administration and financing of the entire operation,
- depreciation on equipment and fixed assets such as stores.

This is not a complete list and a much more detailed analysis of these costs is possible but they are all essential cost elements in an organized seed production system. If each cost element adds between 5 and 10% to the basic cost, then the seed offered for sale must cost at least 75% more than the grain market price, which farmers use as a point of comparison. In fact, a figure of about 100% is more realistic in many situations, i.e. certified seed costs twice the price of grain. As an example, the current cost structure for cereal seed marketed in the UK is summarized in Table 1. Similar figures could be obtained from many other countries. No allowance is made here for seed treatment, the cost of which varies greatly and is therefore always added as an extra charge to the seed cost.

If we look for economies of scale, then the only major opportunity lies in larger processing plants which, in theory, could have lower overheads. However, that benefit is usually offset by the extra cost of transport required to the processing plant since a larger plant automatically implies a larger production and distribution area. In fact, transport costs are usually a significant cost element, especially if the local infrastructure is not good. To reduce the average distance and cost of transport requires more and smaller processing centres, but obviously they must still have some minimum facilities and throughput otherwise the management overheads become too high. Despite the attractions of small-scale units, they do raise other problems because it may be more difficult to maintain regular quality assurance.

The routine management of processing centres must be of a high standard to avoid wastage, for example in the disposal of unsold seed as grain. It is also essential to use labour effectively. The seasonal nature of seed processing and marketing means that it is very costly to maintain the full staffing requirement throughout the year and it is common practice for companies to take on temporary staff to cover the peak labour demands. These related issues of throughput, capital investment and close managerial supervision in processing units, are crucial in the organization of an efficient formal sector supply, and they are often lacking in government controlled organizations.

One alternative approach to the processing centre is to have a small mobile processing unit mounted on a truck, which visits several locations and cleans seed on site. These machines are widely used in the UK to clean farmers own seed, but they have not yet found a significant role in developing countries.

Table 1 A generalized cost structure for wheat seed production in the UK in 1995.

Component	Cost £/ton	Cumulative Cost £/ton
Current market price for wheat grain (min.)	120	120
Contract growers premium (15%)	18	138
Transport to processing plant	5	143
Processing - labour, energy and equipment	20	163
Processing - cleaning losses/drying	5	168
Packaging materials	8	176
Certification charges/costs1	5	181
Quality control facilities/labour2	5	186
Storage costs/losses3	5	191
Delivery to farmers	7	198
Sales commission4	15	213
Management overheads	20	233
Royalty to breeder6	34	267
Sale price to farmers7		267

1. Refers to charges paid to the Seed Certification Agency and administration costs incurred by the company. Certification is compulsory in UK/EC.
2. Refers to in house quality control, mostly for a small seed laboratory.
3. Storage losses are low in UK due to limited pest damage and regular seed demand. This cost element may be much higher in tropical conditions.
4. Some seed is sold direct to farmers on a retail basis, in which case the company makes more profit, but incurs some extra marketing costs. The rest is sold on a wholesale basis to agents who take a commission, as indicated.
5. Profits - effectively the owners salaries/dividends - would be included here.
6. All breeders of these self-pollinated crops in UK obtain Plant Breeders Rights which enable them to collect royalties on the use of their varieties and to finance their ongoing breeding programs. The royalty rate is higher than this for newly released varieties.
7. This is the maximum price the company could charge; a farmer who places a large order, or who takes early delivery of seed, would certainly expect a discount.

To summarize, if the full cost of seed production has to be covered in the sale price, then the component costs have to be cut to an absolute minimum by efficient management and adoption of an appropriate scale of operation. These commercial realities have been neglected for many years when governments or projects simply covered these costs out of a general budget. This in turn removed the incentive for efficiency and that is one reason why transferring existing government enterprises to the private sector can be painful!

One positive point to note is that the capital investment required for seed processing does not have to be very great. It is possible to buy small cleaning machines which do a good job on cereal seed. Similarly, a seed testing facility can use quite simple equipment if it is testing only a few species. One of the effects of past projects is that they often set a bad example in terms of large size and technical complexity. A small seed enterprise would naturally wish to start with only the simplest of equipment and that could be quite adequate for the crops we are considering here.

How to provide quality assurance for purchasers?

There is a clear link between cost and quality in the mind of the purchaser. Since quality in seeds has several distinct components and is virtually impossible to assess visually, farmers will make an overall judgment of the cost/value of seed based mostly on their previous experience. The problem in the case of these self-pollinated grain crops is that there is little mystique about seed production which can be exploited to assist marketing. Farmers naturally make a comparison with the grain they have produced themselves.

Because of the characteristics of seed as a product, quality assurance assumes a special significance as an aid to marketing. The concept of seed testing has been established for well over acentury and seed legislation was one of the first examples of consumer protection. It is also important to recognize that some internal quality assurance is essential for those who market seed in a systematic way as a business. Regardless of any legal requirements, there must be easy access to seed analysis to monitor quality at the time of seed purchase from growers, during processing operations, and in storage prior to sale.

The establishment of quality control facilities and procedures has been a standard component in national seed projects with the overall objective of supplying certified seed through the formal sector. However, the full implementation of these procedures can be technically and financially demanding and in practice seed certification agencies have often been given insufficient resources to do their work properly. As a result, certification has been brought into disrepute in some countries and farmers have lost confidence in the label.

The key problem which arises from privatization is that new enterprises entering the seed supply system may find it very difficult to establish the necessary quality control routines initially and may depend on outside support and verification. Thus, quality assurance is one of the most vital aspects of seed marketing but it may also be a major weakness for small enterprises. In view of this, it is necessary to consider the role of the existing seed certification services in supporting and perhaps advising the private sector about quality control, rather than simply controlling them.

The need for product identity in seed marketing is extremely important. Since farmers cannot reliably assess seed quality themselves, they need some form of reassurance at the point of sale that the seed they are about to buy will give good results. Unfortunately, it is not easy to give the seed itself such an identity. Instead, farmers have to rely on a package, a logo, a certification label or simply the reputation of the seller to provide this reassurance.

What kinds of new seed enterprises can we expect?

Given the difficult economics of seed production in these crops, it is clear that new enterprises cannot expect large profits. It is therefore necessary to consider who will enter the seed market and why. I suggest that the main motivating factor will be the complementarity of seed to existing activities or products. These businesses may regard seeds as a means of diversification to spread risks and management costs or they may represent a vertical integration, intended to obtain more added value for their products. If seed activities form part of other businesses, they will at least gain some financial security. It will be more difficult to establish an enterprise as a specialist seed producer/supplier because the business then is vulnerable, for the reasons stated above, and particularly because of the fluctuations in demand. Some possible growth points for new seed enterprises are as follows:

- input suppliers (agricultural merchants) who wish to extend their product range,
- existing rural industries (eg. processors),
- larger farmers - who produce seed and market it themselves to neighbours,
- growers associations in favourable production areas - for example, existing contract
- growers who want to market their own production directly,
- coops and farmers groups - producing on behalf of members,
- seed traders and merchants - extending into contract production and processing to provide a greater range of crop seeds to their clients or to reduce their costs,
- industrial organizations with rural interests.

If some of these new participants enter the seed market in the next few years and establish a secure business selling seeds, we may say that privatization has taken place. However, what is more important than the ownership by private business, is the commercial diversity this will create in the supply system. There is ample evidence in biological and agricultural systems that too much uniformity increases risk, since there is less flexibility to respond to changes in the environment. The same applies in the commercial environment and a diversity of suppliers, each with their own strengths and specialties, would be a more secure basis for the future development of the seed industry. It would also give farmers a greater choice and thereby expose the suppliers to some competition. However, price competition in the market will have only a limited impact because of the restrictive cost structure already outlined. The benefits of competition may be felt more in terms of improved quality rather than lower price.

How to encourage new enterprises?

It is clear that those who consider entering the seed market will do so for a variety of reasons, but mostly to do with expanding their existing enterprises or extending their range of services. They will do so cautiously and they may need reassurance and support in the early stages. How can government provide this? I suggest two possibilities, but others may be discussed and considered during this meeting.

The inducement most favoured by the private sector entrepreneurs is that of financial incentives, such as grants or tax relief for setting up the business. Ideally, they would like the government (or a project) to pay for the start-up costs; this is understandable but in many cases unrealistic. Such schemes tend to be used by those who are already involved to subsidize the expansion of their businesses and there are many opportunities for exploitation. Access to loans at low interest rates for specific activities may be more likely to encourage new participants, especially if the loan conditions are clearly defined. There is a great interest in the development of small and medium-size enterprises (SMEs) in many countries and seed enterprises may be able to utilize these schemes. However, the basic problem of profitability still remains and it may be difficult to show sufficient returns on investment.

A different type of support is the provision of services to the private sector, especially those which they may find the most difficult to create themselves. The obvious example here is quality control, since it is most unlikely that small scale seed suppliers would have the necessary facilities or expertise for proper quality control in their early stages of development. It would therefore be a logical step for those companies to use the established government certification agency to check its seed crops and samples. Provided the overall standard of certified seed is maintained at a high level, this would have the additional benefit of being an aid to the marketing of the seed by providing independent quality assurance.

Of course this is not a new concept, it is exactly what certification schemes are supposed to do and indeed some such schemes were started by seed growers themselves in an effort to develop a quality image/guarantee for their products. However, that vision has often been lost and in some countries, certification is little more than an administrative ritual for seed produced by official government agencies, who are obliged to sell only certified seed.

If this idea were to be adopted, small private sector companies would use the certification scheme both to save the cost of investing in their own facilities and to support their own marketing through the use of the certification label. In these circumstances, the provision of these services at a subsided rate could be a very valuable catalyst to seed enterprise development. The only problem is the opportunity which always exists for malpractice and the risk this presents if the value of the certification label becomes degraded in the eyes of the farmers it is supposed to assist. Nevertheless, if the subsidies now so often put into production (to conceal the economic realities) were diverted into supporting quality control, they would make a very significant contribution.

I do not suggest that these services should be entirely free since that establishes a bad precedent. Some element of payment can be incorporated from the start to recover a part of the costs and progressively expanded as the service becomes properly established. In the UK, the certification services recover most of their direct costs through a scale of charges and this does not add greatly to the final seed cost. However, in the EC certification is compulsory which means their business is guaranteed!

Policy formulation by government

We are now familiar with the concept that the task of government is to create the right policy environment or framework, instead of being directly involved in production activities as was often the case in the past. The theory is that once that climate is right, the natural energy of the private sector will be released to take up commercial opportunities and thus satisfy the needs of customers.

I entirely support that idea and some of the points mentioned in this paper could form part of that policy, for example the removal of subsidies from production to avoid unfair competition and the provision of support services for the private sector. Two further points which are of crucial importance in this connection should be made.

First is the need for policy stability. Nothing is more likely to deter the private sector than the prospect of the government changing the rules for its own political purposes. For example, if the government were to introduce a subsidy on the seed it sells itself, thus undercutting private sellers. This has happened in some countries.

Second is the need for proper representation of the private sector in the policy making process. Most countries have a high level committee which manages the national seed program and policy. It is usually called a National Seed Council or something similar. The composition and effectiveness of this body varies greatly from one country to another. It may be active and powerful or relatively insignificant! However, such bodies have traditionally been composed of representatives from government institutions, who were there ex officio. Sometimes these are very large committees and many of the members are not actively involved in seed activities.

We must recognize that it is not always easy to represent the private sector properly. It often happens that a few influential farmers or businessmen promote their own interests through such representative bodies, but those interests and needs may be quite different from the small entrepreneurs whom we wish to encourage. The best way to overcome this is to have an association of some kind which is responsive to the membership and represents their interests in discussions with government. Such associations are certainly not immune from domination by power groups but at least there may be a better prospect of democratic consultation.

The aim of both these points is to ensure that the national policy provides equality of treatment to all participants in the seed industry - and certainly does not discriminate against the private sector. One example is that the private sector should have access to foundation (basic) seed of the cultivars released from official breeding programs. The attractions and profits in seed production are sufficiently slim that if the burden of regulation and control is too great, the private sector simply will not bother to participate. Therefore, there is a need to achieve a balance between maintaining sufficient control to ensure standards and protect consumers on the one hand, and encouraging the private sector on the other.

What must the government continue to do?

Optimists may believe that the private sector can take over virtually every aspect of the organized seed industry and that may be true in high value crops or those in which hybrids dominate. However, there will be a continuing role for government in certain activities. For example, it seems probable that the government will remain the major plant breeder in self-pollinated crops, as it was in Europe until Plant Breeders Rights were introduced. The immediate downstream activities of variety maintenance and the production of basic (foundation) seed are also likely to remain a government activity to ensure that sufficient material is available to feed the later stages of the seed production chain.

Official agencies are likely to retain some responsibility for promoting improved seed in a general way through the extension services, although private companies will naturally assume responsibility for providing information to support their marketing at the point of sale. There is a real opportunity for collaboration between official agencies and the private sector in the organization of trials, demonstrations and open days. For example, the extension service may organize the sites and invite the private sector to contribute materials and publicity.

Another function which the government may have to maintain is that of seed security to cope with emergency shortages. It is very difficult for the private sector to accept this responsibility because of the costs of maintaining stocks which may not in the end be utilized. The need for this function may of course vary between countries or areas depending on the risk of natural disasters.

Conclusions

Privatizing the seed supply in these self-pollinated cereal crops is not easy, as they do not offer an opportunity for large or quick profits. Furthermore, the disposal of existing parastatal corporations may also be difficult. However, there are many opportunities for new participants to enter the seed market as an extension of existing businesses. This can create a much needed diversity in the supply system which will hopefully be more responsive to farmers' needs.

The greatest problem likely to be encountered by such enterprises is that of quality control and assurance, since that is technically demanding and specialized work. It is therefore appropriate for the government to offer quality control or certification as a continuing support to the private sector. The other important action that the government should take is to ensure that private sector interests are properly represented at the national level, that they receive equal treatment with those of the public sector and, above all, that the policy remains stable so that private businesses feel confident about making an investment in seeds.

Building the Foundation for a Private Seed Enterprise

Shyam G. Chakraborty and Richard Schroeder[*]

Introduction

The Mennonite Central Committee (MCC) is an international NGO which has been extensively involved in the promotion of the soybean industry in Bangladesh. MCC has worked in agronomic research, extension, utilization and marketing of soybean in Bangladesh for over 20 years. Throughout this time, MCC has been engaged in a constant struggle to make sufficient amounts of good quality soybean seed available for the development of the industry. In this struggle, MCC has employed many different strategies for obtaining good quality seed, but has run into problems in its efforts. In addition, MCC has recognized that an inherent weakness in the soybean industry is its dependence on MCC. With the aim of solving both of these problems, MCC has recently created the New Life Seeds project.

New Life Seeds combines all of MCC's activities related to the procurement, processing, storage, testing and marketing of soybeans within an organizational structure which will eventually be spun off as a private business. Currently MCC, through New Life Seeds, is the only organization in Bangladesh engaged in the full cycle of pedigreed seed production.

Bangladesh's seed industry, in general, is presently in an embryonic stage. The government of Bangladesh is attempting to encourage the private sector to take a stronger position in the production and marketing of good quality seeds. The private sector, however, has been slow to respond to the incentives for entry into the seed industry. This is primarily because of the difficulties associated with financing, technical and managerial complications involved in seed production and storage, establishing a broad based retailing system and establishing confidence in seed quality.

New Life Seeds presents a model by which a private seed company can be established in a developing seed industry. The strength of the model is the assistance that MCC can provide in the establishment of the project as a business and it particularly addresses the problems which have impeded private firms from entering the seed industry. The discussion which follows details the history of MCC's involvement in the soybean industry, the creation of New Life Seeds, its performance as a project, its viability as a business and its potential for the future.

Mennonite Central Committee

MCC is funded by the Mennonite and Brethren in Christ churches of North America. MCC operates in about 50 countries around the world with its head office in Akron, Pennsylvania, USA. MCC places volunteer workers in organizations that primarily work in grassroots development efforts. The volunteers are thereby given the opportunity to learn from the local community they are living in, while at the same time they can assist in community

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and rural development programmes.

MCC has been working in Bangladesh since 1972, only one year after Bangladesh gained independence from Pakistan. Currently, MCC works in Bangladesh in two main areas, job creation and agriculture. The Job Creation Programme is based in Dhaka city and is involved in providing employment to disadvantaged people by working with the design, production and marketing of handicrafts. The objective of MCC's Agriculture Programme is to improve the socio-economic conditions of the people it works with, most of whom are resource poor farmers. This objective is pursued largely by increasing farm productivity through researching and then extension of improved farming practices and also by promoting methods by which the health and nutrition of the local population can be improved.

The soybean programme

Background

MCC's Agriculture Programme began working with soybeans in the 1972/73 season when a number of different field crops, including millet, sorghum, sunflower, barley, wheat and soybean, were introduced into the local area. MCC's initial work with these crops primarily involved trying to grow them in different locations with different soil conditions and determining the response from the market and from the people growing them.

Work with soybean continued from the initial testing period and became one of the central features of MCC's Agriculture Programme. MCC's choice in focusing on soybean was based on the fact that soybean provided the best nutritional value to alleviate deficiencies in the local diet. This implies that soybean production was to be used for direct human consumption as opposed to other uses such as animal feed. To address the general goal of using soybean to improve nutrition, MCC established two primary objectives:

- to establish soybean as a recognized competitive pulse in the marketplace.
- to make soybean a known viable alternative crop for farmers.

Apart from the nutritional benefits of introducing soybean, the fact that it could be cultivated on land which often was otherwise left fallow, and that it is a nitrogen-fixing legume, were seen as complementary factors supporting MCC's decision to become involved in the promotion of soybean. It was assumed that simple food use of soybean would give the crop a market base in local villages; however, it was also anticipated that production levels would eventually increase to a point such that more expensive and sophisticated oil and industrial processing of soybean would be feasible.

From 1972 until the present, MCC has been recognized as the most important agent influencing the growth and development of the soybean industry in Bangladesh.

Research

From its inception until the present, MCC's soybean research activities have been carried out in laboratories, research stations and farmers' fields during the rainy and winter seasons. The central pursuits of MCC's research have been:

- variety development - mainly by selections from existing varieties.
- agronomic practices related to: field inputs such as irrigation, inoculation and fertilization; planting parameters such as sowing rate, sowing date, sowing method and field preparation; seed quality preservation; and cultural practices related to matters such as pruning, planting method and mulching.

In 1975, after MCC had firmly established its work in soybean research, a committee called the Bangladesh Coordinated Soybean Research Project (BCSRP) was created. This project involved the Bangladesh Agriculture Research Institute (BARI), Bangladesh Agriculture University (BAU), Bangladesh Council of Scientific and Industrial Research (BCSIR), several other government institutions, a private food company and MCC. This committee worked for several years but was discontinued in 1981 because the committee felt that the soybean industry could not develop further because of the great difficulty of producing high quality seed and the lack of a solvent oil extractor in Bangladesh. MCC continued soybean research and extension work believing that the problems cited by BCSRP could be overcome or that other solutions could be found. Other organizations, including BAU, also continued to work in soybean research and development, and have cooperated informally with MCC.

MCC's soybean research activity of the early 1970s led to an extension effort which began in the 1974/75 growing season. The soybean varieties used for extension were Bragg and Davis, both acquired from the USA. Davis had a 5 to 10 day longer duration than Bragg, which made it less attractive to farmers because the longer duration affected the following rice crop. Gradually, the area under soybean cultivation grew such that by 1981 it was 117.5 hectares. It became increasingly difficult, however, to meet the demand for seed because both Bragg and Davis did not have good seed-keeping qualities under the hot and humid conditions prevalent in Bangladesh.

In 1982, a new soybean variety was introduced to Bangladesh by MCC to meet the problems associated with storage of the Bragg and Davis varieties. This variety, Pb-1, was brought to Bangladesh from Sri Lanka but was native to India. In variety trials Pb-1 performed better than Bragg and Davis, but the main advantage of Pb-1 was its superiority in maintaining its viability throughout any given storage period. It also could be harvested and planted in adverse conditions and still produce a good plant stand. The introduction of Pb-1 was a major breakthrough for MCC in its work with soybean in Bangladesh.

Pb-1 gradually replaced the other varieties of soybean that were grown in Bangladesh. Today Pb-1, or Shohag as it is known in Bangladesh, is clearly the most important variety of soybean. In fact the only other variety used to any extent is G2120(M7)69-1 (commonly referred to as G2), a variety native to Taiwan. Today Pb-1 is used in about 97% of the total area under soybean cultivation, and G2 is used for the remaining 3%.

In spite of the small amount of cultivated land devoted to G2, this variety has some interesting qualities which make it appear as though it will have an important role to play in the development of the soybean industry in Bangladesh. First, it can be relay cropped with deep water rice. In other words, G2 soybean can be broadcast on fields of deep water rice just before harvest of that rice. Second, G2 is resistant to cold temperatures.

In Bangladesh, G2 is planted from the middle of November to the middle of December and Pb-1 is planted from the middle of December until the end of January. G2 is harvested in the middle of April and Pb-1 is harvested from the end of April to the middle of May. In terms of soybean production, the months of November to May can be loosely referred to as the winter season and are characterized by cool and dry conditions. The winter season is the main season for commercial production of soybean in Bangladesh. Some soybean is also grown in the rainy season. Rainy season soybean is planted from the middle of June to the middle of August and harvest is completed by the end of November.

While MCC has been pleased with the performance of Pb-1 and G2, it still maintains a germplasm bank of 225 varieties of soybean as a research source for new extension varieties.

Inoculant

Apart from the inadequate supplies of good quality seed, the biggest problem that MCC has faced in promoting soybeans as a field crop is related to the fact that in most areas of MCC's soybean extension, nodule development was not possible without the use of inoculant. If inoculant is not used, yields are reduced by as much as 64%. MCC has procured inoculant from sources inside Bangladesh and trained farmers to use it properly, but obtaining and maintaining the quality of inoculant necessary for optimum yields has been difficult.

MCC is currently addressing the problems associated with procuring good quality inoculant by establishing an inoculant research and production project within the activities of the Agriculture Programme.

Extension

Agronomic extension of soybean has been done by MCC in three different ways. First, and most importantly, extension workers are assigned areas in which they make personal contact with farmers, informing them of soybean production techniques and motivating them to try soybean as a field crop. The extensionist maintains contact with the growers during the growing season to answer questions and solve problems at field sites. Extensionists collect visual data and conduct an annual survey of 10% of the growers to track production, utilization, marketing and input patterns. The second method by which soybean has been extended is through group training sessions particularly with staff of other local NGO agriculture programmes. Third, on occasion, extensionists are sent temporarily to a new production area to work closely with the programme participants of another NGO during the growing season.

Soybean utilization and market development

MCC's activity has not been limited to only the agricultural side of the development of the soybean industry in Bangladesh. Extensive work has also been done in soybean utilization and market development. Cooking demonstrations are conducted by MCC in the areas where soybean is grown. This is done to introduce soybean into the diet of the local people and also to help establish local markets for locally produced soybean. The primary form in which MCC has encouraged people to consume soybean has been as a dhal (a kind of pulse soup commonly eaten with rice).

In addition to the cooking demonstrations, MCC also assists in developing market channels by introducing soybean to various businesses involved in food processing. MCC encourages businesses to mix soybean flour with wheat flour for the production of food such as bread, biscuits and snack mixes The amount of soybean flour used in the recipes promoted is usually 10-25%.

Soybean had never been consumed by Bangladeshis as a food other than oil before MCC began the cooking demonstrations. In trying to introduce soybean as a pulse, MCC found that soybean had two disadvantages: first was the beany flavor which the Bangladeshis did not like. Second was that the soybean did not become soft like other local pulses when brought to a boil under normal cooking conditions.

Research into both problems was conducted and a way of making the flavor more appealing was found. However, no satisfactory way of softening the soybean has yet been developed.

Soybean also has a nutritional barrier in the form of a trypsin inhibitor, which prevents proper digestion of protein. However, this problem has also been solved through the use of heat treatment.

In the early years of MCC involvement (1975-1982), MCC subsidized both the producers and the consumers of soybean. Soybean seed was made available to farmers through MCC at a lower rate than that for which MCC purchased it. MCC then guaranteed the farmers that it would buy all of the soybean production from the farmers if no other buyer could be found. Once MCC purchased the production resulting from its extension efforts, it would then sell it at a lower rate to consumers. MCC purchased soybean from farmers at a rate $0.25 -$0.50 per kg and then resold the soybean to consumers at a rate of $0.05 - $0.10 per kg. This subsidy to the consumer was crucial as it allowed for consumers to experiment with a new food at very little cost to them. By this same reasoning, the subsidy to the farmer in terms of the seed price and the guarantee of MCC buying back the soybean production was necessary; without these monetary incentives, the risk to the farmers of engaging in soybean production would have been too great for successful extension to take place.

The production buy-back system was eventually withdrawn as MCC kept its buy-back rate at the same level while the actual value of the crops increased. This led farmers to develop their own market and also to consume a part of their production.

Seed multiplication

When MCC began soybean extension, almost all of the seed was imported from abroad, mostly from the USA. Importation of at least 50% of the seed requirement was necessary until 1981/82. In the late 1970s, MCC experimented with different kinds of storage techniques and in-country seed production but with little success. Even the imported seed was extremely variable in quality. In 1978/79 the seed imported from the USA was found to have 0% germination. The problem associated with the quality and quantity of seed that was available was the central problem that MCC had to contend with up until the 1980/81 growing season.

In 1981 MCC began a seed multiplication project which was conducted in the rainy season and was to provide seed for the following winter season, the main growing season for soybean in Bangladesh. The location for this seed multiplication programme was chosen for its low rainfall and high land type and because of the positive experience that the Bangladesh Agricultural Development Corporation (BADC) had when it worked in that area the previous year.

The seed multiplication project was an improvement over the previous system used for obtaining seeds, however it did have some major problems. The quality of seed produced was always very good, but in some years the supply was short of the total demand. The variability in supply was due to variability in growing conditions and competition from other crops. The rainy season production was more susceptible to problems such as flooding, insects and lodging and in years, when the price for jute was high, it was difficult to convince farmers to grow soybean.

The seed multiplication project conducted in the rainy season was the only source of seed from 1982 until 1991. However, the variable nature of the quantity of seed made available led MCC to try two new ways of making seed available for the winter season production. The first method was through having farmers store their own seed from one winter season to the next. Since the improved varieties of seed, Pb-1 and G2, were now the seeds being used, it was possible for MCC to extend a storage technology that could be employed by individual farmers. This technology was low cost and utilized only locally available materials. It was expected that 20 to 30% of the soybean seed demand could be met in this way. The other method for making seed available for winter season production was through the development of a cold, dry storage facility that would enable MCC to store bulk quantities of seed from one winter season to the next.

The background for the decision to establish the bulk storage facility is that in 1991 MCC set a target for 60 tons of seed to be produced in the rainy season to meet the expected demand for the coming winter season; however, due to the rainy season production problems discussed above, only 30 tons were produced. This finally led MCC to conclude that the seed production from the rainy season was not reliable enough to support the expansion of the soybean industry. In looking for a solution to this problem, MCC consulted with the Crop Diversification Programme (CDP) - a body of the Bangladesh government which includes advisors from the Netherlands. The Netherlands Technical Assistance Unit (NTAU) of the Crop Diversification Programme provided MCC with funding and advice on how to create a storage facility capable of maintaining the required temperature and humidity for storing soybean seed over the rainy season. In 1992 MCC renovated a warehouse to the specifications needed for soybean storage. The renovations included installing four air conditioning units, upgrading the electrical system and insulating the building such that the proper temperature and humidity could be maintained.

MCC used the new storage facility for the first time for the 1992/93 winter season after purchasing 28 tons of soybean from the 1991/92 winter harvest. This soybean was kept at the storage facility and then distributed to farmers for the 1992/93 winter season. From the 28 tons purchased 21.5 tons were found to be of seed quality. That year only 3.5 tons of seed came from the rainy season production.

The example of this first year of winter to winter storage proved that this was a viable system for solving the problems that MCC had encountered in making seed available to farmers each year. The storage facility and activity related to its operation became the basis of the New Life Seeds project which began one year after this facility was created.

New Life Seeds

Organization and management

After the 1992/93 season and before the 1993/94 season, the details of the New Life Seeds project were developed. It was decided that one of the ultimate objectives of MCC's seed production, storage and marketing activities would be to direct MCC's work in these areas such that after a period of time a private and independent company could be spun off from MCC. This company would take on the production, storage and marketing activities for itself as a business enterprise. This was seen as a measure by which the soybean industry could gain independence from MCC, establishing a certain degree of long term sustainability. The company that was to emerge was named in advance - New Life Seeds.

A two year agreement (May 1, 1993 to April 30, 1995) between MCC and NTAU/CDP provided the framework of assistance for MCC to promote variety screening, and through New Life Seeds, the seed production, storage and marketing of soybean and other crops. The finances made available through NTAU were provided specifically for the wages and support of specialized staff, warehouse lease, research and advertising.

A company logo was designed and the decision was made to put it, along with the name New Life Seeds, on every bag of soybean seed that MCC sold, including the soybean seed produced in the rainy season. Another change which occurred when the New Life Seeds project began was that the price subsidy for soybean seed was totally removed. The price of the seed then came to reflect all costs including storage, packaging and processing losses. This was a very big step for MCC, as up until that point there had always been a subsidy in the price of seed. At this time, however, MCC considered privatizing this part of the soybean industry a greater priority than fostering continued growth through continued seed price subsidization.

Personnel were hired to fill three positions in New Life Seeds: business manager, marketing representative and warehouse supervisor. The New Life Seeds project officially began business in the 1993/94 winter season and continues today.

While New Life Seeds does receive some funding from NTAU/CDP it is financially independent from the budget of MCC. However, as New Life Seeds is a cash intensive business, it must make very large expenditures during the harvest of the winter soybean crop and in turn receives large revenues when the seeds are sold the next season. To meet its large financial needs New Life Seeds is able to draw short term loans from a revolving loan fund managed by MCC. When New Life Seeds was set up it received a loan of $45,000. As of September of 1995, that loan was completely repaid. New Life Seeds will be entitled to new loans as soon as it requires cash; however, starting in the 1995/96 procurement season, the loans will be subject to an interest rate and New Life Seeds will be expected to repay the loans as soon as its seed stocks are sold.

New Life Seeds has a certain degree of financial independence, but it remains highly dependent on MCC in terms of its business decisions and for seed procurement, marketing and technical assistance. Ultimate control of New Life Seeds is based in a board of directors which consists completely of MCC personnel. The New Life Seeds business manager sits on the board of directors but only with non-voting status.

For the day to day running of the seed business, New Life Seeds relies on a strong relationship with MCC. Experienced extensionists assist New Life Seeds staff in many aspects of New Life Seeds' business, particularly in activities related to contract seed growing. New Life Seeds has also contracted with MCC to carry out varietal research trials, providing recommendations to New Life Seeds management and supplying breeder seed of varieties to be multiplied by New Life Seeds contract growers. The contract fees with MCC amounts to $1,250.00 per year for research and $0.63/kg for breeder seed.

Over the last 20 years, MCC has built up a dealer network which it has used to sell soybean seed to farmers and also to buy back seed quality soybean from winter and rainy season production for use as seed. This network was turned over to New Life Seeds for both seed marketing and for assisting New Life Seeds in the procurement of pedigreed seed from contract growers. MCC extensionists are still the primary people involved in communicating with the dealers. Currently the dealer network consists of three main dealers and 65 sub-dealers.

New Life Seeds also benefits from other marketing work that MCC performs. MCC extensionists encourage farmers to cultivate soybean, which helps New Life Seeds by increasing the demand for soybean seed. MCC also increases the utilization of soybean through promotional campaigns, cooking demonstrations, large group demonstrations and nutrition demonstrations.

Contract seed growing and procurement

The mechanics of New Life Seeds' management of its contract growers and the procurement of pedigreed seed is relatively complicated and depends on a high level of assistance from MCC extensionists. Procured certified seed can come from contract growers producing in the rainy season or winter season growers or both.

In order to produce certified seed in one winter season such that it can be stored over the rainy season and then made available for the following winter season, three growing seasons are needed to complete the pedigree cycle from breeder seed to foundation seed to certified seed. New Life Seeds uses contract growers in the rainy season to produce foundation seed from breeder seed and then other growers in the immediately following winter season to produce certified seed from the foundation seed. This certified seed is then stored at the warehouse over the rainy season and then made available for the next winter season to commercial soybean growers. As mentioned above the breeder seed is supplied to New Life Seeds by MCC. MCC produces breeder seed on its research plots. MCC extensionists have helped New Life Seeds develop this network of winter and rainy season contract growers and currently assist in the running of this seed production system.

Throughout the process of the production of foundation and certified seed, MCC extensionists are involved in making contracts with growers, and senior MCC staff give training to the growers on seed production methodology. From the time of planting to harvesting, extensionists follow up and visit the individual contract growers to inspect the fields and to ensure that the farmers are using the most current methods for optimum quality seed production.

In the collection of the foundation seed from the contract growers, New Life Seeds staff are able to pick up the seeds themselves as the quantity is not extremely great. However the volume of the certified seed is large and New Life Seeds depends on the assistance of MCC extensionists and the seed dealer network for organization of the transactions necessary for procurement.

When contract growers are ready to harvest certified seed, MCC extensionists inform individual seed dealers who are part of the New Life Seeds marketing network. After the harvest of the certified seed, extensionists record the quantity and test the quality of the seed, using a germination test. These extensionists then inform the dealers of the quality and weight of the seed which has been harvested by each individual contract grower. The contract growers will then bring the seed to the dealers who purchase it, based on the quality rating that the MCC extensionist has provided. In the time between the rating of the seed by the extensionist and the purchase of the seed by the dealer there is no opportunity for the contract grower to mix the seed with lesser quality soybean because the extensionist keeps close supervision over the transaction process and because there are no commercial soybeans available in the area of the contract growers to be used to adulterate the certified seed at the time of the certified seed harvest.

From the dealers, New Life Seeds personnel then purchase the certified seed and bring the seed to the warehouse where it is stored until the next winter season when it will be sold to commercial soybean farmers as certified seed, first generation.

While the seed procurement system explained above is the model that New Life Seeds would like to employ as the main method of obtaining certified seed, it is also involved in purchasing certified seed from the rainy season and then selling that seed in the immediately following winter season. New Life Seeds, therefore, also maintains a network of contract growers in the areas of Bangladesh which can produce soybean seed in the rainy season.

Rainy season production of certified seed follows the same path from breeder seed that was explained above except the initial breeder seed comes from MCC research plots during the previous rainy season. Thus, foundation seed comes from contract growers during the winter season, which is then used in the rainy season for certified seed production. This certified seed is obtained by New Life Seeds using the dealer network and MCC extensionists the same way as was explained for the winter season production. New Life Seeds will then process the seed at its main warehouse, holding it for only a few weeks before it markets the seed through the dealer network to commercial soybean farmers who will use the seed in the winter season.

Production of soybean seed in both the rainy season and the winter season gives New Life Seeds and MCC's Soybean Programme a certain amount of flexibility and insurance against variations in supply in either one of the two seasons.

Seed processing and storage

The seed storage warehouse has a capacity of 120 metric tons of soybean. Temperature and humidity are carefully controlled with four air conditioning units and a dehumidifier. Seed is stored in the warehouse in 80 kg jute bags. The quality of the seed is tested every month on a random sample basis. One and a half months before the beginning of the winter planting period, the soybean is moved to a pre-cooling chamber where the soybean seed absorbs some moisture from the air to adjust to the outside environment. The seed remains in the pre-cooling chamber for 15 to 20 days, until it reaches a 10% moisture level. After this, the seed is cleaned and the poor quality soybeans are separated out (the rejected soybeans are sold as food or feed at a later date). The seed is then packaged in five kg plastic or jute bags. Included in the bags are 100 gram packages of inoculant and cultivation guides. The plastic bags are heat sealed and the jute bags are stitched closed.

Seed marketing

The marketing of soybean seed through New Life Seeds is quite simple. The seed is distributed through the dealer network when either New Life Seeds staff or MCC extensionists communicate to the main dealers that the seed is ready to be picked up at the New Life Seeds warehouse. The main dealers then come to the warehouse and indicate how much seed they want delivered to their own warehouses in various places in Bangladesh. New Life Seeds bears the cost of transporting the seed from the New Life Seeds warehouse to the warehouses of the main dealers. From the main dealers' warehouses, sub-dealers pick up their seed requirements and distribute the seed to farmers. Any bag of New Life Seeds soybean seed which is not sold in any given year is bought back by New Life Seeds. This prevents any poor quality seed from circulating in the market and maintains the quality level associated with the New Life Seeds logo. Once this seed is returned to New Life Seeds, it is un-packaged and sold as food or feed.

New Life Seeds, MCC and the soybean industry in Bangladesh

Growth and development of Bangladesh's soybean industry

New Life Seeds has been operating as a quasi-business for two full growing seasons and as an experimental project one year earlier. This period of time has seen dramatic growth in Bangladesh's soybean industry. The total area under cultivation in MCC's working area rose from 607 hectares in 1991/1992 to 1151 hectares in 1992/93 and then rose again in 93/94 to 1348 hectares before falling in 1994/95 to 973 hectares. It is expected that in spite of the down-turn in 1994/95, the positive trend of the area of cultivation associated with MCC involvement will resume. MCC anticipates that production area will jump to over 1500 hectares for the 1995/96 winter season.

There are several general reasons for the recent growth spurt of soybean production. Demand for soybean has risen sharply over the last few years. This increase in demand has been driven by commercial poultry producers which use soybean as feed for broilers. This has resulted in a general situation of upward pressure on soybean prices and consequently has encouraged farmers to produce more. Currently commercial poultry producers consume roughly 75% of the total soybean output in Bangladesh.

At the same time as the demand for soybean has increased, the industry's ability to produce more soybean has advanced due to the availability of sufficient quantities of good quality seed. This factor is something New Life Seeds can take credit for.

The 1994/95 season

An aberration to the positive trend of the soybean industry occurred in 1994/95. In spite of the structural strength of the demand for the industry's output, the production level was sharply lower that year. The total area of cultivation in MCC's working area declined in 1994/95 from 1993/94. This decline was a result of several factors peculiar to the 1994/95 season and because of a negative experience that many farmers had in the 1993/94 season.

In 1994/95 there was a drought during the planting time, making the soil conditions unfavorable. These conditions dissuaded many farmers from putting in a crop. However, the main factor causing the reduction in area put under cultivation was that in the previous year, the price for soybean at harvest time had been very low and the harvest itself had been very poor. The prices for soybean produced in the 93/94 season had fallen by 10-15% from the previous year because the most important purchaser of seed (a middleman who buys from the farmers and sells to poultry producers) was involved in an automobile accident. Without the presence of this individual, the marketing channel was broken and many soybean producers could not find anyone to buy their harvested crop.

The low price compounded the difficulties for the soybean farmers of that year. The inoculant used in the 1993/94 winter season was not of good quality and resulted in a marked decline in yields. The average yield in 1993/94 was 840 kg/hectare which compares very poorly to the previous year which saw an average yield of 1285 kg/hectare.

With such a bad experience in 1993/94, many farmers chose not to cultivate soybeans in 1994/95. New Life Seeds and MCC did not anticipate that 1994/95 would be characterized with such a significant reduction in the cultivation of soybean. This reduction was, of course, manifested in a very low demand for soybean seed. Most of the existing demand that was met by farmer retained seed - which was abundant because many farmers were unable to sell their soybean crop the previous year. Only 47% of the total demand for soybean seed was met by New Life Seeds, the rest was covered by farmer stored seed. The 47% replacement rate is particularly bad in comparison to the previous year (1993/94) when New Life Seeds had provided 80% of the soybean seed requirements.

New Life Seeds was left in a very difficult business position in 1994/95 because it had procured 158 tons of seed for the winter season, but only managed to sell 40 tons as seed - the rest had to be sold as food or feed at a much lower price.

In spite of the low level of interest in soybean at the time of planting, by the time of the 1994/95 harvest, the underlying strength of demand for soybeans was brought back to a proper level. The prices for commercial soybeans were very good. Many large scale consumers of soybean complained that they were not able to purchase even 50% of the soybeans that they wanted for that year. The season's yields were also very good, which, when added to the high price for the soybean harvest, made the farmers who had chosen to cultivate soybean very happy.

The positive experience that the farmers had in 1994/95, combined with the huge unmet demand for soybean production, leads MCC and New Life Seeds to believe that the area put under cultivation will rise very sharply in 1995/96. It is also believed that New Life Seeds will be able to sell seed to a much greater proportion of the farmers who will grow soybean (the replacement rate should again reach the 80% mark for New Life Seeds; farmer-retained seed ' will be much less). This should yield a very favorable business position for New Life Seeds.

Business viability of New Life Seeds

New Life Seeds incurred a small profit of $1790 in 1993/94. In 1994/95 it incurred a loss of $2160. Both of these figures include non-seed soybean sales and funding payments from NTAU/CDP. The loss in 1994/95 can be attributed to the inability of New Life Seeds to sell most of its stored seed as seed, as discussed above.

In 1993/94 when New Life Seeds seed sold for $0.55 per kg, the average variable cost per kg was $0.53. In 1994 the seed was sold for $0.60 per kg and had an average variable cost of $0.58 per kg. The price will be $0.65 per kg in 1995/96 while the average variable cost is expected to be $0.625 per kg. These prices and costs include a 100 gram package of inoculant per each 5 kg bag of seed. The average cost of the seed does not include losses resulting from soybean seed which has to be sold as food because of excess seed returned from dealers. As mentioned, New Life Seeds also receives revenue from sales of soybean seed as food or feed (that which can not be sold as seed) and from the funding given by NTAU/CDP.

In 1992/93, 25 tons of seed was sold from the project that was to become New Life Seeds the following year. In 1993/94, 75.6 tons of seed was sold and in 1994/95, 40 tons of seed was sold. For the 1995/96 year New Life Seeds is expected to sell over 80 tons of seed.

New Life Seeds' business position is gradually becoming stronger. MCC believes that it will be possible for the project to become a profitable business in subsequent years. The funding from NTAU/CDP will gradually be reduced over a new funding agreement and hopefully New Life Seeds will be able to absorb the reduction in funding by greater seed sale profits. However, the strength of New Life Seeds' future depends, to a large extent, on whether New Life Seeds can diversify its production and marketing to other crops. The transition from MCC control to private owners will also be of crucial importance.

Gaining business viability and directing MCC divestment

For MCC to actually achieve its ultimate goal for New Life Seeds, ie. to spin it off as a private sustainable seed business, two things must happen. Firstly, New Life Seeds must be able to achieve consistent positive returns on the capital which is invested in it - it must be profitable. Secondly, New Life Seeds must be able to release itself from the control of, and dependence upon, MCC.

Efficiency

The first concern, business viability, is fairly straightforward and likely to be achieved through increased production efficiency and diversification. New Life Seeds is looking to increase its efficiency particularly in the area of seed processing. It is possible that labour costs can be reduced in this area by establishing an in line method of seed grading and packaging in a separate building from the New Life Seeds warehouse. New Life Seeds is also considering purchasing a "Crop Boy" appropriate technology air screen separator from NTAU/CDP which would be used along side the spiral gravity separators currently used by New Life Seeds.
New Life Seeds also intends to reduce its seed procurement costs by consolidating the

contract grower system to an area near the seed processing centre.
In the pursuit of optimizing business efficiency, New Life Seeds will have to deal with the question of whether it can afford to maintain a pedigreed seed production system as opposed to simply purchasing commercial soybean which is of seed quality. Maintaining the pedigreed system raises the cost of the seed by a minimum of 8 to 10%.

Diversification

Diversification is also of extremely important in increasing the magnitude and stability of New Life Seeds' annual profits. The New Life Seeds logo is already associated with good quality seed. It will not be difficult to direct other kinds of seeds down the same marketing path which is currently employed for soybean. The dealer network and support from MCC extension personnel are tremendous assets in helping make diversification into other seeds successful. The confidence that farmers have in New Life Seeds seed is a result of the efforts of MCC and the 20 years of experience MCC has in working in soybean and other crops.

Consumers of New Life Seeds seed already have confidence in the seed certificate cards which are attached on every bag of soybean seed. These cards indicate the seed standard, revealing the germination percentage, emergence percentage, inert material percentage, purity of seed, percentage of weed seed and moisture content. Farmers trust that the information given on the card is true and are willing to pay the higher price of New Life Seeds seed because of this quality assurance. It has been seen that farmers are willing to pay at least 80% more for the ensured quality of soybean seed from New Life Seeds as opposed to regular seed sold loose in local markets. With a little bit of effort, there is no reason to think that this confidence can not be passed on to other crops and varieties.

New Life Seeds is pursuing diversification already. Some experimentation has been done on the storage and marketing of groundnut. For the 1995/96 season New Life Seeds procured 8 tons of local groundnut seed which it intends to market under the New Life Seeds logo. In addition, New Life Seeds is researching the possibilities of procuring and marketing sunflower and mungbean seed. CDP has made 15 kg of sunflower seed available to New Life Seeds for this purpose.

Also in relation to New Life Seeds diversification, MCC is considering the option of developing an extensive vegetable seed production and marketing programme which would be done in conjunction with New Life Seeds, again under its trade name and again with the objective of having the vegetable seed programme spin off with New Life Seeds.

MCC divestment

The second concern associated with establishing New Life Seeds as a completely independent business is divesting it from MCC. The fundamental strength of New Life Seeds is in the assistance it receives from MCC extensionists in procuring seed and in the grassroots marketing support that those same extensionists provide. This is also the central weakness that New Life Seeds faces as it tries to separate itself from MCC. If it is determined that New Life Seeds must have that support from MCC, some type of contract system will have to be worked out such that New Life Seeds pays for that assistance and that it is reflected in the cost of the seed. MCC's contracted research activity for New Life Seeds is a model by which such a relationship could be established.

Also in the context of divesting New Life Seeds from MCC, ownership of the business will have to be transferred away from MCC. This is could occur if New Life Seeds assets could be divided up into ownership shares which could then be sold to private individuals. These owners could then gradually replace MCC staff on the board of directors of New Life Seeds. Naturally, this divestment process would have to be very gradual and would require New Life Seeds shares to be considered as assets with an attractive potential for generating returns. This, of course means that New Life Seeds will have to generate profits.

Conclusion

New Life Seeds is in the process of becoming an independent, private seed company. It still has a long way to go, but the groundwork which has been laid by MCC and MCC's commitment to New Life Seeds' development make its future as a private enterprise promising. Apart from the specific goals that MCC has for New Life Seeds in the soybean industry, with diversification it may also have a positive effect in other areas of the agricultural sector.

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Farmers, Small Tribals and Seed Businesses

Vineeta Hoon[*]

Introduction

Seeds are the most important input in all plant-based agricultural systems. Seeds, embody the genetic potential and biochemical make-up of plants and determine the upper limits on plant yield and thereby the productivity of other agricultural inputs as well. Traditionally, farmers grew and maintained their own seeds. Women in the farm household were seed selectors and conservators and have practised the mass pedigree system of selection. By this method they were able to advance, sometimes by 1% per year, the yield potential of the crop (Swaminathan 1993). To improve crop yields they used the naturally occurring genetic diversity among local landraces and selected seeds for higher yield and stability of performance. They took advantage of natural crosses and mutation in plants and tried to identify strains possessing resistance or tolerance to both biotic and abiotic stresses. Such selection processes resulted in the development of locally adopted varieties providing reliable performance patterns. The benefits from such seed selection and maintenance were frequently spread through local communities via farmer to farmer exchange of seed.

Similarly, plant breeders and geneticists in agricultural institutions try to develop new varieties of the same crop each year for distribution to farmer cultivators. The chances for the spread of pests and pathogens increase with the improvement of conditions for the growth of plants. The probability of severe outbreak of an epidemic is greater when a single variety is grown in a large contiguous area. In order to sustain productivity at a high level over extended periods of time, it is vital to maintain varietal diversity along with the replacement of varieties. Resistance breeding is a continuous process with the breeder and the pathogen striving to keep ahead of each other (M. S. Swaminathan 1968).

Seed production chain

Figure 1 describes the seed production process. Breeder seed is produced at agriculture research institutions. It is then transferred to state controlled seed farms for the production of foundation seed. The foundation seed is distributed to registered growers for the production of certified seed. The certified seed is then distributed amongst cultivators for raising crops for consumption.

Competent technical guidance and supervision are essential at all these stages in order to ensure that the cultivator receives high quality seeds. According to government of India's new policy on seed development (1988), the main objective should be providing Indian farmers the best seeds and planting materials available in the world to increase productivity, farm income and export earnings.

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Figure 1 Seed production chain.

Breeder Seed
(research institutions)

Foundation Seed
(state controlled seed farm)

Certified Seed
(progressive farmers)

Mass Crop for Consumption

Evolution of the present seed system

Socio-economic pressures to increase food production to meet the demands of the rising population compelled government intervention to support scientific approaches to develop improved varieties, multiplication, processing, storage and distribution.

For the purpose of the seed industry, we can broadly categorise crops into three major groups:

- self pollinated crops, including major cereals such as rice and wheat.
- cross pollinated plants, where special methods of seed production using hybridisation techniques are adopted.
- vegetative propagating plants: micro propagation using tubers and buds is used on certain vegetable crops and grafts are often used for developing quick growing fruit trees or for rejuvenating orchards.

Over the past three decades, major investments have gone into the development of public seed production, processing and distribution at the national and state levels. The National Seed Corporation (NSC) was founded in 1963 with a view to organising the development of an efficient seed industry and to provide services for seed certification, seed quality control, seed processing, packaging, seed marketing and training in various aspects of seed production. Later state seed corporations (SSC) were started under NSCs to co-ordinate the activities of seed production in different states.

The NSC and SSC are the major public sector producers of certified seeds of self pollinating crops in India. SSCs mainly deal with certified seeds of wheat and rice in relatively compact areas. NSC concentrates on breeder seed production for these crops, and on co-ordinating seed trade between different Indian states. They both rely upon a large number of contract farmers for the actual seed production and also operate large centralised seed production units. However, high subsidies are needed to ensure a steady supply of these seeds. Duplication in investment and activities among the public sector seed corporations is fairly common. High prices, inefficient distribution, insufficient extension work and unscientific use of hybrid seeds have combined to keep the programme from making the expected impact on production.

Private sector involvement

With the improvement the of seed system and the development of the seed market, private sector seed production and distribution began in the early 1960s. Most of the private firms which entered the industry during the 1960s and 1970s were small to medium scale and concentrated on multiplying and distributing public hybrids and improved varieties. The 1975 National Seed Policy, and the liberalisation of internal trade in seeds in 1988 and 1991, have boosted the contribution of the private sector in the seed system.

The concentration of private activity in the production of seed for hybrid varieties could be explained by a natural phenomenon. The crop from a hybrid variety cannot be reused as seed, so this offers built-in intellectual property protection as long as the breeder guards the identity of, or access to, the parental lines used. This suggests that availability of protection encourages more participation of the private sector. For similar reasons, private firms have also entered the market of providing tissue cultured planting materials, especially for fruit trees and ornamental plants for the export market.

Studies conducted in the United States suggest that the availability of plant breeders' rights (PBRs) has increased the number of private sector breeders as well as the number of private varieties released and planted. However, private investment was found to vary unevenly among crops with hybrid vegetables receiving the greatest attention. In anticipation of PBRs, private sector companies are diversifying to include other crops, which hitherto were untouched due to a lower profit margins.

Experiences with tribal, small and marginal farmers

Sources of seed supply

Table 1 presents a summary of results of a baseline survey to analyse the reasons for low productivity of vegetable crops in Chengalpet-MGR district in Tamilnadu. This survey revealed that despite the relatively advanced seed supply network, farmer saved seed forms a large proportion of the seed supply in the farms, especially for small and marginal farmers (CFDRT 1993).

Table 1 Sources of seeds.

Vegetable	Govt. %	Private %	Self %	Total
Brinjal	5.12	14.40	80.48	100
Chili	7.35	9.63	83.02	100
Tomato	1.23	28.35	70.42	100
Cucumber	5.05	2.10	92.85	100
Okra	3.58	3.40	93.02	100
Snakegourd	2.04	8.30	89.66	100
Watermelon	4.82	1.06	94.12	100

A study encompassing 12 districts in India attempted to take the benefits of agribusiness to small farmers and thereby enhance both income levels and employment in rural areas (MSSRF 1995). This study revealed that a majority of small farmers were in no way influenced by the seed revolution taking place in the country for the reasons given below:

- Private and government seed distribution systems only concentrate on popular crops and do not cover the varieties or types of crops preferred by small farmers.

- Small farmers are often unaware of the superior seeds and planting materials available from agricultural departments free of cost.
- They use improved variety seeds for commercial farming of food and vegetable crops and tend to grow traditional varieties for home consumption because of taste or because they also provide fodder.
- Hybrid seeds are too expensive and they lose their hybrid vigour when saved seeds are planted in the next season.
- Because of the centralised procurement system and non-availability in the nearby areas, the planting materials are brought from distant places. As a result, weak and disturbed grafts are supplied to the farmers.
- Specific varieties required by farmers are not available.
- Tribal people living in remote areas are less influenced by the outside world and, hence, are still cultivating traditional cultivars and landraces.

These tribal, small and marginal farmers outside the purview of the seed industry are the people who have managed to maintain biodiversity in fanning systems. The success behind their breeding programmes largely depends on the availability of wider germplasm, particularly landraces and wild relatives of crop plants cultivated by tribal and rural families. This material serves both as the primary feed-stock for the fast growing biotechnology industry and as a safety net for small farmers with reference to crop losses from pest epidemics (Swaminathan 1994).

It is estimated that 38 % of India's total seed requirement is met by the formal agencies. These seeds are invariably purchased by big farmers with resources (land, water and capital assets). The balance (62%) is met by inter-farmer sales, which is considered a fast way of disseminating new improved seed to remote interior areas. The state agriculture departments also have numerous schemes under which they supply planting materials for horticulture, food crops and oil seeds to small and marginal farmers free of cost.

Tribal farming systems

The traditional staple food crops of the tribal people fall outside the purview of the main seed industry and hence are totally dependent on farmer saved seed.

Tribals and small farmers in India practice traditional methods of low input agriculture. Here we must realise that low input agriculture refers only to low market purchased inputs. Input is needed for output, and to maintain high yields market purchased chemical inputs have to be substituted by farm grown biological inputs and improved composting practices. Tribal farming systems are therefore referred to as low external input farming systems because all inputs are supplied from within the village boundary and only the tools are purchased by the farmer. For example the yields for buckwheat farmed by the Bhotiya tribals of the Kumaon (1.3 t/ha) compare well with yields in China (0.5 to 1.4 tons/ha) and the USA (1.2 to 6 t/ha). The NPK content of compost used on a percent dry basis was equal to 1.69% nitrogen content, 0.36% phosphorus and 0.20 % potassium, which indicated that it is of good quality since it is rich in these essential nutrients (Hoon 1995). The farmers obviously maintained yields with fairly high organic inputs. By using locally available inputs, the farmers are also able to maintain soil fertility and to achieve high energy yield ratios (i.e. for every unit of energy input there is correspondingly a greater energy output).

The seed village concept

The seed industry is regarded as a sunrise industry because of its potential for increasing rural income and employment. The seed industry offers scope for decentralised organisation supported by a few key services like appropriate training, material, credit, infrastructure with home and external marketing. Needless to say, wherever farmers have taken up seed production activities, their incomes have trebled or even quadrupled. Village surveys and discussions with farm families have shown that women belonging to resource poor families can master the art and science of seed technology, provided the training methodology is learning by doing The seed industry offers a potential for value addition to time (the working hours) of the women belonging to poor households. Besides improving the livelihood security of the rural poor, it will provide elite planting materials to the farming community.

The Ankapur model

A successful example of a seed village is Ankapur in Andhra Pradesh. It is also an example of how people will co-operate and work together when they have a common focal point - in this case the focal point was higher profits and increased income for all. This village was transformed after the people took up seed production work for the National Seed Corporation 10 years ago.

Hybrid seed production requires great cooperation on the part of all the farmers with adjoining fields and it is preferable that all the farmers grow the same varieties. Purity is lost if cross pollination takes place with other varieties. Once the farmers understood that profits would fall if the purity of the hybrid seed was not maintained, they took to convincing and helping each other to improve their cultivation practices.

They formed a cooperative society to supply seeds to the National Seed Corporation and have recently formed linkages with private seed companies to grow sunflower seeds on a buy back arrangement.

The Indo-American Hybrid Seeds (IAHS) model

The IAHS is located at Bangalore in Karnataka, India and therefore most of their contract seed production activities are focused in this state. In this model all external inputs including transfer of technology are provided by the parent company and the farmers under contract with IAHS have to supply seeds back to it. The company has mainly focused on women seed producers and thereby contributed to value addition to the time of farm women and agricultural labour by imparting new skills and enhanced income (Latha and Brinda 1994). In this model only some farmers grow hybrid vegetable seeds on contract and the entire village is not necessarily involved in seed production.

The Vanitha orchid clubs

The A. V. Thomas & Company Ltd. have come forward with a novel development programme for orchid culture with the help of women's groups in Kerala, India. Conducive climate, educated women, an international airport and access to modern tissue culture laboratories have facilitated the success of this model. Each club consists of 50 members. AVT provides planting materials, other inputs and training to its members. Each member gets 50 orchid plants and a kit which contains a sprayer, fungicide, insecticide, orchid nutrient and a guide book for growing orchids and also gives them preliminary training in raising orchids.

AVT buys back quality flowers produced by these women's clubs and also arranges for marketing to other states.

These are replicable contracts which will be successful in technically feasible areas. However, due to limited resources and management capacities, it is difficult to cover a wider area. NGOs working closely with people could play a complementary role in developing social contracts between farmers and the seed industry to ensure a good deal for both parties.

Seed systems for low external input agriculture

Both private and public seed industries have focused only on high yielding varieties for seed production and promotion. The agricultural department's interventions in improving the seed supply systems have also focused on highly responsive varieties. However, smallholders look for crop varieties with good yield, which are reliable and stable over the years and yield even in adverse environmental conditions, varieties with built in resistance against pests, and which grow well with organic fertilisers.

Many of the traditional conservation habits are tending to wither away. Habitats rich in agri-biodiversity are increasingly under threat due to developmental activities and increase in population. The public distribution system (PDS) for cereals is another villain, because it only distributes the main staples, rice and wheat, and has ignored millets and other rainfed crops. Availability of cheap rice in PDS network tempts people to buy it as a staple. The traditional crops are more expensive to grow, they are low yielders or difficult to process and seem like too much of a bother, since a cheap (subsidised) alternative is available. People therefore have forsaken their traditional farming system.

Unfortunately, the loss of biodiversity is occurring at a time when genetic engineering is gaining increasing precision in the transfer of genes across sexual barriers. The revival and revitalisation of traditional genetic conservation practices is thus an urgent task. Recognising this concern, we have included the following programmes at the M.S. Swaminathan Research Foundation:

Agri-biodiversity conservation corps

We aim to constitute an agri-biodiversity conservation corps by training tribal and rural youth in situ and ex situ conservation techniques and seed technology. Only those who have a stake in living in their respective villages will be selected. They will be supported with the necessary technical infrastructure, so that they can help their own communities to halt genetic erosion and to promote the conservation and sustainable utilisation of their genetic wealth. Training and support will be imparted to these volunteers on:

- the identification and importance of agri-biodiversity including fruits and vegetables, cereals and millets, pulses and oilseeds, tubers, spices, medicinal plants, trees/wood for artisanal works, palm products such as sago, starch, flour, honey, silk/lac and locally adapted livestock.
- documenting the distribution and availability of such agri-biodiversity and also the traditional means of conserving them in situ including sacred groves, home gardens and selective enrichment of natural forests with choice agri-biodiversity.
- identifying and documenting traditional methods of seed selection and storage, paying special attention to vegetatively propagated plants such as colocasia and other yams.

Community gene fund

There are still some tribal families and small farmer families who continue to grow traditional varieties for a number of personal reasons. These people are conserving nature's biodiversity and doing a great service to the community and nation. Recognising that cultivators should be compensated for their service to the community by maintaining low yielding land races, India has a proposal for establishing a community gene fund for the purpose of promoting In situ conservation of local landraces.

The question that arises is will the resource poor farmer go back to cultivating traditional landraces if given adequate resources? Our experience with rural folk shows that while men are easily corrupted by money, it is the women who are the best bet. Women have traditionally grappled with realities and are concerned about providing nutritious food for the family. In Andhra Pradesh, women often reject improved, pest resistant, better yielding varieties of pigeon pea developed by ICRISAT on the grounds that the new varieties did not taste good, took too long to cook or produced less stalk They said that even though their own native landraces yielded less, they would continue to grow them since it provided them with more than just high yield of grain (DDS 1995).

Since much of the low input fanning is managed by women, the seed situation hits the women particularly hard. Earlier, all the seed needed for their farming used to be produced by themselves on their own farms. However, with the growth of the seed industry and the dependency on HYV seeds, this age-old self reliance faces possible extinction.

By being actual controllers of seed, the women will become self reliant and at the same time will be able to provide seeds of traditional varieties to other farmers who want to practice low input agriculture and grow traditional varieties. They will also add value to their time since seed production is a more lucrative business.

Seed villages as a tool for corporate sector farm families and breeder farmerpartnerships

There is a need to foster macro-micro linkages at the village level which would help the resource poor farming community to overcome constraints like the non availability of the technical know-how, credit, technical infrastructure and a producer oriented marketing structure. This would help to establish 'a new social contract' between the private sector seed industry and resource poor rural farm families. Such a step will also help us implement effectively the provisions of the Global Biodiversity Convention relating to in situ conservation of landraces and will help rural women to derive benefits for the forthcoming Plant Varieties Act. This programme aims at the following:

- Developing a social contract with seed companies on the lines suggested by the different models presented above. The seed companies will provide centralised inputs and the farmers will partake in decentralised production on a buy back arrangement.
- Providing linkages for participatory breeding with plant breeders to achieve varietal diversity and local adaptation, an essential requirement for low-input sustainable agriculture.
- Focusing on multiplication of nitrogen fixing legumes seeds such as the stem nodulating Sesbania rostrata as well as plants yielding botanical pesticides
- The national research system should establish a few genetic enhancement centres for producing novel genetic combinations conferring resistance or tolerance to biotic and abiotic stresses.

In this way seed villages will become centres of not only seed multiplication and distribution but also breeding centres for low-input agriculture.

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Supporting Integrated Seed Systems: Institutions, Organizations and Regulations

Robert Tripp[*]

Introduction

Many national seed systems are in the midst of profound changes. This transformation is characterized by the increasing role of commercial enterprises in developing varieties and providing seed, and by the concomitant decline in public sector seed activity. These changes correspond to the four-stage evolution of seed systems described by Pray and Ramaswami (1991), which begins with farmer variety selection and seed supply; progresses to the emergence of public plant breeding programs; develops to the widespread use of public sector varieties accompanied by the increasing role of commercial seed enterprises; and culminates with private firms producing and marketing most varieties, with some basic plant breeding research still managed by the public sector. There is a tendency for national policy makers and external donors to approach seed policy formation as a question of locating national seed systems on this continuum and moving them forward.

There are several factors that raise questions about this unilineal concept of national seed system development, however. First, the rapidly increasing commercial seed activity found in many countries concentrates on crops whose seed is sold frequently to farmers, either as hybrids or because it is difficult or inconvenient for farmers to store their own seed. Second, commercial plant breeding and seed production activities naturally focus on crops and varieties that are widely grown and commercially important, leaving aside the needs of many farmers in what Chambers (1991) calls "complex, diverse and risk-prone" environments. Third, there is growing evidence of the benefits of farmer participation in formal variety testing and selection in order to identify priorities for plant breeding and to develop varieties adapted to specific environments. Fourth, there is also increasing experience with decentralized seed production and distribution alternatives that provide more flexibility than conventional commercial seed operations. Finally, no matter what direction national seed system evolution takes, it must be acknowledged that the state has a continuing role in supporting seed system development and assuring that the benefits reach all farmers.

Thus we need a broader perspective on national seed systems than the simple progression from public to commercial management. We need to take account of local needs and capacities, and public policy responsibilities. The concept of integrated seed systems (Almekinders et al. 1994) is useful here, where local and formal seed supply systems are seen as complementary. This allows us to consider a more varied and complex mix of institutional alternatives for developing national seed systems. This paper outlines issues related to the development of institutions to support seed provision and seed regulation, and it examines the policies that are required to support this institutional development.

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Variety development and seed provision: institutional development

Following sections examine alternatives for promoting variety development and seed provision. They begin with a general discussion of the elements of institutional change, then discuss factors that should contribute to the formulation of seed policy, and conclude with an outline of some specific options.

Organizations and institutions

Before proceeding to describe institutional development, a brief exploration of the term institution is in order. When we speak of institutions, several meanings are possible. The term is often used by economists and sociologists to describe rules and conventions, while management and administration specialists use the term to describe more concrete roles and organizations (Goldsmith 1992). North (1990) distinguishes between institutions as "the rules of the game" and organizations as the players, "groups of individuals bound by some common purpose to achieve objectives". Uphoff (1994) describes a continuum in which institutions are "complexes of norms and behaviours" while organizations are "structures of recognized and accepted roles". Under Uphoff s definition, markets would be an example of an institution, a seed company would be an example of an organization, and a ministry of agriculture might be seen as both an organization and an institution.

The key point for the purposes of this paper is that when we speak of institutional development, we must be concerned with both the abstract and the concrete; with general policies that affect the rules of economic and political development, and with specific strategies to foster the development of organizations that contribute to strengthening national seed sectors. Organizations can be established relatively easily, but whether they make a sustainable contribution to seed sector development depends in part on the institutional background. On the other hand, as organizations are established and evolve, they help to alter and define the institutional environment (North 1990).

Beyond public and private

It will be best to begin with the organizational side of support to national seed systems. One of the problems in approaching seed system development as a simple progression from public to private management is that this division is not the strict dichotomy that we imagine. First, the private side includes both commercial and voluntary entities, and even the definition of voluntary may be problematic. Brett (1993), for instance, points out that some large NGOs may behave more like parastatals, while some cooperatives have many of the characteristics of commercial firms.

Thirtle and Echeverria (1994) provide a useful discussion of the privatization of agricultural research, and point out that few research activities can be seen as purely public or purely private. Instead, they urge a more careful examination of the characteristics of research activities. The criteria they describe can be applied to plant breeding and seed production activities:

- Source of funds: Activities may be supported from public funds, from levies on selected groups (such as producers of a specific commodity), or from private funds (either commercial or voluntary).
- Execution of activities: Independent of the source of funding, activities may be implemented by publicly owned, commercial, or voluntary organizations. Public funds may be used to contract the services of a commercial seed enterprise, for instance.
- Profit motive: The profit motive may or may not be dominant in defining the activity. Again, the public/private dichotomy is not necessarily useful; public plant breeding

programs may reorient their work towards seeking royalties, for instance, or seed cooperatives may be partially supported by public funds.

- Output utilization: The output (eg, a new variety, or improved seed supply) may be in the public domain, directed (or restricted) to particular users, or privately controlled.

Thus there is a blurring of the distinctions among public, commercial, and voluntary activities. This allows us to consider a greater breadth of organizational options for supporting integrated seed systems. It also points to many opportunities for useful collaboration among public, commercial and voluntary organizations.

Exit and voice

Choices among specific organizational options for developing the national seed sector will depend in part on the institutional environment that defines the rules and norms of economic and political life. Reliance on commercial seed options will be conditioned by the status of market development, for instance. Similarly, focus on community organization presumes that mechanisms exist that encourage widespread participation; and the success of public sector contributions depends in part on the presence of representative and responsive government. A useful way of summarizing these factors is through Hirschman's well-known concepts of exit and voice. Exit is associated with "the availability of choice, competition, and well-functioning markets" (Hirschman 1986), while voice is concerned with the capacity to articulate demands and concerns, through trade unions, consumer organizations, and other means. Institutional development should provide increasing opportunities for both exit and voice. Exit gives people the option of withdrawing from a commercial relationship (by seeking an alternative supplier in the market) or from membership in an organization (by seeking an alternative employer, political party, etc.). Voice provides the opportunity to stay within, and to improve, a relationship, by communicating concerns to commercial partners or by influencing the management or direction of an organization.

The concepts of exit and voice are closely linked. As Hirschman (1986) points out, "most real markets involve voice: commerce is communication." When national political and economic institutions provide more opportunities for both exit and voice, the number of organizational options for developing seed systems increases. Although the focus of our discussion is on specific policy options to support the development of organizational innovations for seed system development, we must bear in mind that the success of these options will be strongly influenced by more general development of national economic and political institutions. A principal challenge for developing integrated seed systems to serve resource-poor farmers is that current institutional development allows the poor relatively little access to either exit or voice (Brett 1993). As long as economic and political institutions provide resource-poor farmers little opportunity for exit or voice, the range of options for seed system development will be correspondingly limited.

Policy considerations

Although seed sector development will be increasingly implemented by non-public organizations, there are a number of important seed policy responsibilities that deserve attention. These include contributions to information development and priority setting; the assurance of equitable access to seed systems; concern for the sustainability of different organizational options; and the provision of technical support and training.

Information and priorities

Many past failures to develop viable seed provision systems for resource-poor farmers can be blamed on lack of adequate information about farmers' needs and conditions. National government programs, donor projects, and NGO initiatives are often based on untested assumptions that better varieties are available on the shelf, or that local seed quality or seed access can be easily improved. However, experience shows that careful adaptive research is usually necessary to identify and develop new crop varieties that are compatible with farmers' conditions and priorities (Byerlee et al. 1987; Ashby et al. 1987). There are also many instances where farmer-saved seed is of adequate quality and comparable to what can be offered by the formal sector (Janssen et al. 1992). Similarly, systems for local seed distribution may be quite effective (Green 1987). The design of strategies for improving seed systems must therefore begin with an identification of the problems, and this requires good information. Policies can stimulate the development and dissemination of this type of information by research institutes and universities. Better information on how to identify seed problems and priorities will make a significant contribution to improving the efficiency of integrated seed system development.

Equitable development

As commercial and community-level seed options emerge, public policy also has the responsibility of monitoring and guiding the degree to which these options are available to all farmers. Possible biases in commercial development are well understood; commercial enterprises are more likely to serve accessible and market-oriented farming populations. Public policy can help encourage commercial endeavours to address more isolated and subsistence-oriented farmers by offering various types of incentives and information. Voluntary or community-level seed projects are more likely to focus on resource-poor farmers, but public policy still has a responsibility to promote the equitable distribution of these projects. In addition, the denomination of an activity as community-level does not necessarily guarantee that all farmers will have access to its benefits. Evidence on the local movement of seed of new varieties shows that it is often distributed through kinship or ethnic links that may limit access for poorer members of the community (Sperling and Loevinsohn 1993). Public policy interventions here are much more difficult, but the promotion of information and strategies that promote more widespread participation can help.

Organizational sustainability

It is also important to monitor the sustainability of organizational options. Sustainability of seed systems is determined in large part by their economic viability. NGO seed projects are usually established with the goal that they become self-sustaining, but many of these projects are still far from this goal, and the price of seed paid by participating farmers may be below actual production costs (Wiggins and Cromwell 1995). In such cases we must be concerned about the long-term perspective of such options.

A related issue in community-level projects is the common assumption that the opportunity cost of community members' time is low, and that they will be willing to contribute to community seed production activities. However, an emerging conclusion of research on various aspects of collective action is that farmers will organize and contribute their time only to community activities that respond to their highest priorities (Wade 1988). In many cases, it must be acknowledged that seed supply and variety development do not qualify. This is not to say that all seed activities must be run on the basis of self-interest; there is certainly the opportunity to enlist farmers' research skills and curiosity in local variety development, for instance. However, seed projects that are conceived with the assumption that significant collective community action will be forthcoming may produce disappointing results.

Another policy consideration for seed system sustainability involves the recognition of state responsibility to provide support where alternative sources are absent. Justified criticism of the inefficient performance of many public sector seed activities is sometimes confused with the incorrect assumption that no public funds should be invested to improve seed supply. Where it can be demonstrated that particular groups of farmers will not have access to improved seed supply without public intervention, then that intervention can be justified as long as it can be demonstrated that the investment of public funds yields high social returns.

Training and technical support

One of the most important investments of public funds for supporting seed systems is in the area of training and technical support. The state often has a comparative advantage in providing information and technical advice that no community group or commercial enterprise would be able to develop on its own. Seed policy should ensure that information and training systems are in place to help develop integrated seed systems. The provision of training and technical support should also include a realistic assessment of seed production capacities, however. Even small-scale seed production requires a certain minimum of resources and skills. The goal of assuring widespread seed availability should not be confused with the (often false) assumption that the poorest farmers can be converted into seed producers.

Organizational innovations for variety development and seed provision

In integrated seed systems, varietal development and seed provision will depend not only on conventional seed sources but also on organizational innovations, many of which combine elements from the public, commercial, and voluntary spheres. This section discusses a few of the possibilities.

It is not likely that commercial enterprises will be able to assume complete responsibility for plant breeding. Public sector plant breeding will need to continue research on long-term issues (Knudson 1990) as well as carry out adaptive plant breeding and variety selection for crops and varieties that are important to farmers but are unlikely to attract commercial interest. This latter research is likely to require location-specific strategies, and there is much scope for farmer participation, often fostered by partnerships between public sector plant breeders and community groups, that can help identify farmer priorities and organize variety testing and selection (Sperling et al. 1993; Maurya et al. 1988).

Seed of public sector varieties is now less likely to be produced by public or parastatal seed companies. For public varieties that attract high and continuous demand for seed, commercial companies will be able to develop partnerships with public breeding institutions. For varieties that farmers are able to maintain on their own, innovative strategies for the distribution of initial seed supply are needed. This may require a modest public investment, but will be much more efficient than the pretence of a full-fledged public seed production enterprise. Grisley (1993) describes a successful pilot project in Zambia where small quantities of seed of a new bean variety were distributed to selected farmers. Sperling et al. (1994) describe experiences in Rwanda where seed of new bean varieties was successfully sold in local markets, both directly by research staff and through merchants. Such activities may well be self-sustaining, or at worst would require a small subsidy to provide seed to farmers who otherwise would not have access to it. Activities such as seed fairs

(Tapia and Rosa 1993) can also help spread knowledge about the existence and availability of crop varieties.

Several Latin American countries now have experience with artisanal seed production, where local farmers are provided with training and technical support from public institutions (Lepiz et al. 1994). The farmers follow seed production techniques appropriate for local conditions and resources and are expected to sell or exchange the seed they produce beyond their own needs. In some cases small cooperatives have been formed, or seed production has become a part of an existing cooperative's activities (Janssen et al. 1992).

Small-scale commercial seed production is also an option. After the collapse of the parastatal Ghana Seed Company, the Sasakawa Global 2000 project supported the development of a private seed industry for maize and other crops, where small private producers, often family enterprises, establish their own links with input dealers for marketing their seed. The seed producers receive support and training from the Ghana Seed Inspection Unit (Bockari-Kugbei 1994). In Nepal, the Department of Agriculture helped train and establish "private producer sellers", farmers who are trained in seed multiplication, provided with foundation seed and technical advice, and then given responsibility for selling their seed in local markets (Bal and Rajbhandary 1987).

Where seed must be supplied to farmers in large quantities, but commercial firms are unwilling to enter the market, public agencies may ask for tenders to provide specified types and amounts of seed. In many cases, this will be preferable to the maintenance of an unprofitable parastatal seed enterprise. Public contracting to the private sector is not without problems, however, including many of the same challenges of monitoring contract fulfilment and quality control that plague public seed enterprises (Smith and Thomson 1991).

The public sector can encourage the development of associations of small-scale seed producers and seed merchants. This is particularly useful for achieving economies of scale in the provision of information and training. Local seed producer groups have been established in some areas of Nepal, and a seed entrepreneurs' association has been formed whose representatives contract with small-scale seed producers. Such associations must respond to the needs of their members, however. Crissman (1989) reports on the unsuccessful top-down attempt to promote seed potato growers cooperatives in the Philippines.

Seed regulatory frameworks

As organizational options for variety development and seed provision are devised, seed regulatory frameworks must adjust accordingly. This section discusses issues related to seed regulation, beginning with some institutional considerations, followed by a discussion of relevant policy factors, and concluding with an outline of some specific regulatory options.

Beyond regulation and deregulation

Discussions about the trend toward seed sector privatization are often accompanied by suggestions for deregulation. But it is important to realize that a replacement of public sector seed production by commercial seed enterprises is not necessarily accompanied by diminished seed regulatory responsibility. A more useful approach to seed regulation is to specify the aspects of quality control and consumer protection that need to be addressed and then identify the most effective strategies.

There are three challenges that any seed regulatory framework must confront: how to set standards for the type of varieties that are available and the quality of seed that is sold, how to monitor the degree to which these standards are followed; and how to enforce compliance with the standards. In many commercial transactions involving other commodities, little or no regulation is needed. Buyers use markets to express their preferences and to reject firms that provide unacceptable quality, and sellers are careful to maintain high standards and respond to consumer preferences. But when information is unequally distributed among buyers and sellers, when markets are not competitive (and exit is not an option), or when the risk of externalities exists, some type of formal regulation may be called for. Seed systems at different stages of development and complexity will thus have different needs for regulation.

Regulation may be provided in several ways. The most common instance in the case of seed regulation is for a government body to be responsible for regulatory tasks, but this is not the only option. Some regulatory responsibilities may be placed in the hands of the seed industry itself; this might take place through a seed industry association that performs some regulatory duties. Consumers should be a third participant in regulation, through such entities as farmer associations. Finally, some regulatory duties may be carried out by autonomous bodies such as an independent seed certification agency.

Thus regulatory options for integrated seed systems may involve several distinct duties and participants. A wide range of combinations is possible. The state may define standards for seed quality, for instance, and a seed producer association may be responsible for enforcing the standards by applying sanctions to firms that are found deficient; or producers and consumers may have a more prominent role in defining standards while the public sector takes responsibility for enforcement. Appropriate regulatory formats will depend on technical issues related to seed production as well as on the status of exit and voice among seed users. Policy must promote the possibility of flexibility in regulation. As stated by Ayres and Braithwaite (1992): "for the responsive regulator, there are no optimal or best regulatory solutions, just solutions that respond better than others to the plural configurations of support and opposition that exist at a particular moment in history".

Policy considerations in establishing seed regulatory frameworks

Policy decisions must be taken regarding the degree to which seed regulation is necessary, and which sectors should be assigned responsibility for various regulatory tasks. An examination of capabilities and resources is necessary. It makes no sense, for instance, to propose public agency monitoring of seed quality if funds are not available for seed inspectors. Several factors must be considered in establishing seed regulatory frameworks, including the identification of appropriate standards, the possibility of different regulations for different types of seed systems, and the development of farmer participation in the regulatory process.

A common deficiency of many seed regulatory systems is the mismatch between regulatory standards, on the one hand, and farmers' needs and conditions, on the other. Conditions for variety release may include criteria for distinctness, uniformity and stability (DUS) that are of little interest to farmers who continually select and adapt materials, or value in cultivation and use (VCU) criteria that are not appropriate to farmers' circumstances. Similarly, conditions for seed certification or seed quality established by formal regulatory systems may bear little relevance to farmers' real needs (Tripp 1995).

The concept of integrated seed systems highlights the fact that farmers' seed requirements are not homogeneous. Policy makers should be prepared to design different seed regulatory regimes for different groups of farmers. The targeting of seed regulatory mechanisms will help make alternative seed systems more viable.

A final policy issue is farmer participation in seed regulation. Paul (1992) points out that many public regulatory services are characterized by low exit and high voice. That is, once a particular regulatory system is established, it is difficult for consumers to switch to an alternative; but accountability can be improved by exerting consumer pressure. This might be accomplished by increasing farmer representation in regulatory bodies, or by empowering public interest groups to play a stronger part in the regulatory process (Ayres and Braithwaite 1992).

Innovations for seed regulation

The following discussion identifies some possible innovations for conventional seed regulatory systems that can improve the effectiveness of integrated seed systems.

Variety release requirements may be made more flexible. Variety release committees often do not have access to sufficient information about farmers' priorities, leading to many instances where released varieties fail to be adopted, or where farmers select or improve upon discarded breeding lines to develop their own varieties (Maurya 1989). Wider farmer or community participation in release decisions will be partially achieved through participatory plant breeding methods, but consideration should also be given to developing more farmer representation on release committees. More flexibility in the timing of variety release will also be helpful. Zambia allows varieties that are popular with farmers to be multiplied and distributed while they are still undergoing testing for final release (Danagro 1988, cited in Cromwell et al. 1992).

The adoption of more realistic standards for seed certification and quality control also needs to be considered. A useful set of guidelines for 'quality declared seed' has been produced by FAO (1993). Its basic elements include the establishment of national lists of varieties that are eligible for seed production, registration and monitoring of seed producers, and some government supervision of seed sale. One of the strengths of these guidelines is their flexibility and allowance for adjustment to changing conditions.

The exploration of more flexible seed regulations may seem to clash with national efforts to establish seed regulations consistent with international seed trade. However, small-scale seed production programs can be made subject to separate regulatory standards. This option is now being discussed as part of the harmonization of seed laws for southern Africa, for instance (Commonwealth Secretariat 1994).

The decentralization of national seed regulation services is a possibility (Cromwell et al. 1992), although this is likely to be more productive when accompanied by a devolution of decision-making responsibilities as well. Incentives might be provided for the establishment of regional level regulatory bodies that include the participation of seed producers and fanners. Garay et al. (1988) describe how an ineffective national seed certification authority in Bolivia was replaced by several regional seed boards that were established when local seed producer associations offered to help fund government operations. The regional boards developed their own certification standards and included the participation of a range of local seed producers, including large private companies. government programs and NGOs. The regional boards stimulated the formation of a national seed board and, ultimately, a revitalized and more relevant national seed law.

There are various opportunities for seed regulatory agencies to collaborate with commercial or local seed enterprises, or to depute regulatory duties to them. In hill areas of Nepal, the government instituted a system of local level seed production that assigns extension agents responsibility for maintaining seed standards (Bal and Rajbhandary 1987). Where seed enterprises are well established, they can be licensed to carry out seed certification duties themselves.

In local seed production projects, where seed is produced and sold within a community, farmers' familiarity with production conditions and management may obviate the need for formal seed certification. Scheidegger et al. (1989), for instance, describe 'neighbour-certified' potato seed in a Peruvian project where seed-producing farmers purchased small quantities of basic seed, multiplied it, and sold the product to local farmers. There are also opportunities for strengthening farmers' capacity to monitor the quality of seed available from the formal sector by providing training and support for simple seed testing techniques.

Conclusions

Criticism of the performance of the public seed sector in many countries should not be allowed to grow into general pessimism about the public role in seed system development. Indeed, the growing recognition of commercial and community capacities to contribute to integrated seed systems presents new challenges for public seed policy. A dynamic and responsive national seed policy is required to promote experimentation with innovative seed options and to synthesize and interpret the results. The state contribution to actual seed production may well diminish, but responsibilities for providing technical advice and information, as well as for providing incentives for developing seed systems to serve the more disadvantaged farmers, deserve added emphasis.

The consideration of seed provision options should move beyond the restrictions of the public/private dichotomy. Instead, it should take advantage of the entire range of potential contributors to integrated seed systems and the possibilities for collaboration and coordination. A wide spectrum of organizational options for improving seed provision is available, but choices must be made taking consideration of technological, economic, and institutional conditions. In particular, the viability of any organizational innovation depends in large part on the strength of the options of exit and voice for farmers and seed enterprises. These in turn depend on the strength and equity of local markets and political processes.

Similarly, the design of regulatory options for integrated seed systems does not revolve around the issue of regulation versus deregulation. Instead, it involves careful consideration of the standards that are appropriate for specific situations, judgement regarding when some type of outside regulation is required, and identification of the best way to balance the interests of the state, seed enterprises, and farmers in the regulatory process.

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Genotype x Environment Interaction, Decentralized Breeding and Farmers' Participation

Salvatore Ceccarelli, Stefania Grando and Robert H. Booth[*]

Introduction

Formal, or institutional, breeding has been highly efficient in improving yield levels of several crops. However, its efficiency has remained largely confined to favorable environments, or to environments which could be made favorable by adding fertilizer and irrigation, and by chemical control of weeds, pests and diseases. Therefore, it comes as to no surprise that "in the developing countries, an estimated 13 to 18 million people, mostly children, die from hunger, malnutrition, and poverty related causes each year. That is about 40,000 people a day or 1,700 people an hour" (Speth 1993).

Although resource-poor farmers practice approximately 60% of global agriculture, and produce 15-20% of the world food (Francis 1986), they have not known the benefit of the green revolution. Some 1.4 billion people are dependent on agriculture practiced in stressful environments (Pimbert 1994).

Because of its success in good environments, the characteristics and the assumptions of formal breeding are not questioned, even when the objective is to improve yield and yield stability for poor farmers in stressful environments.

Typical characteristics of formal breeding programs are: i) they generally produce genetically uniform cultivars (pure lines, clones, hybrids); ii) they are largely conducted either in good environments or in highly uniform experiment stations where growing conditions are optimum or near-optimum; in most grain crops, selection is almost exclusively for grain yield and disease resistance; iv) they promote cultivars which can be grown over large areas (widely adapted in a geographical sense); and v) they do not involve the clients (farmers) in any of the steps which will eventually lead to new cultivars, except perhaps in the final field testing of a few promising lines.

Assumptions of formal breeding programs are that i) selection must be conducted under good growing conditions where heritability is higher, and therefore response to selection is also higher; ii) yield increases can only be obtained through replacement of locally adapted landraces (Brush 1991) which are low yielding and disease susceptible; iii) breeders know better than farmers the characteristics of a successful cultivar; and iv) when farmers do not adopt improved cultivars, it is because of ineffective extension and/or inefficient or insufficient seed production capabilities: the hypothesis that the breeder might have bred the wrong varieties is rarely considered.

The implicit assumption is that what has worked well in favorable conditions must also be appropriate to unfavorable conditions, and very little attention has been given to developing new, breeding strategies for less favorable environments.

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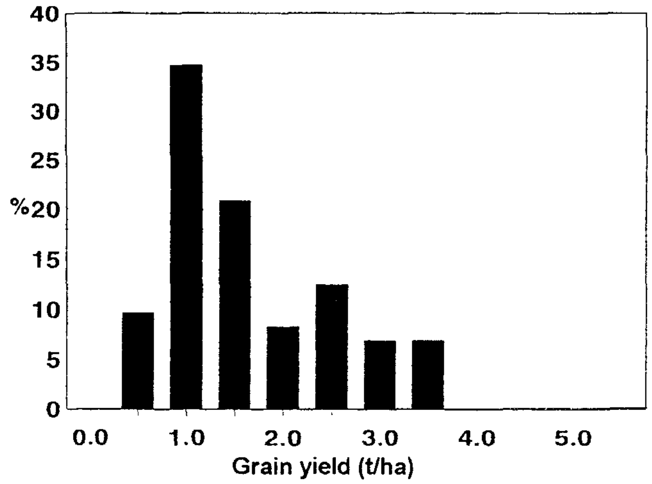
In the last few years, there has been mounting evidence that these assumptions are not valid, and that the special problems of marginal environments and their farming systems must be addressed in different ways.

Agricultural diversity in unfavorable environments

Throughout this paper unfavorable environments are defined as those where crop yields are commonly low due to the concomitant effects of several abiotic and biotic stresses. Most of our conclusions are based on a model represented by the semi-arid areas of Syria, where barley-livestock is the predominant farming system. In these areas not only low annual rainfall, but also rainfall distribution, low winter temperatures, high temperatures and hot winds from anthesis to grain filling are important abiotic stresses. The frequency, timing, intensity and duration of each of these stresses, as well as their specific combinations, vary from year to year. However, low yields of barley are common, crop failures occur one year out of ten, and yields of 3.0 t/ha or more are expected less than 15% of the time (Figure 1). In these areas the use of inputs such as fertilizers, pesticides and weed control is uneconomical and risky for resource-poor farmers. Therefore, the adoption of improved agronomic practices has been limited, and the most economic solution is to increase crop yields through breeding.

Figure 1 Frequency distribution of barley yields in unfavorable environments (less than 250-300 mm annual rainfall) in Syria between 1983 and 1994.



Many of the environments where improved technologies in general, and improved cultivars in particular. have had little or marginal impact have some characteristics in common with those described for the semi-arid areas of Syria. These are as the unpredictability and variability of climatic conditions, and the consequent high probability of crop failures which discourages the use of inputs.

A typical characteristic of the agriculture practiced by resource-poor farmers in these types of environments in many regions of the word is diversity, both intraspecific and interspecific (Martin and Adams 1987). Different crops are grown in the same field at the same time (intraspecific diversity). and the cultivars of the different crops are often genetically heterogeneous (interspecific diversity). A second level of interspecific diversity is obtained by growing. at the same time and in the same field. different cultivars of the same crops (Haugerud and Collinson 1990). The dry areas of

West Asia and North Africa are no exception, and in the case of barley the cultivars which are grown at present, and which have been grown for centuries, are genetically heterogeneous landraces (Ceccarelli et al. 1987; Weltzien and Fischbeck 1990; Ceccarelli et al. 1995).

This diversity is in clear contrast with the uniformity pursued by formal breeding and production practices in most crops grown in favorable environments, and is one of the causes for a different mechanism of seed supply. Whilst in high input agriculture served by formal breeding the seed market is the main source of seed supply, particularly for grain crops, in resource-poor agriculture the seed is usually produced on the farm, after some form of selection done by the farmer, or it is purchased from neighboring farmers (Almekinders et al. 1994). Formal breeding thus not only tries to replace diversity with uniformity, but also tries to reach farmers with the seed of new cultivars through mechanisms and institutions which are not familiar, are not efficient, and often are not trusted by resource-poor farmers.

Genotype by environment interaction

Genotype x environment (GE) interaction is almost unanimously considered to be among the major factors limiting response to selection and, in general, the efficiency of breeding programs. GE interaction becomes important when the rank of genotypes changes in different environments. This change in rank has been defined as a cross-over GE interaction (Baker 1988).

GE interactions in general, and GE interactions of a crossover type in particular, are among the major causes of the failure of formal breeding programs to serve resource-poor farmers. Therefore, the question of how frequently these interactions occur is important.

Examples of GE interactions of the crossover type can be found in the literature in a range of crops and environments, and for various stresses (Ceccarelli 1994, 1996a, 1996b), and a general case of GE interaction of a cross-over type is given in Figure 2.

In general, when different genotypes of a given crop are evaluated in a sufficiently wide range of environments, GE interactions of a cross-over type seem to be very common. This indicates that, as a general phenomenon, genotypes selected under optimum growing conditions do not perform well under poor growing conditions, and vice-versa. This is hardly surprising as physiologists have long recognized, with specific reference to drought, that high yield in favorable conditions and high yield in unfavorable conditions are associated with different physiological mechanisms and different phenologies (Hsiao 1982; Blum 1993).

The range of environments in Figure 2, and their associated yield levels, may represent either variation over time within one given geographical area, or variation over space (different geographical areas within or across countries). We assume that the yield levels below the cross-over point are fairly representative of variation over time within a given geographical area. In areas of this type, the probability of climatic events that will determine yields above the cross-over point is possible but rare as shown in Figure 1.

The implications of a cross-over GE interaction have been discussed by Ceccarelli (1989). Hildebrand (1990), Stroup et al. (1993), Simmonds (1991) and Ceccarelli (1994). Formal breeding has taken a negative attitude towards GE interaction, and, because selection is frequently conducted only in high yielding conditions, has been unable to serve farmers in environments which are at the other side of the cross-over point (Figure 3). Figures 2 and 3 indicate that breeding for environments below the cross-over point must be based on direct selection in the target environments because the best genotypes for these environments can only be identified if selection is done in unfavorable environments.

Figure 2 Cross-over type of G x E interaction: A and B are typical genotypes selected in high and low yielding environments, respectively.

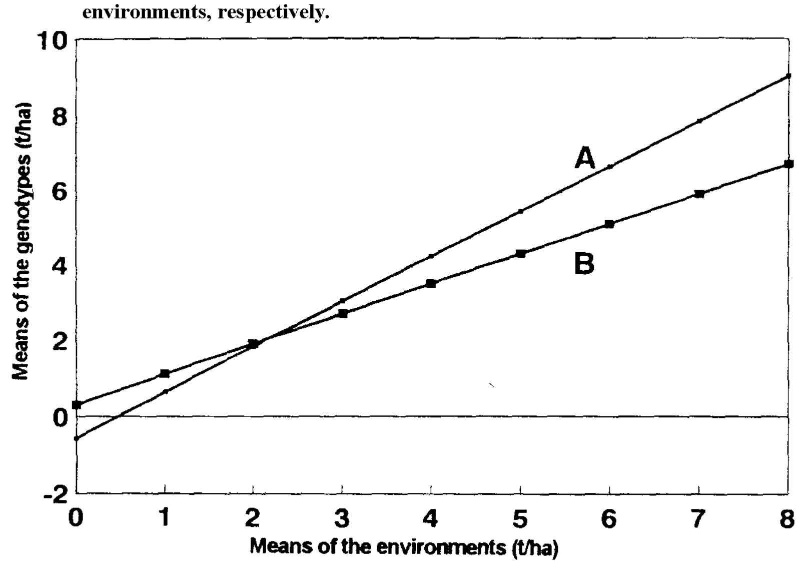
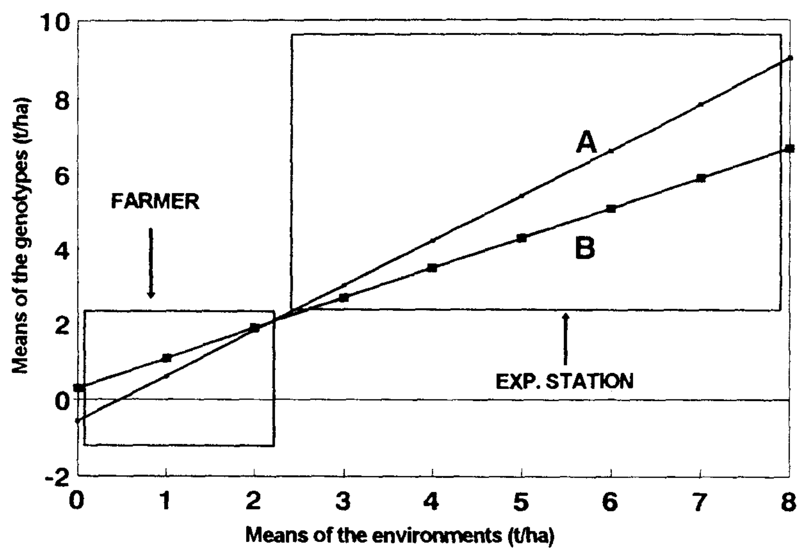


Figure 3 Hypothetical GE interaction of cross-over type between experiment stations and farmers fields.



Selection in unfavorable environments

The conclusion of the previous section is implemented by only a minority of breeding programs. This is because many breeders believe that heritability in unfavorable environments is too low and therefore it is not possible to make substantial progress with breeding. The belief is largely groundless. Theory of indirect selection shows that response to selection done in a different environment is a function of not only heritability but also of the genetic correlation coefficient between the selected trait measured in the two environments. Moreover, the evidence that heritability in stress environments is lower than in non-stress environments is not as obvious as many breeders claim (Ceccarelli 1996b).

Using a methodology for barley breeding at ICARDA described by Ceccarelli et al. (1996), selection conducted in unfavorable environments revealed that locally adapted landraces could be a useful source of breeding material that would have been missed had the selection taken place only in high yielding environments (Table 1). In Table 1 the term landrace refers to pure lines isolated by pure-line selection from Syrian landraces. The data of Table 1 would suggest that repeated cycles of selection in a given type of environment will reduce the frequency of lines specifically adapted to other environments. This explains why testing lines in marginal environments, after a number of cycles of selection in near-optimum environments, has led many breeders to believe that the expected gains with breeding for marginal environments are small. Table 1 also shows that not only do landraces have, as a group, a higher average yield under stress than non-landraces, but that there is considerable variation within landraces. Also, the landraces with the lowest yield under stress always yielded much more that the lowest yielding non-landraces in the same group. The presence of useful diversity within landraces has been documented in many crops. The diversity within barley landraces collected in Syria and Jordan has been documented by Ceccarelli et al. (1987), van Leur et al. (1989), Weltzien (1988, 1989), Weltzien and Fischbeck (1990) and Ceccarelli et al. (1995).

Exploitation of the diversity within barley landraces, an ongoing activity in the barley breeding program at ICARDA during the last 10 years, has been a powerful means to improve barley yields in marginal environments and in areas where the landraces are the predominant cultivars. Arta, a recently released barley variety, and Tadmor and Zanbaka, two lines adopted by farmers but not released, are a good example of the usefulness of the diversity within landraces. Arta, Tadmor and Zanbaka are pure-lines derived from individual heads collected in farmers fields in Syria. They have been consistently outyielding by over 20% the landrace from which they were selected in many trials and in many locations in Syria without addition of external inputs (Table 2).

Table 1 Grain yield (kg/ha) under stress (YS) and grain yield under non-stress (YNS) of barley breeding lines classified according to the germplasm type.

			Yield under stress[b]		Yield under non-stress[c]	
Set[d]	Type of germplasm	Number	Yield	Range	Yield	Range
1	Non-landraces	155	488	0-893	3,901	2,310-4,981
	Landraces [a]	77	788	486-1,076	3,413	2,398-4,610
2	Non-landraces	207	589	197-1,101	5,400	3,558-6,962
	Landraces	43	734	468-954	4,435	2,883-5,728
3	Non-landraces	296	634	0-1,119	2,687	1,241-3,893
	Landraces	83	802	414-1,203	2,513	1,829-3,738
4	Non-landraces	165	525	196-852	3,631	1,339-4,862
	Landraces	76	764	567-990	3,275	1,378-4,309

[a] Group of lines tested in the same locations and years
[b] Average yield in low yielding sites.
[c] Average yield in high yielding sites.
[d] Pure lines selected from landraces.

Table 2 Average increase in grain yield in on-farm trials (kg/ha) over the local landraces of three barley lines obtained through pure-line selection from the two landraces commonly grown in Syria.

Line	Number of environments'	Grain yield	% increase
Arta	51	2,433	22.3
Tadmor	11	780	23.6
Zanbaka	8	945	22.4

[a] Location-year combinations.

These data provide a strong indication that a) it is indeed possible to make progress with selection under unfavorable conditions, and b) that a large amount of potential improvement in unfavorable environments is missed by breeding programs using only selection in favorable conditions and neglecting the locally adapted germplasm.

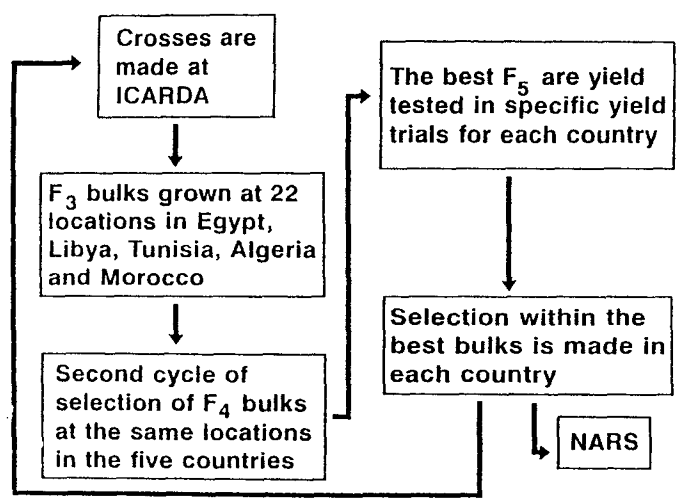
Decentralization: using specific adaptation in international breeding programs

The interaction between international and national plant breeding programs has been largely a one-way process where international programs develop germplasm, distribute it as international nurseries, and national programs test and eventually release selections as varieties. This top-down approach (Simmonds and Talbot 1992) has excluded the use of locally adapted germplasm, which often performs poorly in favorable conditions or experiment stations, and has, in fact encouraged its displacement.

The adoption of a positive interpretation of G x E interactions by international breeding programs has been advocated by ICARDA as a way to address the needs of small, resource-poor farmers, who have been by-passed by the Green Revolution. To exploit specific adaptation fully and make positive use of G x E interactions, an international breeding program needs to devolve most of the selection work to national programs by gradually replacing the traditional international nurseries with earlier generation, segregating material. Early distribution of breeding material reduces the danger of useful lines being discarded because of their relatively poor performance at some test sites.

In 1991 ICARDA's barley breeding program started a gradual and programmed process of decentralization of selection work to the four Maghreb countries of North Africa (Ceccarelli et al. 1994). National programs in North Africa receive now from ICARDA's barley breeding program only targeted F2 segregating populations (based on crosses partly designed by national programs or using parents identified by national programs), and yield trials consisting of lines derived from these Fes selected in-country. Selection between F2 populations is done in the different agroecological environments within each country under conditions as similar to fanners' fields as possible. Lines selected from superior F2 populations are advanced at ICARDA and then yield tested in different locations within each country (Figure 4).

Figure 4 Decentralization of an international breeding program: the example of ICARDA's barley breeding decentralized in North Africa.



However, decentralization to national programs will not respond to the needs of resource-poor farmers if it is only a decentralization from one experiment station to another. If we are to exploit the potential gains from specific adaptation, selection needs to be practiced by farmers under their own conditions. This may be viewed as an example of extreme decentralization.

Maximizing specific adaptation through farmers' participation

The idea of farmers participating in the development of new technology is not new. It was introduced in 1982 (Rhoades and Booth 1982) as the fanner-back-to-farmer model, later modified into the farmer-first-and-last-model (Chambers and Ghildyal 1985) and more recently discussed by Sperling et al. (1993) and Stroup et al. (1993). Using Sperling's terminology, formal breeding programs can be described as a sequential and cyclical process in which 1) an extremely large amount of genetic variability is continuously created, 2) this variability is drastically reduced through selection (we have seen that this is often done in conditions which have little in common with those of resource-poor farmers), and 3) the few lines surviving step 2 are presented to farmers who are asked to verify if the choices made for them are appropriate (Figure 5A).

The process has been very effective for those farming systems which are sufficiently similar or not too dissimilar from those on experiment stations. It has however been used as a model even for target environments very different from those of experiment stations, and it is now acknowledged that the process has been ineffective for unfavorable environments. The reason is likely to be associated with GE interaction. It is also possible that the plant characteristics which are used as selection criteria in a high yielding environment, such as an experiment station, are not those which give the future variety an advantage when grown by a resource-poor farmer. Indeed, there is evidence that when farmers are involved in the selection process, their selection criteria may be very different from those of the breeder (Hardon and de Boef 1993). There is also evidence that, when breeders and farmers select in the same environment, farmers' selection can be effective (Sperling et al. 1993) implying that farmers possess considerable knowledge which is almost totally neglected in formal plant breeding programs.

A typical example of different selection criteria between farmers and breeders can be found in crops, such as barley, used as animal feed. Breeders often use grain yield as the sole selection criterion which usually brings with it high harvest index and lodging resistance. However, in unfavorable environments lodging is often not a problem because of moisture stress, and farmers are interested not only in grain yield, but also in forage yield and in the palatability of both grain and straw.

Farmers' participation in the ICARDA barley breeding program to date has been informal and consisted of discussions during field visits and occasional inspection and selection by farmers of breeding lines. The most significant contribution of this informal participation has been the incorporation by the breeders of plant height under drought and softness of the straw as selection criteria in breeding barley for dry areas. A crop which remains tall even in very dry years, is important to farmers because it reduces their dependence on costly hand harvesting, while soft straw is considered important in relation to palatability. It is obvious that these two characteristics represent a drastic departure from the typical selection criteria used in breeding high yielding cereal crops -short plants with stiff straw and high harvest index. It is also obvious that cultivars possessing the two characteristics considered important by farmers in dry areas will not be suited for cultivation in high yielding environments because of their lodging susceptibility - a further indication of the importance of specific adaptation. Lines extracted from Syrian barley landraces show little variation in straw softness but considerable variation, both between and within collection sites, for plant height. The most promising avenue to improve plant height under drought is offered by the use of the wild progenitor of cultivated barley (H. vulgare ssp. spontaneum), still widely distributed along the Fertile Crescent where, particularly in the driest areas, it can be easily identified at a distance because of its tallness. Table 3 shows the tallest of 1,532 most recently developed breeding lines tested in 1994/95 at a site which received only 222 mm rainfall. While the mean plant height of all the lines was 23.5 cm, the shortest lines were only 12.5 cm tall, and the most widely cultivated landrace (Arabi Aswad) was about 25 cm, some of the lines derived from crosses with H. spontaneum were taller than 40 cm. They were also significantly taller than Zanbaka, a pure line selected from A. Aswad and already grown by some farmers for its plant height.

A formal plant breeding program could combine the concept of a positive use of GE interaction with the utilization of farmers' knowledge by evaluating a wider range of germplasm under farmers' field conditions and in conjunction with farmers (Figure 5B). In those communities where extension services and conventional seed production systems are not able to reach resource-poor farmers, and farmers traditionally use their own seed from one cropping season to another, this will provide a direct link between formal plant breeding and farmers. The benefit to the farmers will be direct access to improved germplasm. The benefit to all the community will be the maintenance of genetic diversity within a crop because different farmers are likely to select different materials. Eventually, the benefit to formal breeding programs could be a higher efficiency by using farmers' selection criteria.

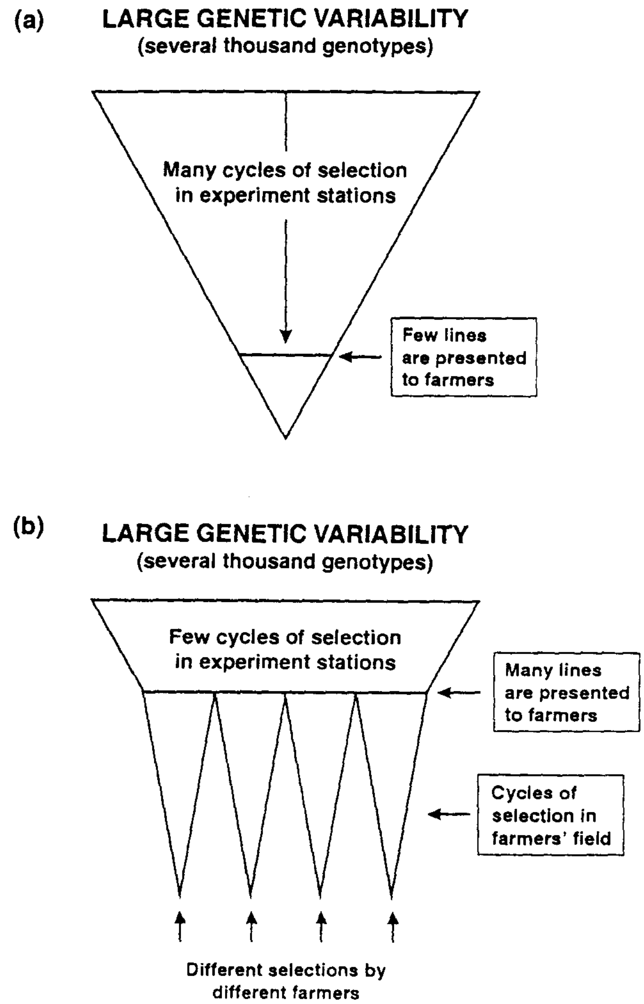
Table 3 Plant height at Breda (222 mm rainfall) in 1995 of barley lines derived from crosses with H spontaneum, compared with the barley landrace most common in dry areas (Arabi Aswad) and with a cultivar selected specifically for plant height under drought (Zanbaka).

Cross/Name	Plant height (cm)
H. spontaneum 20-4/Arar 28//WI2291/Bgs	43.5
SLB 45-40/H. spontaneum 41-1	43.0
Zanbaka/H. spontaneum 41-2	42.5
Zanbaka/H. spontaneum 41-2	41.5
Moroc 9-75/Arabi Aswad//H. spontaneum 41-3	41.0
Arabi Aswad	24.8
Zanbaka	26.0
Mean of all breeding lines	23.5
maximum	43.5
minimum	12.5
L S.D.$_{0.05}$	5.6

Conclusions

This paper has shown that, for a typical crop of marginal and unpredictable environments such as barley, it is possible to exploit genetic differences for specific adaptation to marginal environments under farmers' conditions and improve yield without additional inputs. Breeding for specific adaptation not only offers a solution to how to improve agricultural production in marginal environments, but can do so in a sustainable way. This breeding philosophy, based on a positive interpretation of GE interaction, is in contrast with the common belief that the introduction of inputs, such as fertilizer and irrigation to raise the yield potential, is an essential prerequisite for successful breeding work. Breeding for an agronomically improved environment dictates the type of germplasm which will best exploit it, and is based on genetic uniformity - the reverse of the biological diversity requisite for minimizing risk in most natural systems (Wilkes 1989).

Figure 5 Schematic representation of formal (A) and participatory (B) breeding programs: in the first case farmers are only passive recipients of new varieties; in the second they participate from the early stages in the development of new varieties.



The use of high input selection environments in a market-driven agriculture has been largely responsible for the trend of modern plant breeding towards narrowing the genetic base of our crops accompanied by a trend towards homogeneity: one clone, one pure line, one hybrid (Simmonds 1983). Uniformity and broad adaptation are very useful attributes to accommodate large scale centralized seed production (Davis 1990).

Although the merits of genetic uniformity have been questioned in developed countries (Wolfe 1991), it is still very popular in breeding programs and seed production systems of developing countries at both national and international levels. This is in contrast with the genetic diversity that characterizes agriculture in marginal environments. Genetically heterogeneous landraces are still the backbone of agricultural systems in many developing countries, mainly in marginal environments where their replacement by modern, genetically uniform varieties bred for favorable environments has proved to be a difficult task at the level of inputs farmers can afford.

Breeding for specific adaptation to unfavorable environments implies a reevaluation of the role of genetic resources such as landraces which can play an important role because they possess adaptive features to these environments. This is the first consequence on biodiversity of breeding for specific adaptation.

A second consequence of exploiting specific adaptation on biodiversity is that the number of varieties (not necessarily homogeneous) of a given crop grown at any time will be large. The benefits of maintaining genetic diversity within a crop over large areas has been discussed extensively in the literature in relation to resistance to pests and diseases and does not need further justification. A major constraint of breeding for specific adaptation is the problem of how to distribute many varieties among farmers. However, the distribution of specifically adapted varieties to resource-poor farmers does not have to follow the conventional release-seed production-seed certification schemes used in developed countries. Indeed, there are examples of successful distribution and adoption of varieties through non-market methods (Grisley 1993).

The main conclusion of this paper is that resource-poor farmers and low-input agriculture can only be served by recognizing that breeding can be effective below the cross-over point. This view is not very popular, and consequently there are not very many examples to quote. The few which are available indicate that yield increases with varieties specifically adapted to unfavorable conditions, though far for being spectacular, are sufficiently large to stimulate not only adoption of the variety but also adoption of better crop husbandry. However, specific adaptation is not a very popular concept. Presumably becau se it does not bring the same prestige to the breeder as the concept of wide adaptation and is not in the interest of the seed industry.

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Seed Legislation in Developing Countries: Possibilities and Pitfalls for Seed System Development

Niels P. Louwaars[*]

Introduction

Historical aspects of seed law development

In many countries, the seed industry develops along a characteristic line. The government takes responsibility throughout the seed chain from variety development through multiplication to distribution. The resulting system can be characterised as a development oriented and research driven formal seed supply system (Louwaars 1994a). In this system, seed quality control tends to be done initially by the seed production organisation itself.

Disconnecting seed certification and control from the multiplication operation is commonly the first major change which is deemed necessary when the latter is being commercialised, either by a change of the public multiplication schemes into a parastatal organisation, or when competition is introduced in the seed system by allowing local and foreign seed companies to operate.

This is the moment that seed legislation is brought onto the political agenda. A seed law is necessary to give the seed quality control organisation the appropriate legal powers to enforce the rules and procedures that had been in operation on the basis of common understanding and acceptance. The head of seed quality control is then the person to ask for such a seed law and commonly takes the lead in the preparation of a draft even though this is the formal task of a committee, specially formed for this purpose. Countries differ in the width of the representation of such a committee. The technical knowledge and international contacts of the seed quality control representative is likely to overrule arguments of the less involved members of such a committee.

Common shape of seed legislation

Seed laws commonly concentrate on regulating the seed flow, including international trade, while concentrating on seed quality aspects. After the necessary definitions, it may establish a national body to monitor and regulate the seed sector (national seed board or council). A broad outline is prescribed for the operations of regulatory bodies, involved in variety release, seed certification and testing, and rules are established for marketing of seeds. A linkage is established with phytosanitary control legislation and sometimes plant variety protection legislation. In some cases, a particular section is devoted to measures to promote seed production through e.g. subsidy schemes for private seed companies or for seed growers, and a secured availability of pre-basic seed of public varieties to seed producers. Penalties for violators of the law conclude the mainframe of the law.

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Details are in most cases left to regulations which can be altered more easily as time goes by. These regulations contain, for example, composition and procedures for a variety release committee, methods and standards for certification and seed testing, etc.

Introduction to seed systems

In every country, different seed supply systems operate next to each other. The formal seed supply system is characterised by large scale production of seed of officially released varieties in a certification system. The local seed systems are characterised by small scale supply of locally known varieties without any government interference in quality control (Almekinders et al. 1994). In many countries, attempts are being made to combine these different systems through adaptive research or through relaxed seed quality control procedures. Louwaars (1994a & b) introduced the term integrated seed supply for such situations.

The importance of these seed supply systems in a particular situation is difficult to describe. A formal seed supply is common in commercial farming, whereas subsistence farming concentrates on local systems of seed supply. In many cases however, a farmer will use the formal system for some crops and local seed sources for other, or he will buy seed from the formal system once in order to obtain a particular variety, and produce his own seed from there onwards and share the new variety with neighbours and relatives.

Effects

Effects of the legislative procedure on seed systems

The procedure described above, whereby legislation appears on the agenda when seed quality control has to be formalised, has a significant influence on the resulting legislation, and thus on its applicability to the three major seed supply systems.

In the absence of persons who are at the same time technically and legally competent, copying foreign and often western laws seems the quickest way to proceed. Many Latin American seed laws heavily draw upon the Spanish law (Bombin Bombin 1980), French speaking African countries tend to take the French law as an example, and former British colonies borrow from the English example. The limitation of this procedure is that local conditions are not sufficiently taken into account.

The dominance of the seed quality control experts who are used to working in a strictly regulated system makes it very difficult for seed specialists from outside the formal seed sector to contribute significantly if invited to the committee at all. This means that only the formal sector is taken into account. In many cases, the law prescribes procedures and standards that represent more an ideal condition than the present capability of the seed producers.

The timing of drafting a seed law has an important influence on the resulting law. Drafting at the beginning of a privatisation process bears the risk that since most technically competent representatives are from the public sector, the resulting law protects the interests of these officials rather than supporting changes. When the drafting of the law is delayed until the private sector has gained some strength, there is a risk that farmer-to-farmer seed exchange is restricted beyond acceptable limits in order to assist the commercial interests of the private seed sector.

A general shortcoming in many countries is that an important fact is overlooked, ie. that a law should be the result of a policy. Without a clear policy on the future development of the seed industry, and in particular the level and speed of privatisation, the development of a seed law is likely to become an academic exercise. The technical and legal specialists thus take up an inappropriate task of policy development.

Effects of the law itself on seed supply systems

The strong influence of quality control officials in law development often results in a law where all the seed from all crops is supposed to be inspected and tested and should meet the certification standards without fail. An extreme case is a draft seed law of Turkmenistan, where planting of uncertified seed is prohibited. This means that farms are not even allowed to re-use easy-to-save seed such as wheat. In most cases however, the law prescribes that all seed that enters the market should be certified (Seed Statute of Uganda), as is the case in most European laws for field crops. This seems reasonable for consumer protection, but in many developing countries seed is sold or bartered quite succesfully on local markets in remote areas without any control.

The use of certified seed may be beyond the financial capabilities of farmers, and officially released varieties may even not be beneficial for the farmers concerned because of poor adaptation of the varieties and the cost of such seed from the formal sector. It has been reported that breeders are not able to release uniform varieties for all agro-ecological and socio-economic conditions throughout their target areas for all crops (Ceccarelli and Grando 1991). Too strict variety release procedures and seed quality requirements are in such cases not beneficial for the farmers and in addition these rules cannot be implemented.

This illustrates a major statement mentioned above; i.e. that the law prescribes an ideal situation (in the view of a formal seed supplier and a seed quality control official), rather than supporting the actual needs of farmers.

Even though Western European farmers are highly commercialised, western laws may even be more flexible compared to proposed legislation in developing countries. An example is the variety release procedure in the Netherlands, which is very strict for arable crops, including extensive tests for the value for cultivation and use (VCU) and distinctness, uniformity, stability (DUS), but very flexible and quick for horticultural crops, for which speed of introduction into the extremely dynamic sector is vital.

The strict seed legislation of many developing countries thus carries a strong bias towards the formal sector, and in many cases towards the public sector rather than private initiative. Such laws may have an important negative effect on the use of landraces of many crops, and thus on the in situ biodiversity of crop species. This way, governments that signed the biodiversity agreement may act against their own policies. Wall seed in the market has to comply with the law, local seed supply is outlawed, because of the absence of formal quality control. In practice however, this cannot be enforced, because of inadequacies in the infrastructure to control seed exchange among farmers and the use of seed from the food grain market.

Such legislation may however be a strong tool in the hands of those who wish to limit experiments with new and integrated methods of seed supply or actual operationalisation thereof Commercial seed suppliers could be such opponents, fearing a reduced market when researchers stimulate the farmers to retain new and non released varieties as part of their on-farm research activities, or when NGOs start to promote the use of farm-saved seed and the development of local seed specialists in rural areas. These could also be the ministry of agriculture itself and its seed quality control personnel, because they may be wary of a loss in influence when all kinds of people start to involve themselves in the seed sector.

It is, however, too easy to conclude that a seed law can by definition not support an integrated development of the seed industry.

Suggestion: a more open type of legislation

In order to allow seed supply to develop along different pathways for different crops and uses into a truly integrated supply system, alternative kinds of seed legislation are required. Such legislation should keep the consumers' interests of the users of certified seed intact, while allowing the local seed systems to operate without regulation.

This means that all provisions mentioned above should be operational for those seeds that require this (certified seed). Within this sector, differences may be made to accomodate locally used and exported seed, where regulations should be in harmony with those in the importing countries. The OECD Seed Schemes are a good guideline.

With very simple measures such as adaptation of a few vital definitions in the law, sufficient flexibility can be obtained.

Example 1

The draft law of the Russian Federation states the following: "Seed: plant or its segments used to reproduce a cultivar." If cultivar is defined as a distinct, uniform and stable population of plants, this could mean that only seed of recognised varieties is regulated by the law. The result of this is that seed of local varieties or seedlots that are not pure due to repeated local multiplication without field inspection (and thus not complying with the cultivar characteristics) could be freely distributed and used.

This also allows researchers to distribute seed of new varieties through on-farm trials and other means of participatory research.

Example 2

A law can also define seed as follows: "Seed: plant or part thereof meant to be used to reproduce the cultivar, and offered for sale in a labeled container." This means that seed can be marketed freely, but that as soon as a label is attached, it should meet the requirements of the law. The result is twofold: first, the certification system has to prove its value: seed suppliers will only ask for certification when the label is conceived as a valuable sign of quality. When the certification system is inefficient, expensive or even corrupt, seed producers have the liberty to bypass it. Second, seed growers that do not use the certification system cannot stimulate their sales through the use of a variety name (because they are not allowed to label their seed packs).

Example 3

A refinement of the second example above is the system, whereby all seed containers have to be labeled, but that certified seed bears the logo of the certification agency, showing the customer that the seed has been produced under the certification system, and that it meets the minimum standards. Any other seed can be regulated by a trueness to labeling - provision, whereby the supplier can attach a label for which there is only regulation that whatever is printed on the label has to be true.

A major disadvantage of this system is that when it is used in countries with a high illiteracy rate, marketing of the seed will concentrate on promotion and impressive labels rather than on real quality.

Conclusion

Seed legislation is necessary to regulate the formal seed industry in the interest of the seed users and the bona fide seed producer against unscrupulous businessmen. Such laws, however, concentrate on the formal seed sector only, thereby denying the existence of the local seed systems and obstructing the development of an integrated seed supply system. The main reason for this development is the limited representation of local groups in the law drafting committees and the fact that integrated seed supply as a system is still in a research phase.

An input from persons knowledgeable concerning the non-formal seed supply in the seed law drafting phase could bring about the minor changes in commonly used legislation necessary for an undisturbed local seed supply, and for the experimentation and implementation of integrated seed supply.

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Seed for Food Crops in Indonesia

Secondary Crops in Indonesian Farming Systems

A. Syarifuddin Karama[*]

Introduction

Diversity is a trademark of Indonesia. For our purposes, the diversity in agro-ecosystems and socio-economics is strongly related to farming systems. Within a similar agro-ecosystem, there are many variations in farming systems. The agro-ecosystems existing in Indonesia include technically irrigated, semi-technically irrigated, rainfed lowlands, uplands, tidal swamps, back swamps, high altitudes, low altitudes, wet climate, dry climate, and many combinations of soil types and climates, etc.

Almost all farming systems involve secondary crop(s). Under rice based farming systems, secondary crops occupy the second or the third crop in the early or late dry season. Under upland conditions, secondary crops are grown in intercrop with or after upland rice. Sometimes secondary crops are also grown interplanted in perennials such as rubber, coconut, coffee and others. Indonesia has a traditional term, palawija, meaning those annual crops grown after rice, including secondary crops as well as vegetables and industrial crops or even fish.

This paper describes several aspects regarding the importance of secondary crops under farming systems in Indonesia and their seed supplying systems. The secondary crops discussed in this paper are limited to soybean, groundnut, mungbean, maize, cassava and sweet potato.

Secondary crops in the food crops economy

The production of secondary crops and rice in several years are shown in Table 1.

Table 1 Production of some secondary crops and rice in Indonesia in million tons.

Crop	1984	1990	1991	1992
Soybean	0.77	1.49	1.55	1.87
Groundnut	0.53	0.65	0.65	0.74
Maize	5.29	6.73	6.25	7.99
Cassava	14.17	15.83	15.95	16.51
Sweet potato	2.16	1.97	2.04	2.17
Rice	38.14	45.18	44.69	48.24

Source: BPS 1987 and 1993

Based on the price of crops in 1992, the total contribution of these secondary crops to the national economy was about Rp 4.75 billion. If we add to this amount the price of other secondary crops such as mungbean and cowpea, the total value of secondary crops may reach Rp 5 billion or about one-third of the value of rice production which was about Rp 15 billion. Almost the entire harvest of secondary crops is sold.

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Position of secondary crops in farming systems

As indicated by the name, secondary crops are considered of secondary importance in fanning activities. However, these crops are also called cash crops because they are sold. Under limited resources, these crops are put in second priority in the system after rice. Whenever irrigation is available long enough for rice, farmers will grow rice. Therefore, secondary crops get limited irrigation or none at all. The same is true for spending on fertilizers, other resources and inputs. Thus, the productivity of the secondary crops is relatively low. In 1992 the yields were 1.12, 1.03, 2.20, 12.20 and 9.9 tons per ha for soybean, groundnut, maize, cassava and sweet potato, respectively.

However, due to the economic value of rice, which is gradually decreasing, some farmers reduce their rice growing area or cropping intensity to grow higher value crops including some secondary crops.

Many researchers have described the roles of diversification in farming systems. Some roles of secondary crops in fanning systems are listed:

- to help keep pest organisms below threshold levels. Some pest organisms on rice are different from those on secondary crops or other crops.
- to help keep soil nutrients in proper balance. The rate and intensity of nutrient uptake are different among rice and most secondary or perennial crops.
- to help maintain appropriate soil conditions. The alternating of puddle and dry, anaerobic and aerobic, wet and dry, changes the soil chemical, physical and biological conditions, eliminating some toxic substances such as organic acids, balancing different soil micro organisms and improving soil aeration.
- to maximize the use of land resources. Under limited irrigation supply, secondary crops can be grown instead of paddy.

Farming systems and seed supply

As described earlier, the secondary crops are grown in rotation with, or sometimes intercropped with, rice or perennials. Different crops have different behaviors in response to their environment, including the crop surrounding or preceding it. The interaction among different crop combinations or cropping patterns could be complementary, competitive or neutral, but neutral interactions rarely occur. Strong competitive interaction usually disappears from practice. Complementary interactions are desired by farmers. In reality these interactions occur at the same crop combinations, however, at different parts or growth stages of respective crops. Some crops may leave beneficial residues to the following crops, while others may leave negative residues. Some crops may be distressed by the shadow of others, while some other crops need a certain degree of light attenuation.

Under different land types, which may have different cropping patterns, the same crop may be grown in different seasons. Soybean is grown in upland early or late in the rainy season. In lowland paddy, soybean is grown after the first or second rice, which is late in the rainy season or in the dry season respectively. Maize is similar to soybean. Moreover, sometimes maize and soybean are intercropped. Groundnut and sweet potato are usually grown after rice late in the rainy season or early in the dry season, whether in upland or in lowlands. Mungbean and sorghum are usually grown late in the rainy season after rice.

A cropping pattern is usually dominant in a certain area. For example, soybean grown early in the rainy season is common in the upland areas of the eastern slopes of Bukit Barisan in North and East Aceh. Other large areas grown with soybean in the lowlands include the east coast of North and East Aceh, after paddy early in the dry season. A similar pattern of soybean production occurs in East and Central Java. Large areas are devoted to soybean in upland-hill slopes early in the rainy season. The much larger acreages of soybean are found in lowland paddy, after the first or second rice early or later in the dry season. The same pattern also applies to maize.

These phenomena have some implications for the seed supplying systems for these crops, particularly for soybean, because the seed quality easily deteriorates. The seed supply system is called *Jabalsim*, short for *Jalur benih antar lapang dan musim* meaning seed exchange between sites and seasons. Soybean in uplands grown early in the rainy season supplies seed to areas planted after paddy rice in lowlands, late in the rainy season or early in the dry season. In turn, this soybean supplies seed to areas planted after paddy late in the thy season. The upland soybean planted early in the rainy season obtains seed from areas planted late in the dry season. Upland soybean planted early in the rainy season get seeds from areas planted late in the dry season in paddy rice areas.

One matter that needs attention in the *Jabalsim* system is the quality of seed, which is the concern of seed certification. The concern is that many seedlings emerging from *Jabalsim* seeds are weaker and less uniform compared to seedlings from certified and well-managed seed production systems. Finally, this is expressed in the level of production achieved by fanners.

The seed supply for other secondary crops is not as difficult as for soybean, because these seeds do not deteriorate as easily as those of soybean. However, all seed production, handling, storage and marketing need to be improved further. This improvement can be started at the opkup farmer by adopting proper technologies such as seed production, handling and storage. This adoption may add to the cost and therefore to the price of seed.

To produce the best quality seed by the most efficient seed production systems, there are several factors that should be considered and, of course, these are strongly related to farming systems:

- Find the most suitable soil within the area for seed production. The most suitable soil will produce the highest yield at the lowest cost, with the best quality of the seed.
- Find the most appropriate time for growing the crop, with sufficient rainfall, sufficient solar radiation and low pest populations. Under this condition, irrigation and pest control costs are lower.
- The crop preceeding the seed crop and the seed crop itself should be different.
- Practice appropriate agronomic technologies, such as tillage, mulching, drainage, fertilizing, weeding, cost control, etc.

With these approaches, it is possible to obtain seeds at lower cost than those from existing systems, and these approaches can be applied within the *Jabalsim* system.

The Structure of Seed Trade and Production of Annual Crops in Indonesia

J. W T. Bottema[*]

Introduction

Modernization of agriculture involves adaption of production to demand. Since this takes place through time, in analysis one has to look at both medium to long term change, and short run change. In the long and medium run, locally differential expansions of demand for food and industrial products provide the determinants of spatial and temporal change in agriculture. In the short run, individual initiatives and investments in agricultural production, processing and trade, show the current course of events. Over the medium term, one observes structural change in the proportion of agriculture in GDP in Indonesia, estimated at 27% in 1979 and 23.5% in 1989 (World Bank 1992, current prices). In the same period, growth of the agricultural sector was around 3.5% per year. In the food crop sector, which occupies about 80% of the crop based agricultural sector (estate crops, fruits, vegetables and annual food and industrial crops), rice dominates. Its share went down slightly from 50.4% in 1983 to 48.6% in 1989. The share of secondary crops increased marginally in the same period from 29.1% to 29.8% (Ferrari 1994). Although not entirely up to date, these estimations confirm that secondary crops are of significant economic importance and that actual proportional (or structural) change is a medium and long term process.

Both medium and long run change and short run change are best analyzed with a specific commodity perspective and market in mind. One can distinguish various business options in agriculture and food crops, available to manufacturers, traders and farmers, as the mechanisms facilitating the adaption of production to demand. These options are determined by many factors, among others, infrastructure, market access to producer and consumer markets, and, specifically for producers, by climate and soil (biophysical factors).
Agriculture is by its very nature a business which needs a geographical and temporal approach. Analytical instruments of agriculture include classifications of spatial entities, explicit categories of determinants of options in crop choice and the seasonal flow of resource allocation. This paper looks at the seed markets for annual food and industrial crops in the medium and short run, and therefore uses as givens the spatial trends in urban and rural population and the variation of agro-climatic determinants in Indonesia. Medium term trends in the allocation of land based on monthly data provide avenues of analysis.

The determinants of the seed market are the local biophysical conditions which induce multi- and inter-seasonality in agricultural production. In Indonesia, consumption patterns still show signs of strong influence of seasonal shifts in availability of goods; these are especially strong in the eastern islands and the remoter areas of Sumatra and Kalimantan. Even in the rural areas of urbanized Java, one can observe seasonal influences in consumption. Medium term changes in consumption in urban and rural areas are usually associated with area

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specialization in crops and inter-regional trade in grain and seed, usually also with quality control. Seed supply and changes in the flows of seed between areas are determined by the on-going economic process of interaction between areas with differential comparative advantages in food and other crops.

In Indonesia, the demand for rice and secondary crops increases with population growth and to a small extend with income growth. However, the behaviour of processed goods is distinctly different, and shows more elasticity in demand with growing income (Altemeier and Bottema 1991; Roche 1988). The general characteristic of inelastic demand for food and industrial crops at the farm level makes it less attractive for private investment in seed, and, therefore, improvement of seed and farm technology; this is why the state generally invests in production technology and farm imputs such as water, fertilizer and also seed. Some authors say that shifts in factor prices (land, labour, money) stimulate or induce government support and investment; the outflow of resources in agriculture is thus partially replaced by centralized investment. Yet, such investment is in its effect dependent on the specific markets of commodities involved. Of the farm inputs of grains (rice and maize) and food legumes (soybean, groundnut, etc.), the price of seed hangs together with the price of grain because seed can be used both for food and as planting material. This means that enterprises can capture advantages by integrating processing and distribution activities with production of raw material. An investigation of the seed market will therefore reveal private and public efforts in ordering of the market, ie local integration between processing and production and spatial market segmentation through vertical integration or vertical diversification (Hedley 1987), whereas the actual adoption of improved varieties shows the influence of public R & D efforts.

This paper will analyze the structure and current development in the seed market and relate the analysis to the structure of food and industrial crop agriculture in Indonesia.

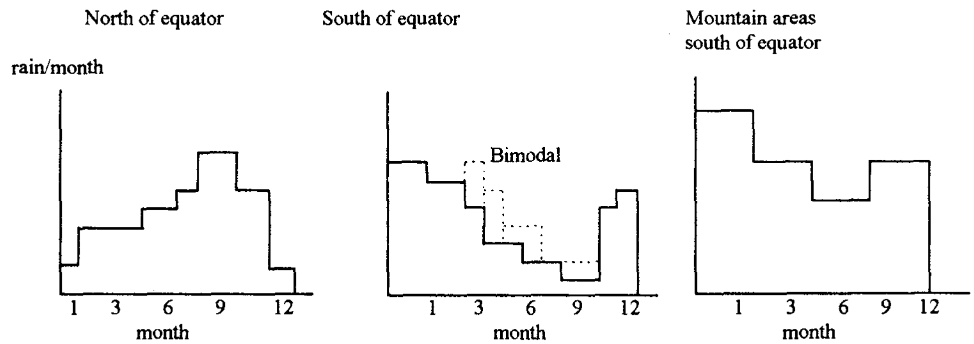
The structure of agriculture in Indonesia

The rainfall and radiation variation, temperature differences, and soil types in the regions of Indonesia result in high variability of agriculture (Dauphin and Bottema 1987) and a complex array of various comparative advantages in crop production, collection and processing and services of the regions (Djatihari and Rusastra 1990; Gijsbers and Altemeier 1989; Kasryno and Simatupang 1990; Pasandaran et al, 1991; Simatupang et al, 1990; Jierwiriyapant et al 1992; Roche et al. 1992; Pakpahan et al. 1990).

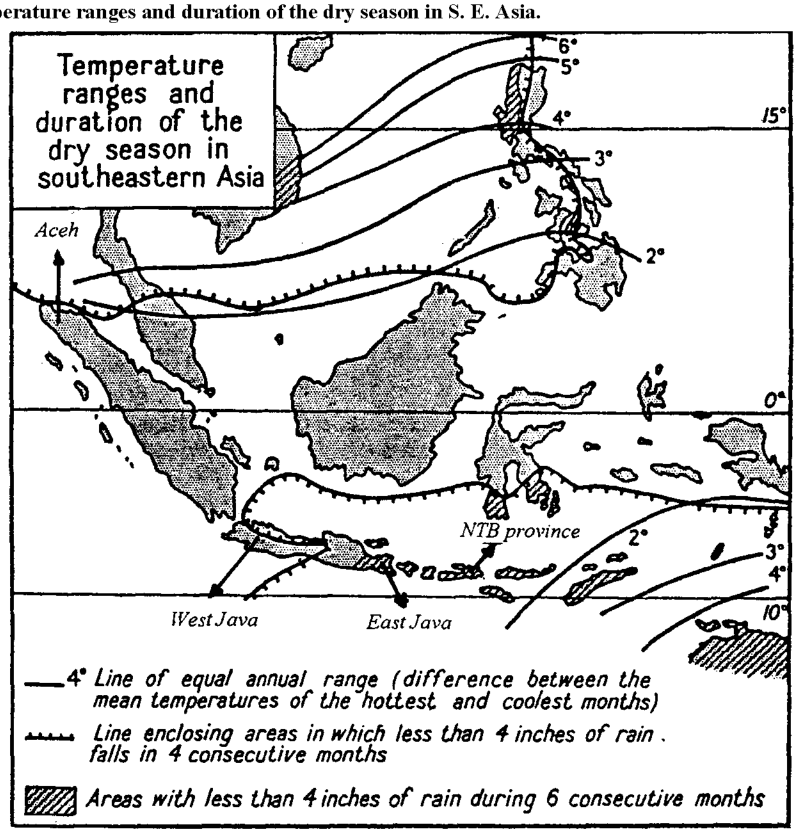
The complexity of comparative advantages of crops in Indonesia goes well beyond the well known intensive annual food and industrial farming in Java and extensive livestock and rubber farming in the other islands. Intensive annual food and industrial crop cultivation and horticulture have spread well beyond the long existing production centres into lower uplands, drained swamps, and higher up the mountain ranges throughout the archipelago. One can distinguish on a seasonal basis, sustained production centres of rice, soybean, and groundnut; on a yearly basis, sugar, tobacco, and cassava; and on a temperature basis "cold" and "hot" horticultural crops. Because of multi-seasonality, production is usually highly diverse, if measured on an annual basis.

The spatial diversity of production hangs together with the local temporal structure of production and derived trade. Local variations in options for production and trade relate to the local rainfall pattern. The variations can be placed in a grid of north-south and east-west transects. While day length (one of the major variables in breeding) is constant in the archipelago, there is inter-seasonality north and south of the equator, i.e. when it rains north of the equator, it is dry south of the equator (Figure 1). This leads to spatial and temporal division of labour and trade. In the Indonesian archipelago, only Aceh is located north of the equator, and recent statistics show that this province has taken advantage of its position (Appendix A, Graph A 6). Soybean production has also spread towards the east, especially to NIB province where soybean production expanded rapidly in the early 1990s. In addition, the local variations run from a long rainy season in the west, towards a bimodal pattern in the eastern part of Sumatra and western part of Java and a short unimodal rainy season in the eastern islands (Figure 1; Map 1). In the mountainous areas, rainy seasons usually start earlier than in the

Figure 1 Temporal variation in rainfall in monsoon area.



Map 1 Temperature ranges and duration of the dry season in S. E. Asia.



plains, leading to temporal variation between low land high land, and contributing to options in production and trade. The diversity is highest in the intensive, multi-seasonal agriculture in the western part of the archipelago.

Multi-seasonal agriculture, as defined in seasons of annual crops determines options for farming and trade. Whereas traders and processors have a number of basic business options, farmers can diversify production sequences. This becomes very clear if one analyzes agriculture on a monthly or seasonal basis, as shown by SYGAP reports and data (Morooka and Mayrowani 1990; Roche et al. 1992) and the recent analysis of the rice market (BULOG/NRI 1991). The options go well beyond the singular sequences of crops encountered in many reports. In depth research shows that dozens of cropping sequences are in use, one usually encounters domination of only two or three sequences in a given season. This means that farmers are not necessarily in some type of temporal cultivation bind, which would leave them in the hands of local collectors. In fact, there is some justification for the statement that the multi-seasonality and inter-seasonality, the variety of scale in processing, and the responsiveness of local demand together create a well integrated market.

Variability in consumption

Agriculturalists in Indonesia know that there are many production environments for annual food and industrial crops. The same applies for consumption and use. The common view on consumption holds that under structural transformation of agriculture, the proportion of processed goods increases. In the densely populated parts of Indonesia, however, one can observe the consumption of both processed and non-processed agricultural goods, and although there are ample indications that processing industries expand, this seems to be more a matter of scale than in fact an expansion of proportion of processed food (Bottema 1995).

If one looks at annual food and industrial crops from the demand side, one perceives the existence of a number of different markets for given commodities. Annual food and industrial crops are essentially commercial and provide intermediate produce for a large number of end products in the food and feed industry. The food and feed industries operate at a huge variety of scale, the food industry more so than the feed industry. The food industry encompasses a vast cottage/home industry (estimated at two to four million households), and a large number of small, medium and large industries. These industries produce a wide range of intermediate and end products at varying quality levels. The feed industry in Indonesia has been of medium and large scale since the mid 1980s. The demand for processed food and livestock products grows under conditions of expansion of expendable income, and, in general, the proportion of demand for industrial end products is slowly growing. Whether or not an industry would benefit from the exclusive use of a specific variety, or a specific set of quality standards depends entirely on the type of industry and the actual process of product transformation. The feed industry usually satisfies its requirements by using quality standards, the major ones being moisture content, foreign matter, and aflatoxin incidence (Yonekura 1996; BINUS 1988c; Altemeier et al. 1989; SFCDP/DGFC 1990). The vegetable oil industry, still emerging in Indonesia, prefers to process on the basis of variety homogeneity. The tahu and tempe industries have specific requirements for soybean, and most of these translate into variety characteristics. Likewise, for groundnut, the trade which supplies the snack business uses variety and seed size characteristics (Altemeier and Bottema 1991). Vertical integration is important in horticulture (Braadbaart 1989, 1993, 1994; Bottema et al. 1989) and also in

annual food crops (Hedley 1987; Altemeier et al 1989). Testing on quality characteristics expands with the scale and period of storage and is quite common in inter-regional trade.
On the other hand, there is ample evidence of persisting local consumption patterns (Achmady and Schneider 1995; Gross et al. 1994; Mayrowani 1993; Kuntjoro et al. 1989). Persisting local consumption patterns are observed in the eastern islands and the thinly populated islands of Sumatra and Kalimantan, but also in rural areas on densely populated and rapidly urbanizing Java (Collier et al. 1993).

Urban growth in Indonesia shows two patterns; in Java it seems that growth of smaller cities and towns accounts for most of the population growth in urban areas, whereas in the other islands, growth is centered in the major coastal/riverside cities. The continuity in the proportion of GDP of rice and secondary crops is partly explained by the fact that the lower income strata in urban centres have a consumption pattern which depends largely on secondary crops and derived produce. The expansion of consumer centres, major and minor urban centres, is usually accompanied by inter-regional grain and seed trade. The fact that secondary food and industrial crops supply both industry as well as consumers explains both a shift towards industrial processing and indirect consumption as well as persisting local consumption patterns. The recent medium term crop shifts (see Appendix A) in the regions of the archipelago show that the various commodity markets increasingly rely on inter-seasonality as a devise of stability in sourcing.

The seed market

The characteristics of production and consumption of food and industrial crops and the individual crop and seed properties determine the structure of the seed markets for the commodities. The first and foremost characteristic of the seed market for grains and food legumes is its seasonality. The second is that individual lots are small and spread out in the country side. The third characteristic is that the harvested product can be used as food and feed as well as for seed (with the exception of hybrid maize), and the fourth is that seeds of grains and food legumes are somewhat perishable, i.e. the germination rate declines over time. These four major and general characteristics mean that the major reward for seed is simply based on timely local availability. They also explain why seed distribution is a costly and time consuming business. With regard to the seed market, multi- and inter-seasonality facilitate both short supply lines and short stock keeping times. The features of the seed markets of annual crops are not likely to differ much from inter-seasonal patterns observed in horticulture, although in horticulture temperature differences play a larger role in seed production (Bottema et al. 1989; Ferrari 1994). In annual crops, seed trade is more likely to be influenced by the temporal differences in production among areas, as earlier observed by Bottema and Altemeier (1989) for rice. The following analysis will draw out the relation between the seed market and multi- and inter-seasonality in Indonesia, focusing on soybean, rice and maize. The guiding thoughts are i) that concentration of producer areas is stimulated by concentration of consumer areas, ii) that with expanded inter-regional trade, standardized quality rewards become more important in the product as well as the seed market, and iii) that the positive elasticities of soybean and groundnut suggest that such would be part of a medium term process.

The cross tabulations in Tables 1 through 4 show quite distinct seasonal patterns of production and related seed use by land type. The data are presented following a north-east to south-west transect, starting in Aceh, north of the equator, through West Java and East Java, and ending in the western part of the eastern islands (NTB). The data were obtained in a farm survey, targeting soybean growers throughout Indonesia, and included 510 respondents, 210 in East Java, 90 each in NTB and Aceh, and 60 each in North Sumatra and West Java. The overall provincial seasonality pattern is given in Appendix A; the differences in seasonality between the sample farms and the overall pattern is caused by the fact that soybean growers were selected.

Aceh

In Aceh, soybean farming is a three season business taking place primarily in the dryland area and to a lesser extend in rainfed and irrigated land (Table 1).

Table 1 Aceh: area planted to food crops by land type and season, 1994/95.

Maize (ha)	n	irrigated wetland	n	rainfed wetland	n	dryland	Σn	Σha.
2nd dry season	0		2	1.8	2	0.8	4	2.5
rainy season	0		0		2	0.8	2	0.8
1st dry season	0		2	1.8	2	0.8	4	2.5
Total	0	0.0	4	3.5	6	2.3	10	5.8
Rice (ha)	**n**	**irrigated wetland**	**n**	**rainfed wetland**	**n**	**dryland**	**Σn**	**Σha**
2nd dry season	1	0.3	2	1.3	0		3	1.6
rainy season	19	8.0	16	15.1	0		35	23.1
1st dry season	12	4.7	2	0.6	0		14	5.4
Total	32	13.0	20	17.0	0	0.0	52	30.0
Soybean (ha)	**n**	**irrigated wetland**	**n**	**rainfed wetland**	**n**	**dryland**	**Σn**	**Σha**
2nd dry season	18	7.7	18	16.8	47	59.8	83	84.3
rainy season	1	1.0	5	5.4	47	62.8	53	69.2
1st dry season	5	3.1	20	21.6	48	61.8	73	86.5
Total	24	11.8	43	43.7	142	184.4	209	240.0

Note: In Aceh the rainy season starts in September, followed by two drier seasons

It is obvious from the land allocation data that soybean farming in Aceh is a fairly specialized type of farming. Rice and maize are secondary crops among soybean farmers in Aceh. In the rainy season (with the smallest land allocation to soybean) 87% of soybean seed is purchased, in the first and second dry season around 50% of soybean seed is purchased.

West Java

In West Java, soybean farming takes place in conjunction with rice farming as the allocation of land to crops indicates. Soybean dominates in the second dry season, whereas rice dominates in the wet and the first dry season. Soybean production is spread out over the three major land types, with soybean as major crop also in dryland areas in West Java. In the first dry season, with the largest land allocation to soybean, 92% of soybean seed in West Java is purchased; in the rainy season 44% and in the second dry season 37% is purchased.

Table 2 West Java: area planted to food crops by land type and season, 1994/95.

Maize (ha)	n	irrigated wetland	n	rainfed wetland	n	dryland	Σn	Σha
2nd dry season	0		0		5	2.4	5	2.4
rainy season	0		0		9	4.0	9	4.0
1st dry season	0		0		1	0.1	1	0.1
Total	0	0.0	0	0.0	15	6.5	15	6.5
Rice (ha)	**n**	**irrigated wetland**	**n**	**rainfed wetland**	**n**	**dryland**	**Σn**	**Σha**
2nd dry season	0			2.4	0		2	2.4
rainy season	20	10.9	12	9.8	10	3.8	42	24.5
1st dry season	20	10.9	9	8.5	0		29	19.4
Total	40	21.7	23	207	10	3.8	73	462
Soybean (ha)	**n**	**irrigated wetland**	**n**	**rainfed wetland**	**n**	**dryland**	**Σn**	**Σha**
2nd dry season	20	10.6	12	6.8	16	6.7	48	24.1
rainy season	0		4	0.8	18	8.2	22	8.9
1st dry season	0		6	1.8	12	4.9	18	6.7
Total	20	10.6	22	9.3	46	19.8	88	39.7

Note: In West Java, the rainy season starts in October, followed by two drier seasons

East Java

In East Java, the producer centre of secondary crops in Indonesia, the seasonal pattern differs from that in Aceh and West Java. The major growing seasons in East Java are the first and the second dry season, with irrigated land as the dominant land type. Soybean growers diversify land allocation among rice, maize, and, although not included in the survey, also cassava.

Table 3 East Java: area planted to food crops by land type and season, 1994/95

Maize (ha)	n	irrigated wetland	n	rainfed wetland	n	dryland	Σn	Σha
2nd dry season	17	10.4	8	4.2	5	2.0	30	16.6
rainy season	1	0.1	5	2.0	40	21.4	46	23.6
1st dry season	4	2.6	6	2.8	11	11.8	21	17.2
Total	22	13.1	19	9.0	56	35.2	97	57.3
Rice (ha)	**n**	**irrigated wetland**	**n**	**rainfed wetland**	**n**	**dryland**	**Σn**	**Σha**
2nd dry season	2	1.7	0		0		2	1.7
rainy season	141	105.0	40	25.1	6	3.2	187	133.4
1st dry season	51	37.1	4	4.2	0		55	41.3
Total	194	143.8	44	29.3	6	3.2	244	176.3
Soybean (ha)	**n**	**irrigated wetland**	**n**	**rainfed wetland**	**n**	**dryland**	**Σn**	**Σha**
2nd dry season	126	91.6	3	4.1	1	6.0	130	101.7
rainy season	8	3.6	4	1.1	37	22.1	49	26.8
1st dry season	99	69.4	34	20.3	48	27.4	181	117.1
Total	233	164.7	41	25.5	86	55.5	360	245.6

Note: In East Java the rainy season starts in November/December followed by one drier and one dry season

In East Java, farmers purchase 75% of soybean seed in the rainy season (with the smallest land allocation to soybean, and in both dry seasons around 65% of seed is bough[1].

NTB

Finally, towards the east, in the province of NTB, the seasonal pattern differs again. Soybean production takes place in rice soybean farming. In NTB the second dry season is the dominant soybean growing season. As in East Java, soybean is grown in the irrigated areas.
Trade in soybean seed in NTB is important; in the rainy season, the season with the smallest land allocation to soybean, 97% of seed is purchased; in the two dry seasons, 84 and 90% is bought.

Table 4 Eastern Islands (NTB): area planted to food crops by land type and season, 1994/95.

Maize (ha)	n	irrigated wetland	n	rainfed wetland	n	Dryland	Σn	Σha
2nd dry season	1	0.4	0		0		1	0.4
rainy season	0		0		0		0	0.0
1st dry season	0		0		2	0.6	2	0.6
Total	051	0.4	0	0.0	2	0.6	3	1.0
Rice (ha)	n	irrigated wetland	N	rainfed wetland	n	dryland	Σn	Σha
2nd dry season	1	4.1	0		0		1	4.1
rainy season	60	54.	19	21.9	0		79	75.9
1st dry season	48	39.5	0		0		48	39.5
Total	109	97.6	19	21.9	0	0.0	128	119.5
Soybean (ha)	n	irrigated wetland	N	rainfed wetland	n	dryland	Σn	Σha
2nd dry season	55	47.5	0	0	0		55	47.5
rainy season	1	1.5	0	0	1.3	9.7	14	11.2
1st dry season	16	14.1	17	20.8	0		33	35.0
Total	72	63.2	17	20.8	1.3	9.7	103	93.7

Note: In NTB the rainy season starts in December followed by two dry seasons.

General Remark

In the north-west to south-east transect, soybean farming is most specialized in the areas which profit most from inter-seasonality with the other zones in Indonesia. Moving to the south-east soybean farming becomes more and more diversified, with rice as the dominant partner of soybean in the eastern islands.

In terms of seasonality, soybean tends to shift to the second and third growing season, moving from the north-west to the south-east,. This means that, taking into account the different calendar months of the seasons in the zones, the overall temporal structure of production in the archipelago shows a peak in the months May - November because all four producer areas fit in soybean in production. In the months October to May, Aceh and East Java dominate in supply. Overall production of soybean takes place year-round in Indonesia, which means that in theory seed can be supplied through domestic inter-regional and inter-local

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[1] The data complied by Cuijpers (19901&b) would facilitate disaggregated analysis for East Java. See also Brotonegoro et al. (1986)

trade. In practice, this depends on variety preferences and zonal fit of varieties. This issue is analyzed to some extent in a separate section.

In terms of land type, it is obvious that towards the east irrigated land dominates, whereas in the wetter west rainfed land (dryland) dominates in cultivation of soybean.

The proportions of seeds purchased run from 40 to 90%, with maize and rice at the lower end, and soybean at the higher end. This range does not differ from proportions of farm produced seed in Europe. The proportion of soybean seed purchased is around 70% on the average for all Indonesia. This confirms that both purchased and farm saved seed are of importance in soybean. There seems to be a high proportion of purchased seed in the rainy season, which is the least important from an area allocation point of view. One would expect the purchase of seed to be high in the major growing seasons, but only in the relatively unimportant producer area of West Java does this seem to be the case. This could indicate that the produce of the major growing season is all sold, and that no produce is retained as seed, which then induces purchase of seed to be proportionally highest in the least important growing season. With regard to the actual timing of introduction of seed, one could target specific seasons in actual local seed supply; logically, one would assume that the least important growing season is the seed introduction season.

It is well known that traders play a dominant role in addition to public agencies such as cooperatives, rural banks and state distribution firms, such as PT Pertani and NSC. There are signs that traders are the most important as providers of market information and as agents organizing quality in the flow of intermediate produce (Chilver and Suherman 1992). It is most interesting to note from research on seed that farmers in a multi-seasonal agriculture are virtually always capable of obtaining seed in their locality. This hangs together with local land diversity. It is obvious that farmers seeking seed can utilize the existing local supply, thereby shortening supply lines, in addition to regional and even inter-regional trade.

Intervention in the seed market

The central idea behind public investment and intervention in the seed market over the last decades in Indonesia conforms very well to the spatial characteristics of production in specific zones and the local distribution requirements of seed. The government has set up a number of seed stations in the various producer zones of the archipelago and smaller seed farms in the provinces. These stations supply, among others, seed to newly settled areas; the smaller seed farms multiply seed in a second step. Farmers are involved as contract seed growers in seed multiplication. Certification covers primarily harvesting time, and thus indicates shelf life of seed, enabling buyers to assess germination ratio.

The general features of seed certification of soybean in Indonesia show recognition for the need to minimize costs of certification and to shorten supply lines. The involvement of contract seed growers and the collection of grain as seed shows a close similarity to the current and widespread practices in private seed and collection trade. Current evidence indicates that the majority of certified soybean seed is equal in quality to non-certified seed, and one would thus conclude that the major directions of present public efforts in seed purchase and collection resemble those of private trade.

A question concerns the recognition for inter-regional trade in soybean seed. It is well documented that inter-regional trade in soybean for food is quite important, and one would therefore wonder whether soybean seed requirements could be met by inter-regional and inter-local trade. Such is only possible if soybean varieties perform well in a variety of seasons and land types, as Tables 1 to 4 indicate.

Spatial distribution of soybean varieties

In order to assess area specific use and spreading of soybean varieties, one needs time series data on the planted varieties in the various producer areas in the archipelago. Sustained and large proportions of a single variety in a specific area would indicate a specific fit of the variety concerned. Before taking a look at spread of varieties of the secondary crops and an in-depth analysis of soybean, it is necessary to indicate the major bio-physical variables in the archipelago. Temperatures vary with altitude, soil types vary but day length does not vary. This last characteristic, which is caused by the east-west spread of the archipelago, reduces the possibilities for the use of specific varieties for zones with different day lengths (and temperatures), and so poses restrictions on the contributions of breeding and introduction of varieties. There are many detailed assessments and reports on location specific variety trials as given in Arsyad and Asadi (1991), Sudjana et al. (1980), Balittan Bogor (1990), Balittan Sukamandi (1988), Ponidi et al. (1989), Subandi and Manwan (1990), Sudjana and Subandi (1990), Sudjana (1991), Sumarno et al. (1983, 1986, 1988), Manwan et al. (1990), CRIFC (1991), Hutabarat (1992) and the admirable compilation by Roche et al. (1992). The varieties differentiate somewhat in terms of cropping duration, resistance to pests and diseases and fertilizer response. There are, as expected, no clear indications of differentiation among the varieties of secondary crops in terms of suitable zones in the detailed compilations of variety trials by area.

Based on the actual spatial distribution of varieties of secondary crops in Indonesia, one observation needs to be made. In Indonesia, the R & D efforts in annual food and industrial crops have generally resulted in high rates of adoption of improved varieties, in many locations at even higher rates than rice. The proportion of area allocated to improved rice varieties increased in the 1970s and 1980s from around 40 to 70%; locally, proportions of improved soybean seed were estimated at around 90% in the early 1990s (AARD, various yearbooks).

The distribution of varieties over Indonesia by province shows substantial variation among producer areas. Table 5 presents the proportions, running from the east to the northwest in Aceh, based on estimations by the Seed Directorate of the Ministry of Agriculture. This compilation conveys two types of information, namely the proportion of non-classified varieties, captured as local varieties, and the actual proportion of area planted to specific varieties of maize, groundnut, mungbean and soybean. In East Java, where the data may actually be fairly reliable, the proportion of local varieties of maize and soybean is limited, and ranges below 10%. In NTB and Aceh, much higher proportions of local or unidentified varieties are reported. To some extent, this may be caused by the local monitoring and identification capacity. It is of considerable interest that local varieties seem to dominate groundnut and mungbean production across all producer areas, including East Java. We have to leave this matter outside this analysis.

Looking at the individual varieties of soybean, one observes that the Wilis variety is popular in the north-west and the south-east producer areas. The low proportion of Wilis in Aceh is rather striking. The proportion of local varieties is estimated at a very high 90% in this area. This is most unlikely in an area where soybean has been introduced fairly recently, as is the case in Aceh. The widespread popularity of Wilis throughout the archipelago conforms with the expectation that it is difficult, if not impossible, to generate area specific varieties.

Aceh and West Java are the exceptions in the general pattern. In West Java, Lokon is the dominant variety. The reasons for this phenomenon need specific analysis on the basis of the variety's characteristics, and taking into account location specific soybean expansion programmes with a seed release component.

Table 5 Proportion (%) of varieties of secondary food crops by province, 1993/94.

Crop Variety	N.T.B.	East Java	West Java	N. Sumatra	D. I. Aceh
Maize Arjuna	24	44	33	27	3
Hybrid C-1/C-2	27	5	4	42	5
Hybrid CPI-1	-	5	10	-	-
Hybrid Pioneer	-	4	17	16	I
Genjah Kertas	-	20	2	-	-
Orther improved	7	15	22	1	1
Local	42	7	12	14	90
Soybean Wilis	79	73	9	79	5
Orba	3	1	24	<1	4
Lokon	2	2	48	<I	-
Lumajang Bewok	-		10	-	-
Galunggung	<1	2	-	4	-
Other improved	9	14	9	-	1
Local	6	8	(-)	16	90
Groundnut Gajah	22	17	51	3	<1
Kidang		9	21	<1	-
Schwarz	-	<1	6	-	-
Other improved	-	13	22	1	1
Local	78	60	(?)	95	99
Mungbean No. 129	-	13	41	14	-
Merak	-	11	21	-	1
Bhakti	-	3	2	25	-
Betet	90	2	<1	-	-
Other improved	-	18	29	1	
Local	10	53	6	60	99

Source: SCCS provincial annual report 1993/94

Table 5 contributes to a general impression of the spatial distribution of varieties in Indonesia. The survey data provide similar information. Table 6 shows estimations of variety proportions in earlier years and a fairly reliable approximation of the distribution of soybean varieties among soybean growers in the various producer centres in Indonesia. The reliability of information of the distribution of soybean varieties in earlier years suffers from a recall bias which increases the farther back the period is from the actual time of the survey in 1995. The survey also carries a bias because it pinpoints soybean growers, and may therefore not be completely representative for all soybeans grown in a province.

The survey identified the local variety in Aceh as Kipas Putih, which does not stem from the government soybean breeding programme, and, judging by its performance, it enjoys a distinct popularity. The Kipas Putih beans are somewhat larger than the Wilis beans, and may therefore contribute to its popularity in the tempe industry. It seems that Kipas Putih was already in circulation in the 1970s, and that its proportion declined with the introduction of Wilis in the 1980s. It is most striking to note that in North Sumatra Wilis enjoys popularity, in contrast to adjacent Aceh.

The farther ones moves to the east, the more popular Wilis becomes. It has established itself since its release as the dominant variety in both East Java and the eastern islands.

The general observation with regard to the proportion of local varieties is that the survey reports higher proportions of local varieties in the provinces, but more or less in the same pattern as can be derived from the annual report data in Table 5.

Table 6 Soybean varieties (%) planted by province, 1970 to 1995.

Province	1970s	1980-90	1991-94	1995
Aceh				
Wilis		33	26	10
Lokon				
Orba		33	30	22
Tidar	33			
Improved other				
local (Kipas Putih)	67	34	43	68
N. Sumatra				
Wilis		33	60	63
Lokon				
Orba		33		7
Tidar				
Improved other				
local	100	33	40	31
W. Java				
Wilis			50	21
Lokon			33	13
Orba			8	21
Tidar				
Improved other			4	8
local	100	100	4	38
E. Java				
Wilis		4	38	68
Lokon				4
Orba				
Tidar	8		6	0
Improved other		13	13	13
local	92	83	43	15
NTB				
Wilis			36	84
Lokon				
Orba				
Tidar				
Improved other				7
local	100	100	65	9
All Indonesia				
Wills		9	39	54
Lokon	5		5	3
Orba		6	6	7
Tidar	10		3	0
Improved other		9	6	7
local	85	76	41	28

It would seem likely that the actual distribution of soybean varieties may reflect local user requirements more than agronomic fit. The fact that Wilis is widely popular and is grown under both irrigated as well as under rainfed conditions seems to confirm the low pay-off view in soybean breeding. However, the popularity of Kipas Putih in Aceh and Lokon in West Java may indicate that there are rewards being captured in variety choice which can be traced to the user side. This matter obviously warrants more investigation. In carrying out such an investigation one would have to take into account the denominations of varieties in the trade. A brief comparison of the breeders' terms with the trade vernacular in Indonesia, as compiled by Altemeier and Bottema (1989) shows many differences and a continuing need to use seed determination in the analysis of quality rewards in trade.

Concluding remarks

The lack of variation in daylength in the Indonesian archipelago and the wet climate in the western and mountainous parts do not make very favourable production environments for soybean, and they limit the contributions to be expected from breeding. Nevertheless, in view of the popularity of soybean in a wide range of intermediate and end uses, there are benefits to be captured in introducing soybean in the various zones and in improving cultivation practices. It seems quite reasonable for the government to maintain an apparatus which supports seed renewal and circulation. In view of the agro-climatic homogenity and the temporal differences in production among the various zones, it would seem that inter-regional trade in soybean seed is possible.

The relative success of adoption of certified rice seed coincided with a still expanding proportion of improved varieties in the 1980s, whereas seed certification in secondary crops would seem to coincide with a phase of already high adoption of improved seed. The general question arises whether the success of distribution and certification of seed is related to expansion of adoption of improved varieties. It is logical to expect a positive relation. If it is indeed true that the extent of use of improved seed of secondary annual crops was already wide in the 1980s, one could argue that the expansion of the state participation in the seed system, to marketing and certification, should have had a better chance in earlier years. This matter needs in-depth follow-up.

If we now turn to the non-rice annual food and industrial crops in Indonesia, we observe that there have not been spectacular medium term widespread yield increases; however, there are many examples of shorter term and area specific advances. These are usually based on cultural practices, crop shifts and improvements in the market. The state in Indonesia does invest in the development of varieties; it also has, in the case of soybean, some instruments to control imports and exports. However, it is clear that its efforts to supply seed have, in the case of non rice annual food and industrial crops, not resulted in recognizable and sustainable niches in the seed market and market rewards for its produce. The broad spread of improved varieties shows at least some impact of R & D, whether private niche investment (such as in hybrid maize) will follow, remains a question. There are examples of current private investment in hybrid seed distribution in the case of the maize oil industry, whereas in soybean private seed production and distribution seems to be incidental, as yet without clear linkage to downstream industrial requirements.

There are examples of current investment. On the demand side, there is ample evidence of persisting local consumption patterns and further investigation may yield specific local use of varieties.

Over recent years, there has been considerable debate on agricultural policy in Indonesia. Modeling exercises by BINUS (1988a, b) and Altemeier and Bottema (1991) have shown that relative producer prices do have the expected effect on production shifts. Other studies, such as that by Wiebe (1990), question the economic benefits of inducing high domestic prices. More recently Pomeroy (1995) made a case for soybean meal deregulation in Indonesia. The internal working of the domestic seed market is not likely to be influenced by the trade regime and price policy, but there are signs that government authorities expect some effect of the ban on meal import on private investment in soybean. This matter may need some investigation as it would, if protection indeed continues, open options for end product focused breeding and seed distribution. Timmer (1987) has repeatedly warned against the so-called local booster programmes, noting that especially soybean has been subject to many local boosting programmes. The question arises whether one is, in fact, analyzing many location and time specific impacts of local soybean programmes, when looking at soybean in the 1980s and early 1990s.

The current direction in agricultural R & D in Indonesia, if one would venture to generalize, shows more recognition of the variability of production environments. To some extent, this recognition is part of a wider movement. Since the 1980s, the CGIAR system has increasingly attempted to move towards a resource management focus, whereas agricultural R & D throughout Asia has received a more regional focus. The question is whether this shift reflects indeed a shift in perception in public investment, based on expected social and economic benefits, or merely an operational device to strengthen the local density of public service. A question is whether this move is accompanied by a continued pervasion of the central intervention philosophy, which proved to be successful in rice. There seems to be no easy answer to this question. One will probably observe the interplay of many elements in decision making.

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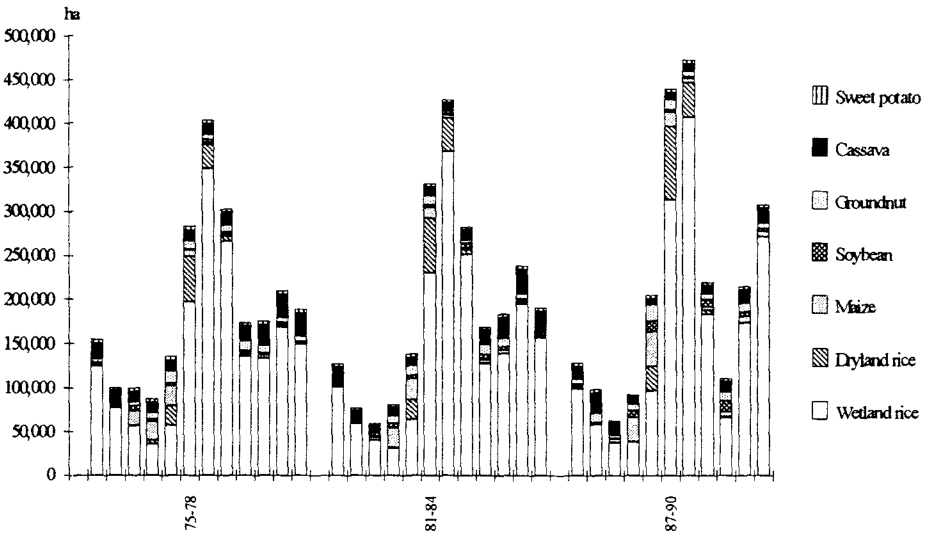
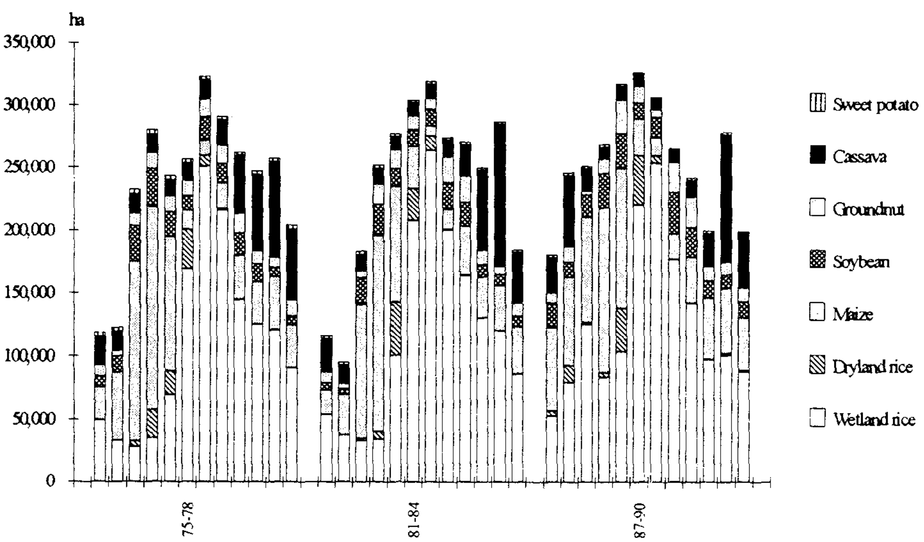
Appendix A

Graph A 1 Monthly area harvested of food crops in West Java, 1975 - 78, 81 - 84, 87 - 90 (three crop years average).



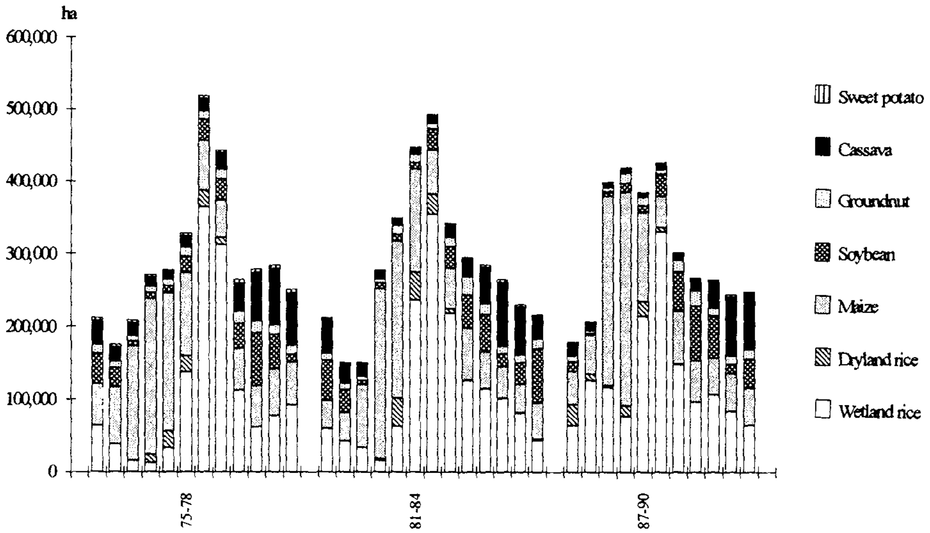
Source: Unpublished data, CBS.

Graph A 2 Monthly area harvested of food crops in Central Java, 1975 - 78, 81 - 84, 87 - 90 (three crop years average).



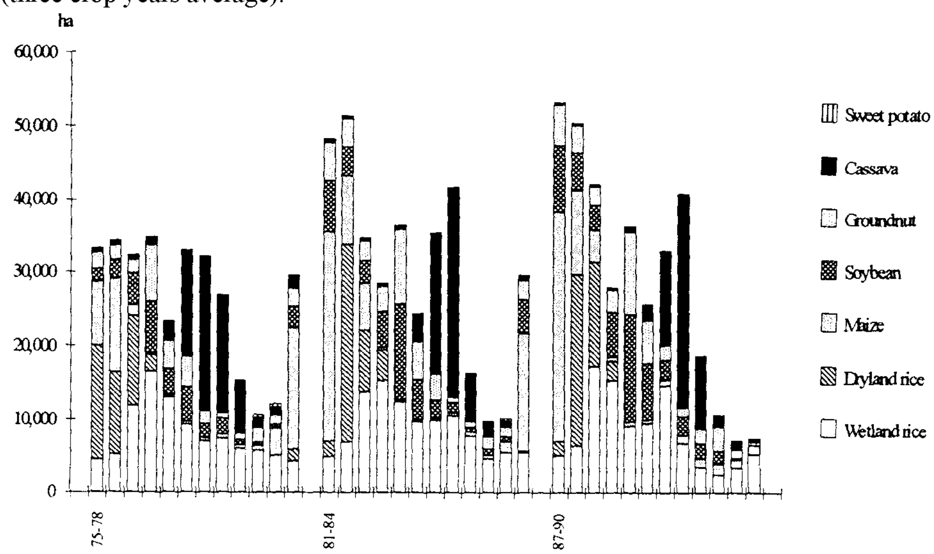
Source: Unpublished data, CBS.

Graph A 3 Monthly area harvested of food crops in East Java, 1975 - 78, 81 - 84, 87 - 90 (three crop years average).



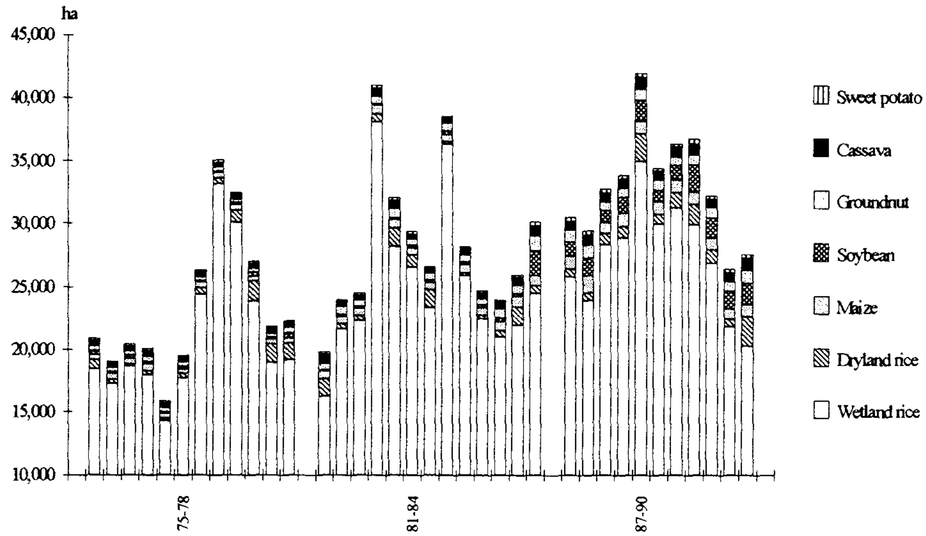
Source: Unpublished data, CBS.

Graph A 4 Monthly area harvested of food crops in Yogyakarta, 1975 - 78, 81 - 84, 87 - 90 (three crop years average).



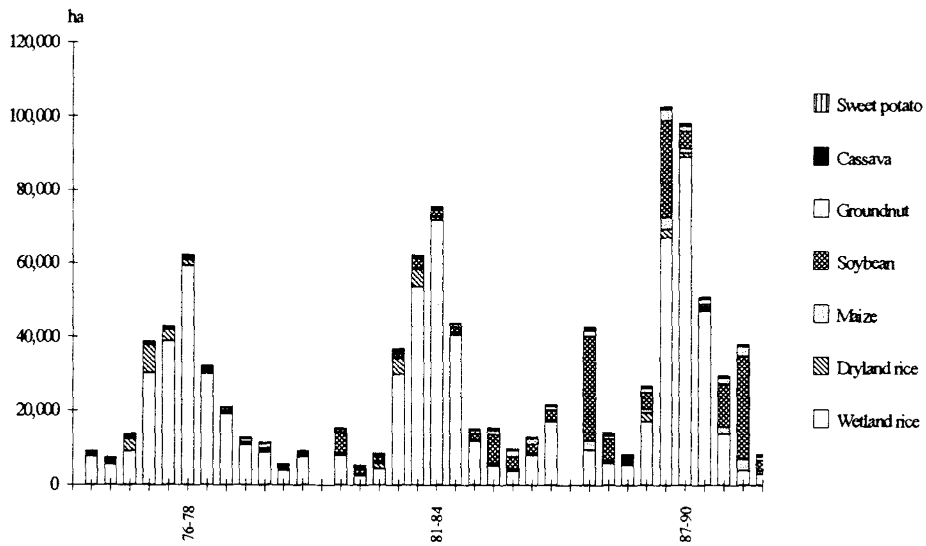
Source: Unpublished data, CBS.

Graph A 5 Monthly area harvested of food crops in West Sumatra, 1975 - 78, 81 - 84, 87 - 90 (three crop years average).



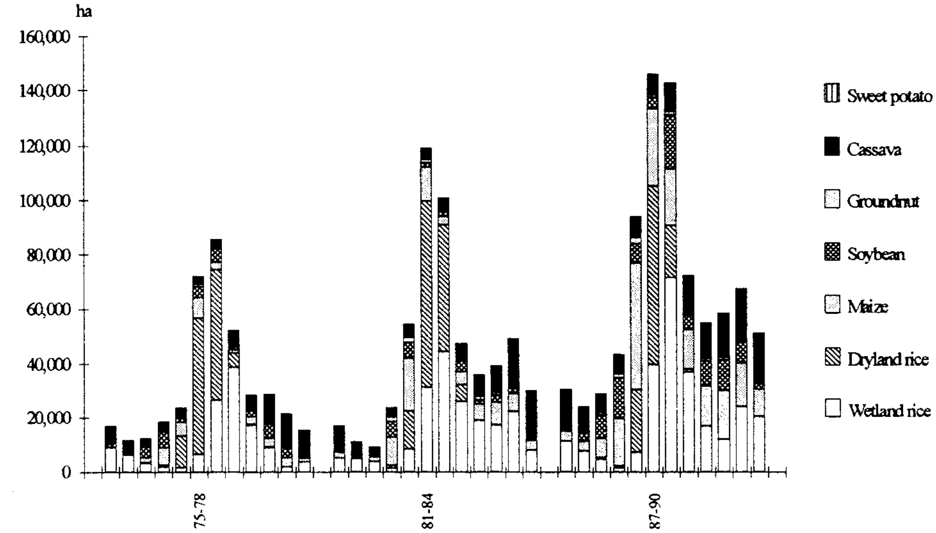
Source: Unpublished data, CBS.

Graph A 6 Monthly area harvested of food crops in Aceh, 1975 - 78, 81 - 84, 87 - 90 (three crop years average).



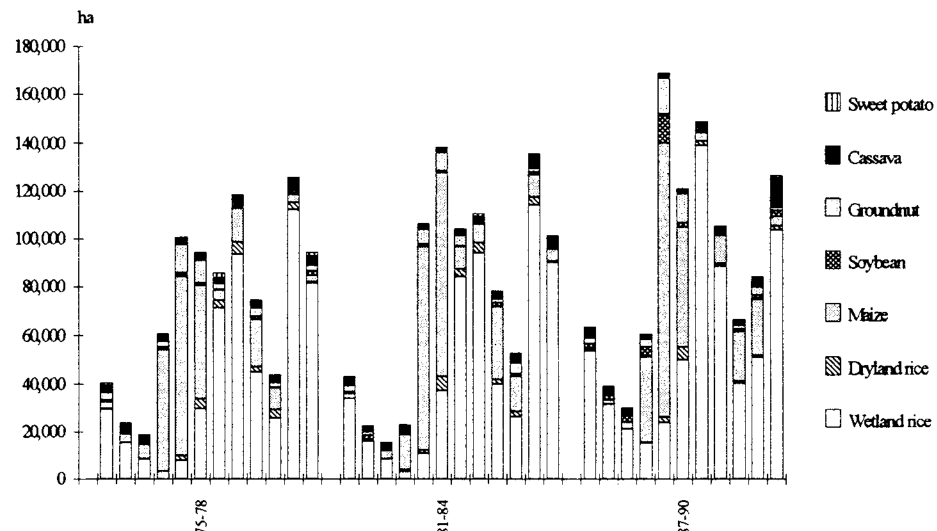
Source: Unpublished data, CBS.

Graph A 7 Monthly area harvested of food crops in Lampung, 1975 - 78, 81 - 84, 87 - (three crop years average).



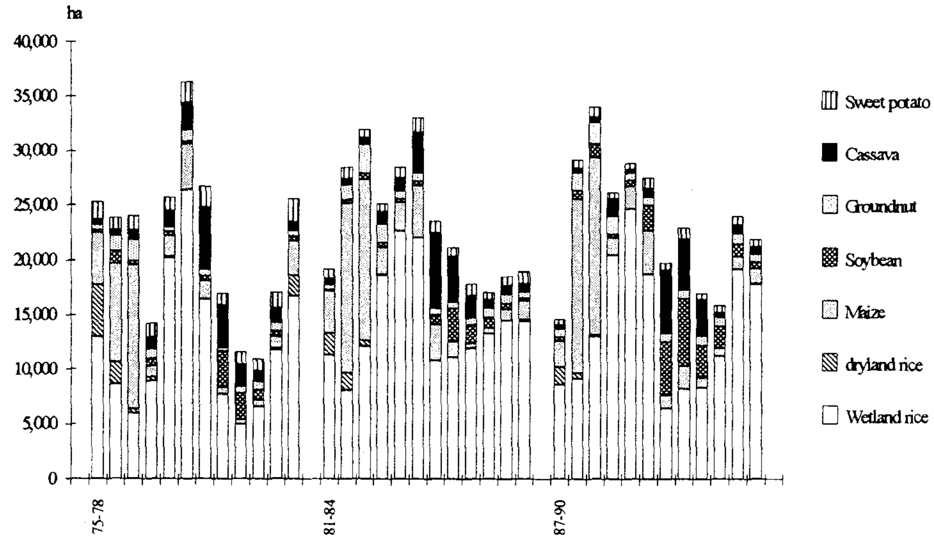
Source: Unpublished data, CBS.

Graph A 8 Monthly area harvested of food crops in south Sulawesi, 1975 - 78, 81 - 84, 87 – 90 (three crops year average)



Source: Unpublished data, CBS.

Graph A 9 Monthly area harvested of food crops in Bali, 1975 - 78, 81 - 84, 87 - 90 (three crop years average).



Source: Unpublished data, CBS.

Structure and Policy of the Formal Food Crops and Horticulture Seed Sectors in Indonesia

M. Sidik[*]

Background

The globalization era not only promises market opportunities in a fair international trade order, but it also brings challenges in agricultural development in Indonesia. Efforts to increase efficiency and productivity in the agricultural sector are expected to answer the challenge of converting our comparative advantage into a competitive advantage. This is required in order to keep up with the development of other domestic sectors and also to compete against similar products in international markets. In this way, agricultural development, in Indonesia can be sustained, with respect to economic, social and environmental aspects.

Activities related to seed matters, from plant breeding and release of improved varieties to quality seed multiplication and distribution, play an important role in efforts to increase efficiency and productivity in the agricultural sector. To be able to play such a role, the seed industry itself has to grow and develop healthily, efficiently, and competitively in order to provide for the needs of farmers for seed in terms of the right crop/variety, the right amount, quality, location, time and price.

Seed structure

Seed structure in Indonesia is marked by variety, which is caused by the level of development and different guidance given for each crop or group of agricultural crops. For instance, before PELITA (the five year development plans) started, the level of knowledge, social-economic conditions and farming orientation of the highland vegetable farmers were development to the extent that effective demand for quality seeds was increased, which provided an opportunity for the private sector to establish businesses in trading/importing seeds for several vegetables, such as English cabbage, Chinese cabbage, etc.

It is clear here that the role of the private sector was important in supplying and distributing quality seed, but it was different in the case of paddy seed at that time. Rice farmers have known and always looked for improved varieties. However, their limited awareness of seed quality was not able to create demand that could attract the private sector to establish businesses in rice seed production and distribution. The main vehicle for spreading rice improved varieties and supplying seeds of these varieties, in fact, lies in government institutions, such as research farms, research institutes, government seed farms, etc. Regarding government seed farms, there are three different categories, i.e. the central seed farm (CSF) which produces foundation seed (FS), the main seed farm (MSF) which produces stock seed (SS), and the supplementary seed farm (SSF) which produces extension seed (ES).

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The diversity in players mentioned above is decreasing, in line with the implementation of a wider coverage of extension and services conducted by the government. Currently, there is already a standard requirement for quality and labeling of rice seed traded. Apart from that, units of the seed certification service are ready to start expanding their activities to include seeds from secondary crops, lowland vegetables and fruit trees.

Components in the Indonesian seed structure up to this time are:

- LP3 Branch Sukamandi now known as Research Institute for Sukamandi, which was assigned to conduct research that supports the seed sector and to produce seed of certain classes (Minister of Agriculture Decree No. 183/Kpts/Org/5/1971).
- Perum Sang Hyang Seri, a state-owned company which was established to initiate the development of the private sector in the production and distribution of certified seeds (Government Regulation No. 22, 1971). Initially, Perum Sang Hyang Seri only dealt with rice seed as rice is a strategic commodity. However, during its lifespan, it is also expected that Perum Sang Hyang Seri can be a pioneer for the secondary crop and horticulture seed industry. Actually, this company has already started to diversify into secondary crop seed and horticulture seed. Another state-owned company in the seed business is PT. Pertani (Persero).
- Local and multinational private companies, which have already started and spread in Indonesia, and do business not only in highland vegetable seed but also lowland vegetable seed, and are even starting to be involved in rice seed.
- Seed growers, who have played a large role in supplying and distributing rice seed. To process seeds that they produce, some of these growers cooperate with government seed processing units.
- Units of seed quality control and certification, which are service units provided by government for the regions, while at the central level, seed matters are specially handled by the Directorate of Seed Development.
- National Seed Board, which was established by Presidential Decree No. 27, 1971, and has a task of formulating seed policies and seed quality standards, and also of releasing varieties, etc.
- Other components which are important in the Indonesian seed structure are seed laws and regulations. The Presidential Decree on Guidance. Marketing Control and Seed Certification (No. 72, 1971) was followed by regulations for its implementation which were stipulated in the Minister of Agriculture Decree No. 460/Kpts/Org/XI/1971, revised by No. 67/Kpts/Org/2/1977 and No. 415/Kpts/Um/7/1979. The legal basis for seed matters was upgraded in 1992 (Chapter III, Law No. 12 1992 on Agriculture).
- Other components, which are also important, are the farmers themselves who use seeds. These farmers always get extension information on the benefits of quality seed. In this case, farmers' groups are important target groups for effective extension. Extension is also indirectly conducted through the BIMAS (mass guidance) program, in particular for INSUS (special intensification) C and D packages, and Supra INSUS (super special intensification), where the use of certified rice seed is mandatory.

Seed policy

Government has established the following basic policies for the seed sector:

- The seed business will be gradually transferred to the private sector with the development of seed systems for each crop/group of crops.
- The role of government will gradually focus on research, guidance, control and extension.
- In the process of providing guidance, the government still has a role in seed supply and distribution, in particular for crops that are not attractive to the private sector.

Policies regarding the transfer of the role of seed supply and distribution to the private sector are important to achieve the level of efficiency and competitiveness needed to enter the era of free trade. The role and capability of the private sector should always be increased. Moreover, seed certification will also be gradually delegated to a sector capable of getting accreditation from the government. Also, it is expected that research activities will be a part of private sector activities.

Recent developments

Some recent development in the Indonesian seed sector are listed below:

- Many private seed companies and even state-owned companies are still reluctant to produce soybean certified seed, so that much soybean stock seed (SS) produced by government seed farms was directly marketed to farmers for consumption production. However, for this coming season (1995/1996), it is difficult to get soybean stock seed in the market. This is because government seed farms are keeping their products for their own use for producing soybean extension seed, and also due to the demand of 50 tons of soybean stock seed by PT. Pertani (Persero) for its program to produce soybean extension seed.
- There are some private seed companies that have started producing certified disease free potato seed.
- Virus disease-free citrus seedling production, which was initially done by the government, is now also conducted by private growers.
- Rice seed production is undertaken not only by state-owned companies, but also by several private seed producers, which are members of the seed producer and trader association in East Java, and by PP Kerja, a private seed company in Central Java. One large private seed company in East Java has also started to produce and market certified rice seed.

The Source of Farmers' Soybean Seed in Indonesia

Charles E. van Santen and Heriyanto[*]

Introduction

This paper is based on a survey conducted by the Palawija Seed Production and Marketing Project (the project) attached to the Directorate General for Food Crops and Horticulture (DGFCH) of the Ministry of Agriculture of Indonesia. This project is assisting DGFCH in strengthening the entire seed chain for palawija (non-rice food crops), in particular for soybean, maize, groundnut and mungbean. A basic assumption for the project is that farmers face a shortage of quality palawija seed. For rice, Indonesia has a well-developed seed supply system, mainly operated by semi-public national seed organizations. In attempting to copy this system for the supply of seed for palawija crops, the project encountered the problem that there appeared to be only a small demand for soybean seed supplied by the public (formal) seed system. This finding which contradicted the basic assumptions of some project activities led to an attempt to understand whether and why demand for seed from public agencies is small or non-existent. To record the characteristics of the local (informal) seed supply, the project initiated a survey and collected information on local soybean seed systems in major soybean production areas in the five provinces of Indonesia assigned to the project.

Seed is an indispensable input for agriculture. Farmers obtain seed from the following sources (FAO 1955):

- grain retained on-farm and used as seed;
- grain bartered at the local level and used as seed;
- grain sold as unlabeled seed bought from the local market;
- certified or labeled seed bought from the public distribution system.

Government seed supply systems operate within a framework of public laws and regulations and distribute only tested seed of approved varieties, operating under strict quality control. However, the share of the public seed supply in the total seed supply for most food crops rarely exceeds 10% (Almekinders 1994). This is partly because of the high costs of seed obtained through the designated supply channels, which may be too expensive for farmers in food crop agriculture with a low value per unit product relative to, for example, horticulture. As a consequence, it may not be financially interesting for seed agencies to produce seed for the secondary food crops as risks are high and margins per unit seed sold are small for this category of seed. Private seed companies thus often concentrate on horticultural crops or on hybrid varieties of food crops. It is, therefore, not surprising that the bulk of seed for food crops is supplied locally, based on seed saved on-farm or seed obtained from other farmers or traders.

While public seed systems have been well documented (Almekinders 1994), very little research has been carried out to date on how farmers obtain the seed they need for planting

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food crops through local seed supply systems. This applies also to palawija crops in Indonesia. It is hoped that the present study will help to better understand these local seed systems.

In view of the government of Indonesia's priority on soybean production, the survey focuses on this crop. Soybean, after rice and maize, is the third most important food crop in Indonesia. Grown in Java for hundreds of years, it was probably introduced before 1600 by Chinese immigrants. Since the 1950s, it has spread rapidly to the other islands. Production since then has rapidly expanded; however, demand has increased even faster, resulting in large soybean imports to cover the shortfall. In November 1985, the government therefore launched a special soybean development programme to again achieve the self-sufficiency in soybean supply which existed before the seventies (Sebayang and Sihombing 1987). This effort, supported by a controlled trade regime and high domestic farm prices, resulted in an increase in the annual area planted with soybean from 0.9 million hectares in 1984 to over 1.5 million hectares in 1994, while average yield levels increased from 0.9 t per ha in 1984 to 1.1 t per ha in 1994. In the five provinces studied (Aceh, N. Sumatra , W. Java, E. Java and Nusa Tenggara Barat), the area more than doubled from 399,000 ha in 1984 to 907,000 ha in 1994 (Table 1). The national total annual soybean production for 1994 was estimated at about 1.54 million tons.

Table 1 Planted area of soybean in the five provinces under the project.

Province	Hectares in 1984	Hectares in 1994
Aceh	35,500	166,000
North Sumatra	4,500	52,000
West Java	28,000	98,000
East Java	285,000	453,000
Nusa Tenggara Barat	46,000	138,000
Total	399,000	907,000

Source: DGFCH

Soybean is an important food crop with a high protein content of about 40% and a fat content of 20%. The annual consumption per person in Indonesia is approximately 16 kg, of which 60% is for food and 40% for feed (Lancon 1995). Soybean is not directly consumed like most legumes, but is processed into products such as tahu (coagulated beancurd), tempe (fermented soybean cake) and ketjap (soybean sauce) or used for livestock feed or industrial purposes.

Soybean seed

The total minimum amount of soybean seed needed for planting in Indonesia is estimated at 75,000 tons per year, based on a planted area of about 1.5 million ha of soybean per year and an average seed rate of 50 kg per hectare. The formal seed sector, operated by government agencies and commercial companies, produces approximately 10,000 tons of soybean seed per year. This implies that some 65,000 tons of soybean seed is supplied and handled by local seed systems, either on-farm saved seed, locally-purchased seed, or exchanged seed. The question is, how do these local soybean seed systems operate? In particular, since soybean seed rapidly looses its germination capacity and many farmers grow only one soybean crop per year, farmers would need to store their seed up to nine months when using their own grain crop as a seed source.

Seed has received substantial attention in farming systems research and research supporting the re-settlement (transmigration) programme. However, little research has focussed on local soybean seed supply systems in Indonesia. Only six papers were identified in which local soybean seed systems were discussed as such: CGPRT (1988), Syarifuddin Karama and Sumardi (1990), Lenggogeni (1990), Saenong et al. (1991), Yustika Baharsyah and Syarifuddin Karama (1995) and Harnowo D. (1996). All these studies mention a specific local seed supply system, termed "jabal" (jalur benih antar lapang) or, in English, inter-field seed flow.

The Lenggogeni (1990) report is the only one of the above studies which focuses on soybean seed systems and which was based on original field work. This field work covered six provinces: E. Java, C. Java, Yogyakarta, DKI, Lampung, S. Sulawesi and NTB, of which only E. Java and NTB are also covered in the present study. A total of 96 farmers were interviewed in the Lenggogeni study, compared with 510 in the present study. The Lenggogeni study interviewed 192 product (grain) traders and 18 seed traders. This study interviewed 69 traders.

The Lenggogeni study identifies seed flows from major production areas to major consumer areas at district and provincial levels, although some attention is also paid to seed flow between farmers. The seed flow between farmers is the main focus of the present study. It is directed at the farm level, and describes farm production and use of soybean seed and local seed supply systems.

The following findings of the Lenggogeni study are consistent with findings of the present study:

- The *jabal* seed supply system provides the bulk (-65%) of the seed requirements of annual crops. It is a dynamic system, whereby local initiative is taken to transport seed from one area immediately after harvesting to other areas where farmers are planting soybean.
- Seed is supplied from the farmer's own field (15%); other farmers (9%); traders (40%); kiosks or village shops selling agricultural inputs (25%); extension services (2%); and the National Seed Corporation (4%).
- Farmers' perception of quality seed is still weak.
- The amount of certified seed used by farmers represents only 0.6% of total seed requirements.

Yet, in spite of useful information contained in the Lenggogeni study, to date very little quantitative information is available on local soybean seed systems in Indonesia and answers to the following important seed issues are still required:

- How does this *jabal* system operate, and what are the differences between regions, if any?
- In which major soybean producing areas is *jabal* operating?
- What are the strong and weak points of *jabal*?
- How can local seed systems such as *jabal* be integrated with the formal seed supply system to:
  1. create an efficient method of introducing improved genetic material to farmers, using the existing local seed supply systems operating at low costs, with the overall aim of increasing per hectare soybean productivity; and,
  2. capture the wealth of well adapted local genetic material, which may be essential for further genetic improvements. Locally adapted material in most cases has useful genetic characteristics such as tolerance to local pests and diseases, problem soils (acidity, iron and aluminum toxicity), flooding, drought and day-length neutrality, which may be essential for future genetic improvements of the crop?

Objectives of the survey

In view of the above, the objective of the survey was to describe the local soybean seed system in the five provinces in which the project operates, in particular to discuss:

- farmer's source and management of soybean seed;
- the role of soybean in the farming systems;
- the local soybean seed and grain market.

In addition the survey collected primary information on:

- costs and returns of soybean production;
- local soybean seed growers;
- farmers' soybean seed: quality; identification of varieties grown by farmers; yields obtained with farmer's soybean seed.

Methodology

To obtain the information required, a survey was conducted during May-July 1995, covering the provinces of East Java, Nusa Tenggara Barat, Aceh, North Sumatra and West Java, all of which are major soybean producing areas. The geographical location of these provinces is indicated in Map 1. Table 2 lists the seventeen districts which were included in the survey:

Table 2 Districts included in the survey.

Province	Province	Province	Province	Province
East Java	Nusa Tenggara Barat	Aceh	North Sumatra	West Java
Districts	Districts	Districts	Districts	Districts
Lamongan	Sumbawa Besar	Aceh Timur	Dairi	Pandeglang
Blitar	Lombok Tengah	Aceh Utara	Langkat	Garut
Pasuruan	Lombok Barat	Pidie	Deli Serdang	Subang
Banyuwangi				
Jember				

In each province, the three districts (E. Java: five districts) with the largest area of soybean were selected; within each district, three sub-districts with the largest area of soybean were selected with a proportional coverage of the three crop seasons and land use types used for this crop; within each sub-district, 3 to 6 villages were selected, again considering crop seasons and land use types; within each village 5 to 10 farmer-respondents were selected randomly in such a way that their farms were representative for their village. Farmers with very large or very small soybean plots were excluded from the sample.

The sampling of farmer and trader respondents is roughly in proportion to the soybean cultivated area in each of the five provinces. Note that this is not a statistically representative sample. However, the method applied is adequate for the purpose of the present survey, which is a basic inventory. Information on the distribution of respondents by province is shown in Table 3, in combination with general information on the study area.

As indicated in Table 3, the survey covered interviews with 510 farmers and 69 traders. In addition, the survey covered interviews with 6 small seed growers and with local officials and other resource persons; collection of 87 provincial and district annual statistical reports; and collection of 89 farmer soybean seed samples at the time respondents harvested or planted.

Map 1 Location by province of 17 districts surveyed.

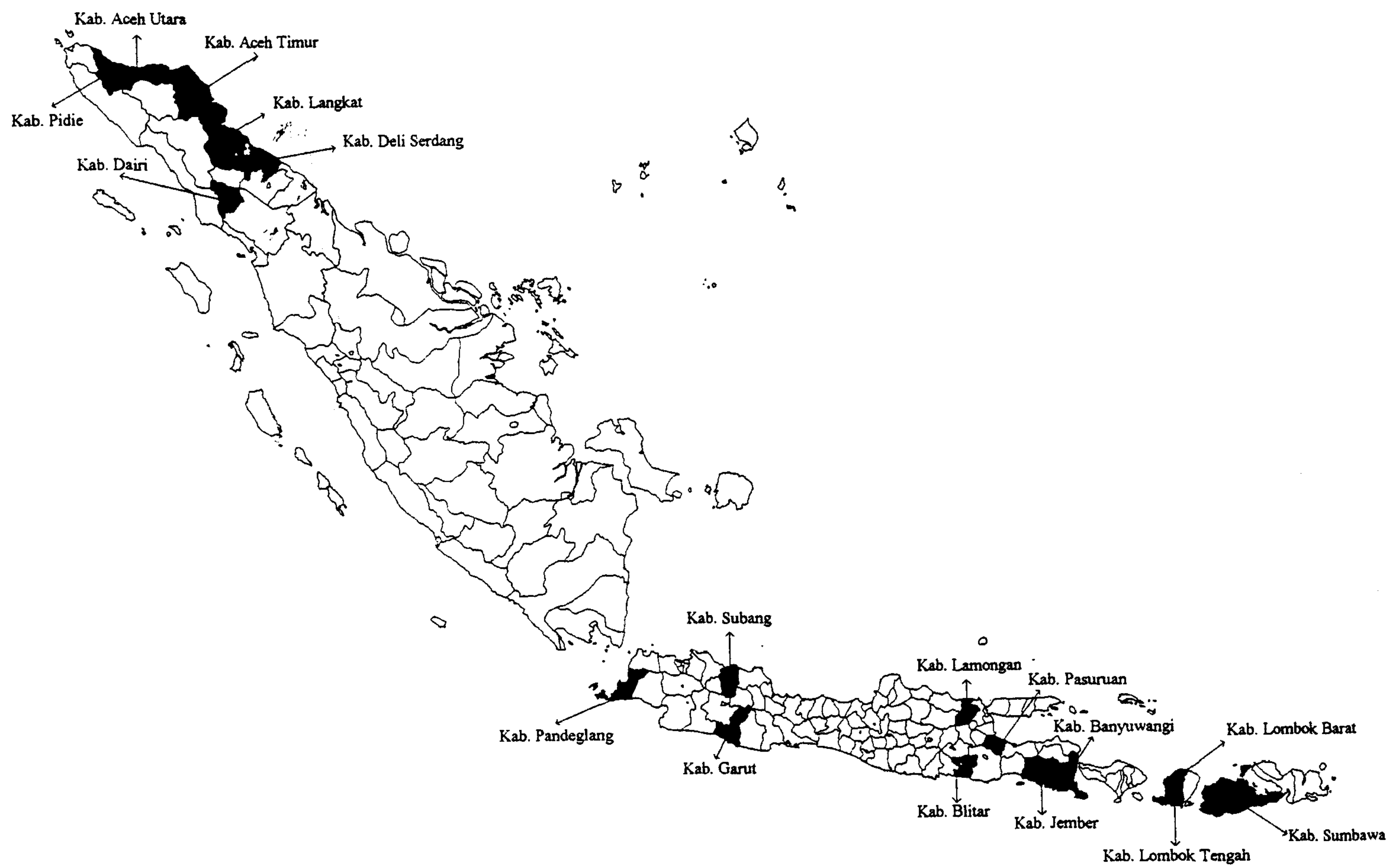


Table 3 Number of farmer- and trader-respondents together with basic data per province included in the survey.

Province	Total area (km2)	Total land under food crops (000 ha) 1994	Soybean planted area ('000 ha) 1994	Estimated seed needs (ton)	Total population (million) 1990	Survey 1995 number of farmer respondents	Survey 1995 number of trader respondents
East Java	48,000	2,342	452	22,600	32.4	210	32
N.T.B.	20,000	1,779	138	6,900	3.5	90	10
D.I. Aceh	55,000	684	166	8,300	3.6	90	11
N. Sumatra	71,000	869	52	2,600	10.8	60	8
West Java	46,000	1,871	98	4,900	38.1	60	8
Study Area	240,00	7,545	907	45,300	88.4	510	69
All Indonesia			1,509	75,500	190		

Source: Central Bureau of Statistics and DGFCH

The field work for the survey was conducted by a team consisting of three senior researchers and five junior researchers, while data processing was carried out by a separate data processing team, consisting of a senior researcher, programmer and six data processing clerks, using a mainframe computer.

A report with detailed findings of the survey is available with the project (Santen et al. 1996).

The local soybean seed supply system

This section describes the local soybean seed supply system. As discussed in the introduction, the acronym *jabal* is given to the local soybean seed supply system which operates in the study area of the five provinces and other soybean production areas of Indonesia. The *jabal* system supplies 66% of all soybean farms with seed, while on-farm saved seed is reported at 34% of the soybean farms.

Operation of the *jabal* system is based on a combination of three features:

- The diversity of physical conditions found in all major soybean producing areas in Indonesia results in three land use types: dryland, rainfed wetlands and irrigated wetlands, located within a short distance of each other.
- Due to the relatively high rainfall with favourable annual distribution, sufficient water is available in food crop producing areas in Indonesia in most years to allow farmers to grow two to three successive crops, among which is soybean. The crop seasons are rainy season, 1st dry season and 2nd dry season.
- The fact that soybean genotypes so far planted in Indonesia appear suitable for rainy season as well as for the first and second dry season plantings (Sumarno 1985).

Soybean is thus grown during three cropping seasons, using one of three land use types. This allows the movement of seed between seasons and land types, thereby avoiding the problem of reduced germination due to seed storage over one or more cropping seasons. Thus, for example, seed needed for dryland plantings during the rainy season is obtained from irrigated wetlands where soybean was planted during the second dry season from the previous crop year. Farmers planting soybean in rainfed wetland during the first dry season obtain their soybean seed from the dryland soybean crop grown during the previous rainy season, and in their turn supply seed for the irrigated wetland soybean crop, which is planted during the second dry season, after which the cycle is repeated.

Some farmers in E. Java, who operate all three land use types, will save soybean seed from the previous crop as planting material for the next crop. Other farmers use the same land use type for three successive crops of soybean in one year, as for example on drylands in Aceh province; they also use farm saved seed. Other farmers, who can only grow one soybean crop per year, plant soybean during the off season on small plots on the bunds or in a corner of their fields to produce seed for the next crop. In other areas, where farmers plant two successive soybean crops per year, they will buy seed for the first crop and use on-farm saved seed for the second soybean crop. Farmers in W. Java province have found a method to store soybean seed mixed with ash in air tight tins. In this way, they are able to keep on-farm saved seed for up to nine months with hardly any reduction in germination and vigour.

However, the majority of farmers (66%) report that they buy seed, at least once per year. This applies in particular to farmers who plant one soybean crop per year and to the first crop of farmers who plant two crops per year. Farmers who buy seed indicate that it is most important that this seed is recently harvested. When buying seed from other farmers or traders, the farmer will assure himself that the seed has been recently harvested, which is the main indicator for sufficient germination and viability.

The team found that in East Java and NTB basically all seed purchased is supplied from within the same district or from an adjacent district. This is feasible as all three land use types are present and all three crop seasons are used for soybean production in these districts. Obviously, farmers living in a specific sub-district will purchase seed from an adjacent sub-district of another district, rather than from a far away sub-district of their own district. The survey consistently found that in all cases when seed was bought it was obtained from within a distance of at most 30 kilometres.

Another feature is that, in most districts, an overlap in time exists between the harvest period of the previous soybean crop and the planting period for the following soybean crop. The survey team actually observed in a number of locations in adjacent fields farmers harvesting, others threshing and again other neighbours already planting soybean, all on the same day. In most areas farmers report that soybean seed is usually planted within one week after being harvested.

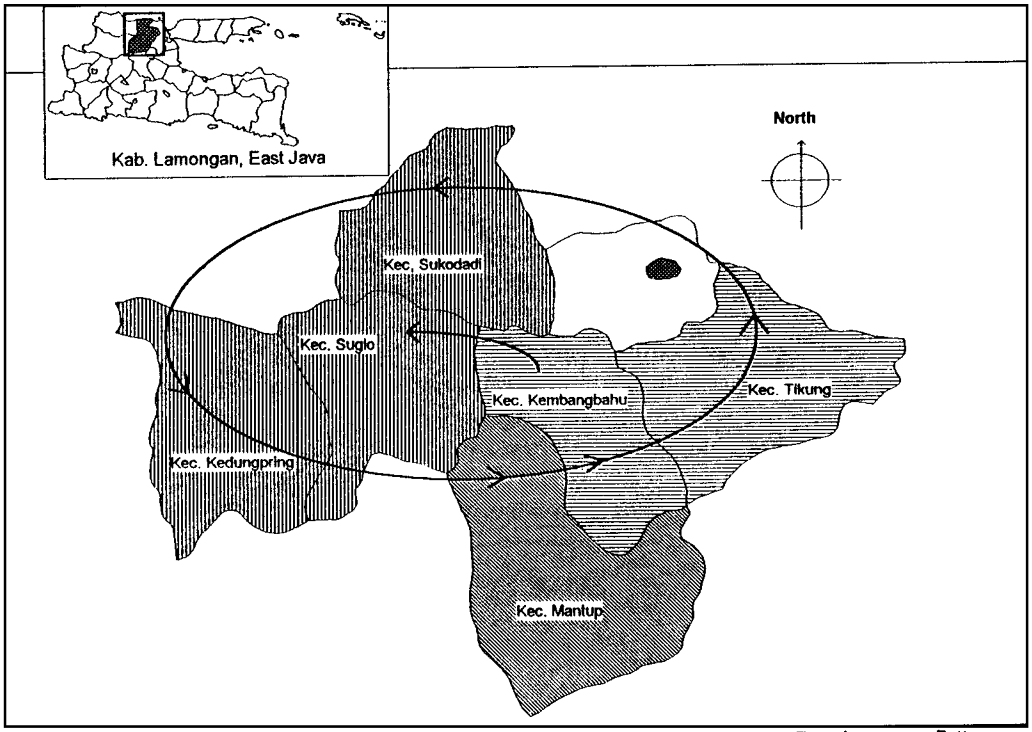
The seed flows discussed above are illustrated in Maps 2 to 6, one for each of the five provinces included in the survey. For all the other districts in the five provinces surveyed, similar maps can be drawn with local seed flows between seasons and land use types. According to staff from the provincial agricultural services of the five provinces, similar seed flows exist in the other districts not included in the present survey.

The local soybean seed and grain markets

The findings of the survey regarding the marketed proportion confirm the general conclusion of the well researched soybean market (Morooka and Mayrowani 1990; Bottema et al. 1987; Hayami et al. 1987; BINUS, 1988a,b; Altemeier and Bottema 1989) The entire soybean crop is marketed, apart from a small amount of grain some farmers keep as seed for their next planting. Most of the crop is purchased by various industries producing food and feed products and a small part is sold as seed.

The survey focused on village and district markets. Information on these was collected through informal interviews with 69 seed and grain traders. The overall conclusion from the survey is that the local soybean seed and grain markets in the study area of the five provinces are well organized. There is practically no direct government intervention or regulation. Differences in soybean prices at various locations and at various levels of the market are largely

Map 2 Soybean seed flow, Lamongan district, East Java.

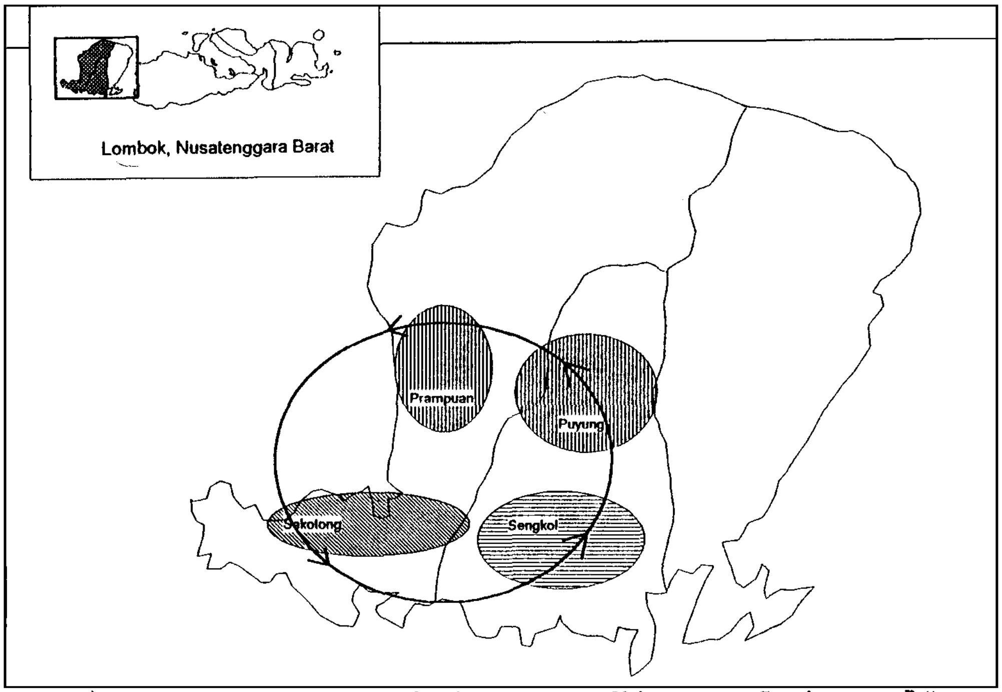


→ Direction seed flow

	Location Sub-District	Major Rainy Season	Cropping 1st Dry Season	Pattern 2nd Dry Season
Dryland	Mantup	Soybean	Soybean	Fallow
Rainfed Wetland	Kembangbahu Tikung	Rice	Soybean	Maize
Irrigated Wetland	Sukodadi Sugio Kedungpring	Rice	Rice	Soybean

Map 2 shows the seed flow in Lamongan district, E. Java province. In this district soybean is planted on dry land during the rainy season in Kecamatan (sub-district) Mantup in the period November to February. Farmers in Kecamatan Tikung and Kembangbahu, who plant their soybean during the first dry season from February to May on rainfed wetlands, buy their seed from Mantup, either directly from farmers or through traders. Farmers in Kecamatan Sukodadi, Sugio, and Kedungpring, who plant soybean on irrigated fields during the second dry season from June to September, in turn buy seed from Tikung or Kembangbahu. When farmers from Sukodadi, Sugio and Kedungpring harvest, farmers from Mantup will buy seed from them for the next year's rainy season crop, starting in November, thus continuing the cycle.

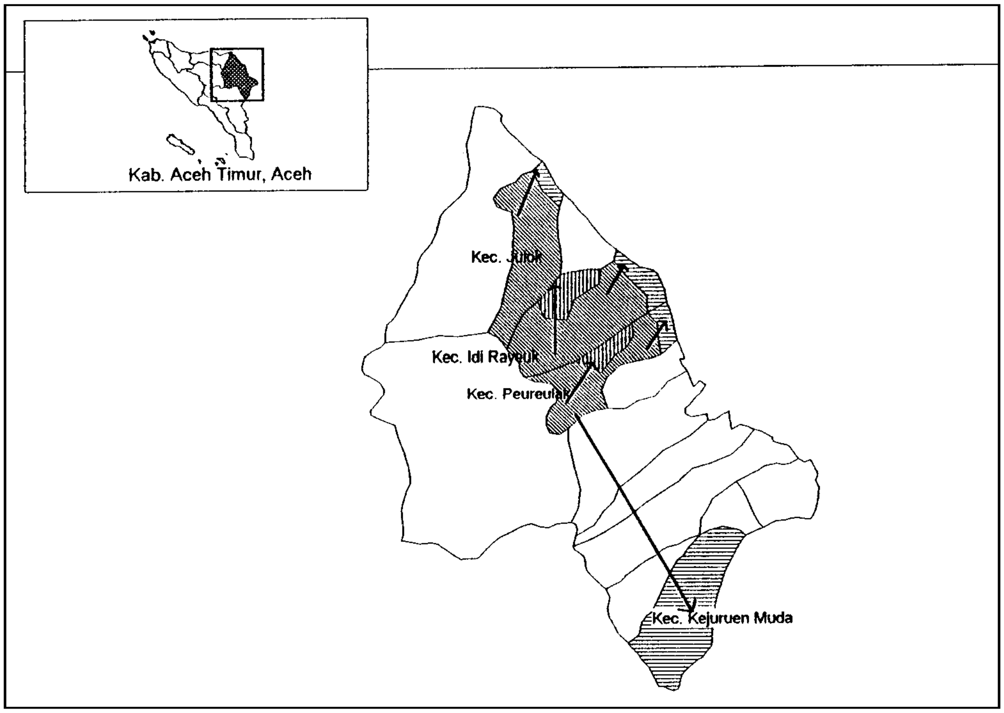
Map 3 Soybean seed flow, Lombok, NusaTenggara Barat.



→ Direction seed flow	Location Sub-District	Major Rainy Season	Cropping 1st Dry Season	Pattern 2nd Dry Season
Dry Land	Sekotong	Soybean	Maize	Fallow
Rainfed Wetland	Sengkol	Rice	Soybean	Fallow
Irrigated Wetland	Puyung Prampuan	Rice	Rice	Soybean

Map 3 shows the situation in Lombok, NTB province. In the Sekotong area, soybean is planted during the rainy season on drylands. From here, seed is sold to farmers in the Sengkol area, where soybean is planted during the first dry season on rainfed wetlands. From Sengkol, seed is sold to farmers in the Puyung and Banyumulek areas, where two rice crops are followed by soybean on irrigated wetlands during the second dry season. Seed from Puyung and Banyumulek is bought by farmers from Sekotong for the next year's dry season crop, continuing the cycle.

Map 4 Soybean seed flow, Aceh Timur district, Aceh.

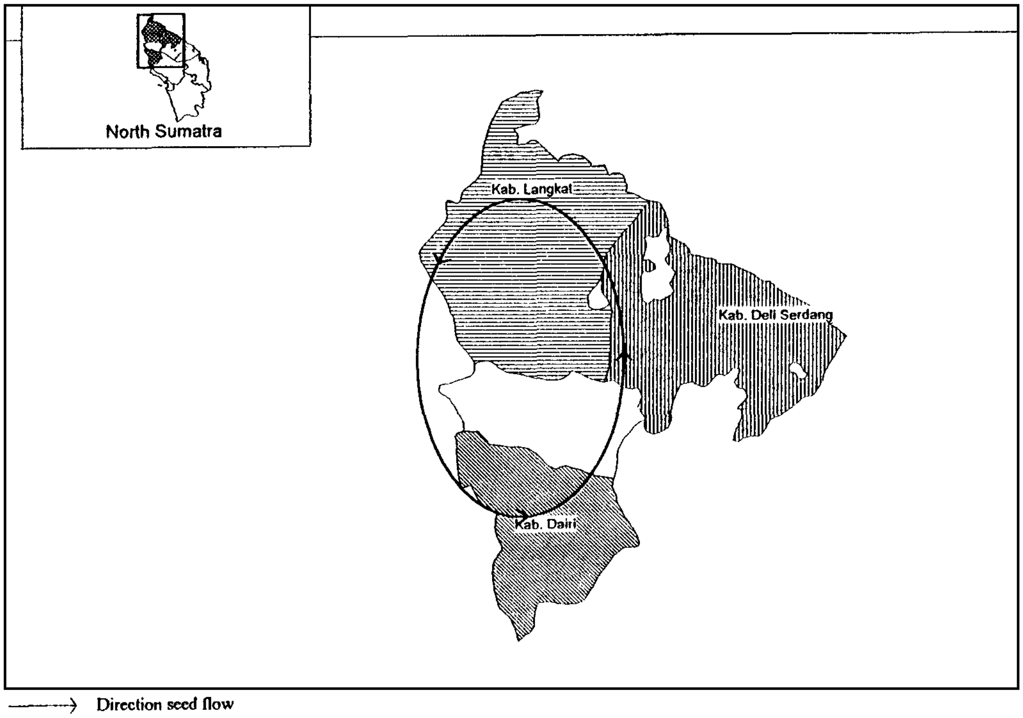


Direction seed flow

	Location Sub-District	Major Rainy Season	Cropping 1st Dry Season	Pattern 2nd Dry Season
Dryland	Peureulak Julok Idi Rayeuk	Soybean	Soybean	Soybean
Rainfed Wetland	Kejuruen Muda Peureulak Idi Rayeuk Julok	Rice	Soybean	Soybean
Irrigated Wetland	Peureulak Idi Rayeuk	Rice	Rice	Soybean

Map 4 shows the situation in Aceh Timur district, Aceh province. In sub-districts Peureulak, ldi Rayeuk and Julok, soybean is planted on drylands during the rainy season. From here, seed is sold for soybean planting during the 1st thy season on rainfed wetlands to farmers in Idi Rayeux, Julok and Peureulak and to far away sub-district Kejuruen Mudi. From this crop, soybean seed is sold for 2nd rainy season soybean planting on irrigated wetlands in Peureulak, Idi Rayeux and Julok sub-districts, respectively. Note that on the drylands in these three sub-districts, there are three successive soybean crops, while on the wetlands there is one or at most two soybean crops per year.

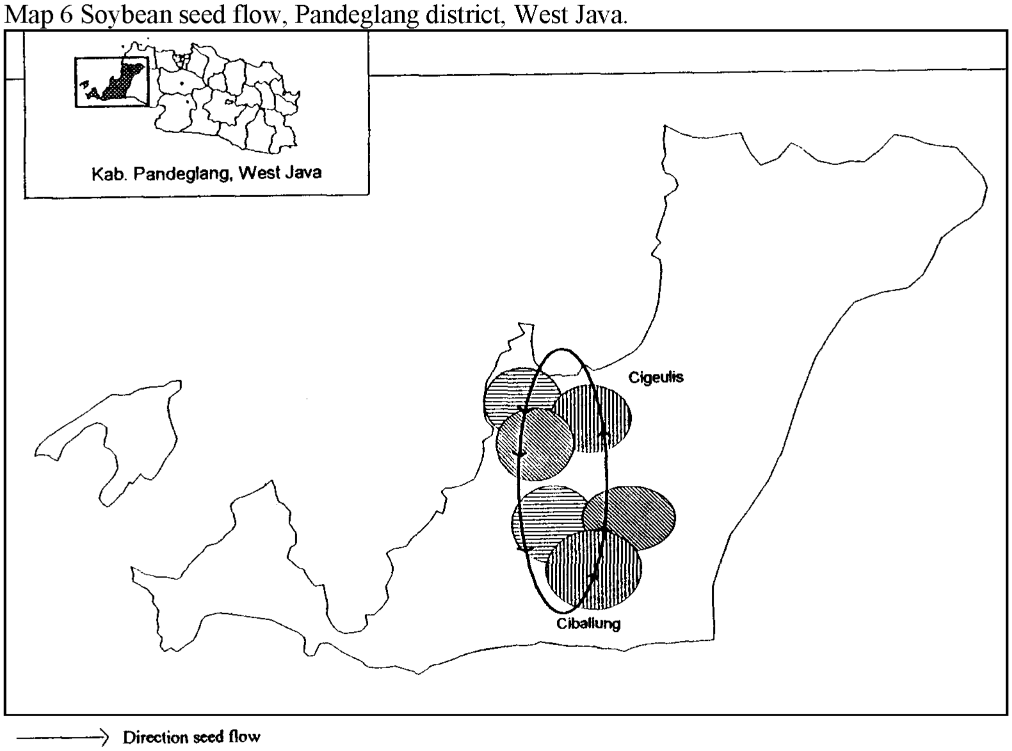
Map 5 Soybean seed flow, North Sumatra.



	Location Sub-District	Major Rainy Season	Cropping 1st Dry Season	Pattern 2nd Dry Season
Dryland	Dairi	Soybean/ Upland rice	Soybean	Soybean/ Fallow
Rainfed Wetland	Langkat	Rice	Rice	Soybean/ Groundnut
Irrigated Wetland	Deli Serdang	Rice	Soybean	Rice

Map 5 shows the situation in N. Sumatra. In this province, soybean is planted on dry land during the rainy season in Dairi district. From here, seed is sold to the Deli Serdang district for soybean on irrigated wetlands during the 1st dry season. From Deli Serdang, seed is sold to Langkat district for soybean plantings on rainfed wetlands during the second dry season. From here, seed is bought for the next rainy season crop in Dairi district, continuing the cycle.

Map 6 Soybean seed flow, Pandeglang district, West Java.



	Location Sub-District	Major Rainy Season	Cropping 1st Dry Season	Pattern 2nd Dry Season
Dryland	Cibaliung Cigeulis	Soybean	Maize	Fallow
Rainfed Wetland	Cibaliung Cigeulis	Rice	Soybean	Soybean/Fallow
Irrigated Wetland	Cibaliung Cigeulis	Rice	Rice	Soybean

Map 6 shows the situation in Pandeglang district, West Java province. Here the major soybean
areas are in Panimbang and Cibaliung sub-districts. In both sub-districts, soybean is grown during three seasons and moves within the sub-district from the drylands during the rainy season to the rainfed wetlands during the 1st dry season and from there to irrigated wetlands during the 2nd dry season .

explained by marketing costs and risks involved. The market operates with near perfect competition. The price at each level of the market system is determined by the price set at the next higher level.

Ultimately, the soybean price at the national level is the pilot price for the entire soybean market system in Indonesia. The soybean price at the national level is determined on the supply side by:

- the soybean import quota set by government for a specific year;
- the soybean world market price for the same year;
- the mark-up for imported soybean determined by BULOG, the national procurement agency;
- the total national production for the same year.

On the demand side, the soybean price at the national level is determined by the demand from cottage industries producing food and from the large scale feed and other soybean processing industries.

Entry to the local market is open and competition is intense allowing no room for traders to manipulate prices except for very short periods of price changes. The conclusion, therefore, is that the soybean market operates efficiently and supports farm production.

Soybean demand and supply

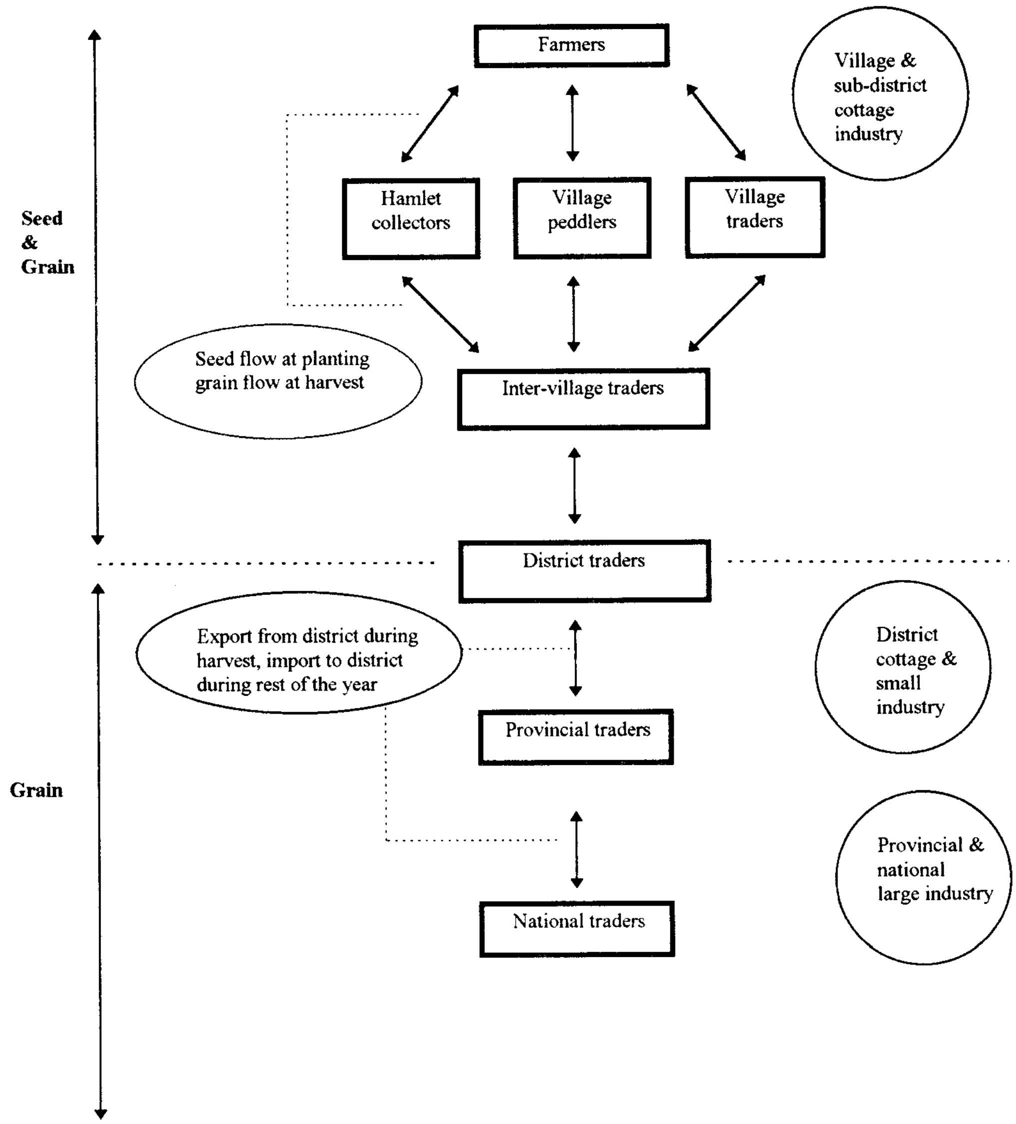
Soybean demand and supply in Indonesia are both determined by two independent sub-sectors. The first subsector on the demand side is the cottage industry which produces tahu (coagulated soybean curd), tempe (fermented soybean cake) and other soybean-based produce directly suitable for human consumption. The bulk of the locally-produced soybean is used by this sub-sector, the annual requirement of which is estimated at 1.8 million tons soybean per year. The second sub-sector on the demand side is the large scale industry producing livestock feed and other industrial produce such as cooking oil, soaps, and lecithin based products. The bulk of the imported soybean is used by this sector and the yearly requirement is estimated at about 800,000 tons of soybean (Lancon 1995).

The first sub-sector on the supply side is locally produced soybean which is estimated for 1994 at about 1.5 million tons and the second sub-sector on the supply side is the soybean import which is estimated for 1994 at 700,000 tons of soybean and 360,000 tons of soybean meal; the latter is equivalent to about 500,000 tons of soybean. The total soybean import for 1994 represents thus approximately 1.2 million tons of soybean.

General features of local soybean markets

This study covers the local market. It includes the market system from farmers through village, sub-district and reaches the district level. Another study of the project reports on markets at provincial and national levels (Schroeder and Legowo 1995). The local market handles both soybean seed and grain. It should be noted that grain and seed are interchangeable and that, during the time of planting, good quality grain is bought and used as seed. This means that the study also covers soybean traders. Movement of soybean seed is. mainly reported within districts and between adjacent districts, although inter-regional trade occurs. During harvest periods, up to 95% of soybean grain is exported from the major soybean producing districts to other parts of the country, mainly to the major urban consumer areas and to feed mills. During other parts of the year, a reversed flow, albeit smaller, occurs, with soybean imported into the same districts to supply the local soybean processing industry.

Figure 1 The local soybean market and its links with the national market.



Categories of traders

Several categories of traders operate in local markets as is shown in Figure 1. The local market has two main sub-sectors i) the farm and village level, and ii) the inter-village, sub-district and district level.

The following categories of traders operate at farm and village level:

- Hamlet and village collectors (HC; pengumpul/penampung). They are nearly always agents for inter-village traders. Farmers from one or more adjacent hamlets bring agricultural commodities they wish to sell to the house of the hamlet/village collector who buys the produce and ships it to the warehouse of the inter-village trader for whom he works, often within two days after buying.

- The village peddler (VP; tengkulak or pedagang keliling) fall in the same category as the hamlet/village collector and operates within a small area covering a few hamlets only. The difference with the hamlet/village collector is that the village peddler visits the farmers' fields or house and buys the soybean directly from the field, usually immediately after threshing. He subsequently arranges transportion of the soybean to the warehouse of the inter-village trader for whom he is the agent. Some hamlet/village collectors and village/peddlers also sell soybean seed and other farm supplies to farmers at the time of planting.
- Village traders (VT; pedagang desa) run shops at the village level and serve customers from a number of hamlets. Village traders buy soybean and other agricultural commodities from farmers at harvest time and supply them, during planting time, with agricultural inputs, including locally obtained soybean seed. During the entire year, most village traders sell groceries and general merchandise to the village population, including farmers. Most village traders operate independently and trade with several inter-village and district traders, selling agricultural commodities and buying inputs, groceries and other merchandise.
-

The following categories of traders operate at inter-village, sub-district and district levels:

- Inter-village traders (IT) specialize in trading in two or three agricultural commodities, including padi (unhusked or rough rice) and soybean. Depending on the local crops, they may also trade in maize, groundnuts, mungbean, tobacco, or other local crops. Operating from their warehouse, most buy produce from a relatively small area, covering typically ten to twenty villages located within one or two sub-districts. For an outlet of their produce, however, inter-village traders often have links with traders far from their own district, and in some cases, even outside their province. They participate in inter-regional trade. For example, some inter-village traders in East Java sell their soybean to Surakarta and Yogyakarta in Central Java. Inter-village traders in Sumbawa district sell their soybean directly to Surabaya, East Java, either by ship or by inter-provincial truck, bypassing Mataram, the provincial capital on Lombok, altogether. Inter-village traders in Aceh sell their soybean directly to Medan, North Sumatra. In the latter case, the buyers are large provincial and inter-provincial traders and soybean processing industries. Some are located in Medan, others are located in Jakarta, but buy through an agent in Medan. Most deals are made by telephone or fax. Many of the inter-village traders are wholesalers of farm inputs, such as soybean seed, groceries and general merchandise. They sell mainly to village traders and hamlet/village collectors and village pedlars.
- District traders (DT) trade only in two or three farm commodities, operating from their ware-houses. The area from which they buy may cover one or more districts, each including ten to twenty sub-districts. Most deals are made by telephone or fax. In most locations, district traders handle both local and imported soybean. They buy imported soybean from provincial traders and sell this to other traders, or directly to district and sub-district level small-scale soybean processing industries. At the district level, traders handle soybean all year round. During harvest periods, they export soybean from their district to other areas, and they import soybean into the district

during other periods of the year to maintain a constant supply to the district's local soybean processing industry. Provincial traders operate similarly from provincial capitals, with inter-provincial trading as their main concern.

Commodities handled

Table 4 gives an overview of the commodities handled by different categories of traders. All traders included in the survey deal in soybean grain. Some also deal in rice as grain (61%), and maize grain (35%) and seeds (20%). Other commodities are handled by a small number of traders only, depending on the local situation. Such commodities include tobacco, chili, pinang, kemiri, vegetables, fertilizers, chemicals, equipment and groceries.

Table 4 Commodities handled by category of trader.

	Category of Trader				
	Hamlet collector and village peddler	Village trader	Inter-village trader	District/ provincial trader	Total
No. respondents per category	13	21	23	12	69
Commodity					
soybean	13	21	23	12	69
path	7	9	21	5	42
maize	3	7	12	2	21
mungbean		5	11	5	21
other commodities	4	10	6	3	23
seed	1	4	8	1	14
fertilizers	2	7	10	1	20
chemicals	1	8	10	1	20
equipment		2	3		5
groceries	2	9	10		21

Market margins for soybean grain sales

The market margin, e.g. the difference between the price the trader offers to the farmer or the collector when buying produce and the price the trader receives when selling the commodity, is determined by four factors: i) the price the trader receives when he sells the commodity; ii) transport costs; iii) handling and processing costs; and iv) the condition of the crop.

Several alternative arrangements are found concerning transportation costs:

- Farmers or hamlet collectors bring the commodities to the warehouse of the trader. The price they receive includes the farm gate price plus the costs of transportation from the farm to the warehouse of the trader. The compensation for the transport is in accordance with the distance between the farm and the warehouse; or
- The trader uses agents to collect the commodities. The trader, through the agent, pays the farmer the farm gate price and himself pays the costs of shipping the commodities from the farmer's field to his warehouse.
- When selling commodities, the provincial trader sends a truck to collect the goods from the village or inter-village trader; or
- The trader rents a truck or uses his own truck to send the grain or other commodities to the buyer and pays the shipping costs himself.

Handling and processing costs do not always apply since most village traders do not process the soybean grain. They try to ship the grain out to the next trader in the chain as soon as possible, often on the same day or at most within one or two days after having bought the commodities, depending on quantities handled, specific location and buying arrangements. However, at the inter-village level some traders state that they further dry, clean and grade the grain before selling it onwards. Obviously, the costs of this and the costs of storage, if applicable, are included in the calculation of their margin.

Before buying, traders assess the condition of the commodity offered on sale. Farmers will receive a reduction in price for their soybean, if the quality of their produce is below standard for one of these four aspects:

- moisture content;
- foreign matter content;
- percentage of damaged grain;
- uniformity of the produce e.g. a pure variety or a mixture.

Table 5 Criteria important to traders when buying soybean.

Quality Criteria	Trader respondents (%)
1. Moisture percentage	
- As 1st criteria	40
- As 2nd criteria	28
- As 3rdcriteria	7
- Not important	25
Traders determine the moisture content by traditional methods (testing with teeth). Only traders at district and provincial levels use moisture meters.	
2. Foreign matter content	
- As la criteria	31
- As 2nd criteria	35
- As 3rd criteria	14
- Not important	20
The percentage of foreign matter is estimated by eye.	
3. Percentage of damaged grains	
- As lst criteria	20
- As 2nd criteria	9
- As 3rd criteria	19
- Not important	52
The percentage of damaged grains is estimated by eye.	
4. Variety-purity (uniformity of colour and bean size)	
- As 1st criteria	10
- As 2nd criteria	6
- As 3rd criteria	6
- Not important	78

Table 5 shows that the main criteria traders use to assess and classify samples of soybean offered for sale are moisture and foreign matter. Varietal purity is of little concern as most traders and the local market show no interest in particular soybean varieties. Most traders accept any mixture offered, provided moisture content and foreign matter percentage of the commodity are within the limits set. This contradicts information supplied by the soybean processing industry, which indicates that the tempe industry prefers large "soft" beans (imported beans are preferred), while the tahu industry is indifferent or has a slight preference for small beans such as those of the locally produced Wilis variety. Both tahu and tempe industries prefer clean and undamaged grain.

Based on the four factors mentioned, the following range of margins is applied'

- Rp 25 and Rp 50 per kg if no transport is involved; and
- Rp 50 to Rp 150 if transport is involved, either for collecting or forwarding or both and further depending on the distance over which the commodity has to be shipped.

Handling costs for unloading and loading trucks at the warehouse of the trader are included.

Soybean seed sales

Early on in each interview, traders were asked in which commodities and produce they traded. At this stage of the interview, only 20% of the traders reported dealing also in seed, but they were in fact referring to a regular trade in rice and horticultural seed during the entire year. In the second part of the interview, after a detailed discussion of the soybean grain trade, the respondents were asked if they ever dealt in soybean as seed. This time 61% of all respondents stated that they did sell soybean seed, but only during a period of two to three weeks per year during the major soybean planting seasons in their district. Without exception, all traders see this as a service to their regular customers from whom they hope to buy produce including soybean grain. The short two week period, once or twice per year, and the service nature of this activity explains why traders did not report on the early phase of the interview seed trade as regular trading line.

In all cases where traders supply seed to farmers, they have to make a special effort to buy freshly harvested soybean from a nearby area where soybean was produced in the previous season. As only relatively small quantities are involved, which moreover must be of good quality, the price of the soybean seed is usually about 50% higher than the current soybean grain price. Furthermore, the trader risks not being able to sell all the soybean as seed, but being forced to sell the balance as grain at a lower price. These conditions very clearly explain why traders see selling soybean seed as a service to their customers, rather than as a regular trade opportunity .

Table 6 shows that traders of all categories sell soybean seed, with the inter-village traders as the most active category of selling seed (74%). This is explained by the position of the inter-village traders, whose trading area is large enough to include all three land use types and seasons. To date, no soybean seed growers' industry has emerged in the study area; one would not expect this in view of the interchangeability of soybean grain and seed. However, some specialization occurs. During intensive investigations in the five provinces, the team managed to meet four soybean seed growers. However, their main business was the production of rice and horticulture seed.

Table 6 Number of traders reporting soybean seed sales during planting time, by category.

	Total number by category	Number of respondents reporting seed sales	Percent respondents reporting seed sales
Inter-village traders	23	17	74
Village traders	21	12	57
District traders	12	7	58
Hamlet collectors	13	6	46
Total	69	42	

The trade in soybean seed is well distributed over time. Forty percent of the soybean seed trade takes place during the December-January period. The trade covers mainly purchase of seed from farmers operating drylands during the rainy season, and the sales to farmers who plant soybean in rainfed wetlands during the next season. Thirty-six percent of the seed trade occurs during March-May and 22% of the soybean seed trade is conducted during the July-August period, serving the irrigated wetland crop plantings.

Traders buy the seed when they anticipate that farmers in the area will start planting soon. Seed is kept in stock for a few weeks at most. When no more planting in the area is expected, traders will sell the balance of their seed as grain.

The research team carefully checked the locations where each trader bought seed. It was found that these were all located within the same district or at most in an adjacent one, but always located near to the trader's residence. In fact, seed is seldom bought from further away than 30 km and in most cases from much nearer. Traders buy seed from an area where they know that farmers planted soybean during the previous crop season and recently harvested their crop. They either buy directly from farmers or through collectors or local village traders, whom they know recently to have bought freshly harvested seed. The need for the knowledge of harvest time of soybean traded as seed is the cause of the relatively small area of soybean seed sourcing.

Based on the interverviews with traders, the following ranges of quantities of seed sold by category of trader have been compiled:

- Twenty-five percent of the traders selling soybean seed, mainly hamlet/village collectors and village pedlars, report selling about 1 ton of soybean seed during each planting period. This represents sufficient seed for planting an area of 18 - 20 ha of soybean.
- Forty-six percent of the traders, mainly village traders and smaller inter-village traders, sell from 2 to 5 tons of seed during each planting period. This is sufficient for planting about 100 ha of soybean.
- Seventeen percent of the traders, mainly larger inter-village traders, sell 6 to 10 tons of seed per planting season, which is sufficient for planting of 200 ha of soybean.
- Twelve percent of the traders, mainly very large intervillage traders and district traders, sell per planting season 15 to 50 ton of seed, which is sufficient for planting of 1,000 ha of soybean.

Traders handle only part of the total seed traded. Most of the seed is traded directly between farmers, either on the market or directly. How this system operates was not investigated in detail in the present study and would need further research, probably through an in depth village study at a few selected locations.

Sales of labeled seed

None of the 69 traders interviewed sells labeled soybean seed. Most were not even familiar with labeled seed except those in NTB and North Sumatra. When discussing the option of labeled and certified soybean seed, most traders stated they would reject certified seed. Many traders would agree with the candid and clear observation by a trader in Jember, East Java:

> "All farmers in my area want freshly harvested seed for planting, as they know that this gives the best yields. They buy the soybean seed from me because they know that this is from farmers who always have produced good seed, with good germination, giving high yields. Farmers here mistrust soybean seed from sources they are not familiar with, such as this labeled seed you are talking about."

The comment on this opinion by the district head of the agricultural office, fully supports the trader's opinion:

> "This trader is completely correct. The turnaround time between the three soybean seasons in our district is so short that there would be insufficient time to introduce certification which involves processing, testing, bagging and labeling soybean seed. The planting for each season starts before the harvest of the preceding soybean crop has been completed. All farmers in our district want fresh seed for planting as this is the only guarantee for good germination. The soybean seed in our district is in general of very good quality. Imposing a certification procedure would not be practical in this situation. This would upset the present efficient seed supply system as it would cause delays in planting and thus result in yield losses, while it would add unnecessarily to the costs, and thus to the price of seed."

Traders do not object to labeled seed as such. Twenty-three percent of the interviewed traders reported selling labeled rice seed and 17% labeled maize seed, in particular commercially produced maize hybrids and improved open pollinated varieties. None of the traders had any objection to trading labeled rice and maize seed, knowing that rice and maize seed remains viable for a long period after harvest.

Soybean grain sales

All four categories of traders operating at the local market buy and sell soybean grain for about one month during the harvest period for each soybean crop produced. In some areas, this is once per year, in other areas two or three times depending on the number of soybean crops produced in the specific area in which the trader operates. Hamlet and village collectors and village peddlers typically collect one to two tons per day for a period of four weeks per harvest period. The total amount handled per harvest period per trader may range from 30 to 60 tons of soybean. Village traders typically collect two to five tons per day with a total of 60 to 150 tons per harvest period. Inter-village traders typically collect from 5 to 20 tons per day with a total of 60 to 600 tons per harvest period. District traders typically collect 20 to 30 tons per day, while some larger traders buy up to 100 to 200 tons per day during the peak period of the harvest, with an estimated total of 600 to 900 tons for the smaller traders and up to 6,000 tons for the larger traders for each soybean harvest period.

Concluding remarks

This section summarizes the major aspects of the local soybean seed system. The summary follows a list of ten issues initially given to the survey team as guidance in its survey activities. These issues cover the traditional soybean seed supply system, and the question of how to introduce improved certified seed into this system.

Farmers' traditional methods of seed production, selection, and storage

Soybean seed, unlike rice or maize seed, rapidly looses its germination capacity when stored, unless special measures are taken. Therefore, in the early phase of the project it was thought that a large proportion of farmers would prefer their own seed. However, about 66% of the farmers buy soybean seed and only 34% of the farmers use on-farm saved seed. Most of the on-farm saved seed used by farmers is from their first soybean crop of the year, which is the case in about 67% of the farms. Typically, on-farm saved seed is planted again, within one or two weeks after harvesting. Other farmers (14%), especially in West Java, have found a way to store on-farm saved seed in air tight tins mixed with ash. With this method, seed is reported maintain adequate germination for one full year. Other farmers (1%) plant soybean on the bunds of their fields or in a small corner during the off season to produce seed for their next crop.

Selection of on-farm saved seed was done on 63% of the farms: 22% of the farmers select seed from the standing crop before the harvest; 31% select the seed after the harvest; 10% do seed selection both before and after the harvest. thirty-seven percent of the farmers using on-farm seed do not apply any seed selection procedures. The number of farmers who do not do seed selection is much higher in the areas where soybean was introduced during the last ten years, such as NTB, whereas the number of farmers selecting seed is higher in areas with a long tradition of soybean production, such as East Java, where nearly all farmers apply seed selection.

Fifty-two percent of the farmers using on-farm saved seed do not store soybean seed. Most of the farmers who store seed use a plastic or gunny bag, placed on a rack or on a concrete floor.

Follow-up investigation of ways and means of saving of seed would seem to be useful.

Measured and perceived quality of on farm saved seed

The most important quality of on-farm saved seed as perceived by the farmer is that germination and vigour is sufficient. During the survey, 89 soybean farmer soybean seed samples were collected by the team and sent to the Malang Research Institute for Legumes and Root Crops for testing, including germination testing. The preliminary findings of these tests show that in nearly all samples germination and vigour is at least sufficient (over 70% germination) or good (over 85%). In general one can conclude that farmers' judgement of seed quality has sufficient validity and reliability. This is a good basis for advanced level field days aiming to demonstrate and introduce new planting material, and possibly, improved ways of judging seed quality.

Farmer's varietal preferences and major characteristics on which these are based

The majority of the farmers in E. Java and NTB (54%) plant the Wilis variety; in Aceh 68% of the farmers plant Kipas putih, a local variety which has a larger bean size than Wilis; while in W. Java, Orba (21%) and Lokon (13%) varieties are popular. Good productivity was one of main reasons given by farmers for the selection of a specific variety (29%). Other reasons included maturity, seed size and colour, and also tolerance to pests, diseases and drought. The spatial distribution of varieties needs more research.

Major factors determining the farmer's choice of types of seed

The farmer's entire soybean crop is marketed, apart from a small amount of grain some farmers keep as seed for their next planting. Both market requirements and growing conditions, therefore, determine the farmer's choice of types of seed. On the production side, these include productivity and relative costs of inputs. On the demand side, the market criteria are important. The main criteria used by traders to buy soybean grain from farmers are moisture and foreign matter content. Some traders also check the percentage of damaged grain, but so far in the market, up to district level, little or no importance is given to varietal purity. There appears, therefore, not yet to be a strong pull from the market for selection of specific varieties. Under the circumstances, the actual availability of a specific variety is probably the main reason for its selection by farmers.

However, during the survey it was found that in one area a premium was given for larger sized beans by the main local buyer, a soybean milk processing industry. This premium was gradually making farmers in this area conscious of the need to produce varieties with specific characteristics.

The actual choice of variety should, in follow-up inquiry, be analyzed in conjunction with availability of a range of varieties as seed. The local existence of various land types in multi-seasonal growth conditions may lead to relatively slow natural spatial dissemination of seed, and thus constrain the available options.

Seed sources and seed suppliers operating in the traditional seed supply and distribution system (the *jabal* system)

Approximately 55-65% of soybean seed is bought and most of this is bought through the *jabal* system. Most of this seed is bought from other farmers (53 to 62% depending on the season), either from neighbours (21 to 28%) or from other farmers, directly or on the local market (32 to 34%). Local traders are another important source of seed supply, providing 41 to 31% of all seed bought, depending on the season. From the traders interviewed 61% sell soybean seed to farmers in their area during planting time, once or twice per year for a 2 to 3 week period.

The structure of seed supply in terms of its sources is thus shaped like a pyramid, where closeness to seed is the main factor. The present study needs follow-up on the bottom level of the pyramid, farmer to farmer seed supply, as well as the top level, inter-regional seed supply.

Quantitative importance of the traditional seed supply and distribution system within the entire soybean seed supply system

Eighty-six percent of all soybean seed purchased by the farmers included in the survey is non-labeled. It can therefore be assumed that all this non-labeled seed is supplied by the traditional seed supply system. The sample of 510 farmers interviewed during this survey does not form a true statistical sample of the entire group of soybean producing farmers in the study area of the five provinces. Yet it may safely be assumed that their situation is typical for the study area. Extrapolating their situation to the overall situation in the study area, it is estimated that most of the soybean purchased by farmers (80 to 90%) is bought through the traditional seed supply system.

Most farmers who buy labeled seed from the formal system have obtained this through participation in special crop improvement programmes organized by the provincial agricultural services. However, a considerable percentage of this seed is pink label seed, which is not certified, but carries only a guarantee of adequate germination (70%).

The Lenggogeni study (1990), the only published study similar to the present study, estimated that certified seed used by farmers represents only 0.6% of total seed requirements. The present study indicates that this amount is higher (6%). One can, however, not infer on the basis of the percentages alone that the use of certified seed is increasing, because of different sampling frames of the two surveys. Elsewhere the total production of certified seed is discussed.

Unlabeled seed from traders: quantities and qualities

Twenty-five percent of the traders, mainly hamlet and village collectors and pedlars, sell an average of 1 ton of seed during each two to three week planting period; 46% of the traders, mainly village and small inter-village traders, sell an average of 2 to 5 tons of seed per planting period; 17% of the traders, mainly larger inter-village traders, sell 6 to 10 tons of seed per planting period; and 12% of the traders, mainly large scale district traders, sell 15 to 50 tons of seed per planting period.

Traders intending to supply seed to farmers make a special effort to buy freshly harvested soybean from nearby areas where soybean was produced during the previous season. Traders selling seed regard this is a service to the farmers - from whom they later hope to purchase grain - rather than as a regular trading opportunity.

It is obvious that traders need to garantee harvesting time as the germination indicator to farmers, and that they therefore source their seed from local farmers. As a consequence, the bulk of traded seed is unlabeled. One would need more field research to verify whether unlabeled seed is indeed recently harvested local seed, with good germination. This issue is addressed elsewhere in these proceedings.

Major factors determining demand for and price of other than on-farm saved seed

The major factor determining the demand for other than on-farm saved seed is the need of farmers to buy seed, if they are not able to save seed from the previous crop (75%). For some farmers, the reason for buying seed is that they perceive the quality of purchased seed to be better than their own seed (20%). The price of soybean seed is about 5C.% higher than the grain price for the same season. Availability and quality are therefore the main factors in price formation.

The role of extension seed in the traditional seed supply and distribution system

Only 14% of all seed purchased by farmers is labeled seed. Of this, 48% was blue labeled or extension seed and 34% was pink labeled seed. However of the total amount of seed traded, including seed supplied by the local and by the formal systems, extension seed forms only 6%. This seed was mainly found in NTB and N. Sumatra, in areas in which government soybean promotion programmes were operating. One can conclude that the importance of extension seed correlates directly with local soybean booster programmes.

Measured and perceived benefits of certified seed compared to unlabeled seed; marketing prospects for certified seed

During the present survey it was not possible to actually measure the benefits of certified seed as the team did not find any certified seed in the field in any of the five provinces included in the survey. Discussions on the possible benefits of certified seed with local officials and traders show that most of the informants are not convinced of the superior productivity of certified seed in comparison with the available soybean seed. The informants furthermore underlined the disadvantage of the higher price of certified seed compared with locally produced seed. The introduction of certification of local soybean seed is also not seen to be feasible, due to the time involved for the certification process, which takes at least one month. This is confirmed by the experience of the four soybean seed growers the team was able to meet during the survey. The three soybean seasons in most areas overlap and most soybean used as seed is planted within two weeks after being harvested. The conclusion, therefore, must be that there is little or no prospect for a market for certified soybean seed.

Intervention and the jabal system

In summary, the multi-seasonal structure of production of the short duration food and industrial crops makes local production of seed possible in all areas researched. The jabal system efficiently supplies seed at a low cost. It is operated by farmers and local traders, and established by local initiative without government assistance. The existence of this local seed system explains why there is little or no benefit for farmers to buy certified soybean seed from the formal seed system. If it cannot be proven to farmers and traders that certified seed material performs better, as is the case to date, one can not expect farmers to change the current practice. The best and most efficient development strategy for government would therefore appear to confirm that new available soybean varieties are indeed superior. If such can not be done, it seems best not to intervene in the jabal system. Once new improved soybean varieties become available, these could be most efficiently introduced using the jabal system, rather than by attempting to create an additional seed distribution channel. The introduction of these new varieties could best be done through a combination of demonstration plots and farm-days. The distribution of small quantities of improved material to interested farmers on farm-days ensures that new varieties enter the jabal system, provided that farmers are convinced of the superior performance of new planting material.

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Market for Palawija Seed in Indonesia

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Introduction

General opinion in Indonesia seems to hold that there is not sufficient quality seed available for palawija (secondary food crop) farmers and that the marketing of seed is a bottleneck. Marketing activities are expected to boost sales of this quality seed with the expected impact of improved yields and farm income. Such impact would contribute to the objectives at the national level, as reflected in the five-year development plans (Pelita V and VI), which put some priority on self sufficiency in soybean and maize.
This paper pays attention to several economic aspects of the seed market of soybean, maize and groundnut, and discusses some results of a survey on inter-regional and regional trade. The paper is structured in three parts covering soybean, maize and groundnut respectively. These parts treat seed demand, availability of certified seed, and identify, where possible, current trends. The paper analyzes seed use at the national level and in five provinces, East Java, West Java, North Sumatra, D.I. Aceh and NTB, and compares this to current production of certified and labeled seed. Sales of this seed to the private sector and quality of produced seed receive attention. Finally, in the three crop sections, we will identify the commercial interest of traders in the seed business and implications for their role in the distribution and sales of certified and labeled seed.

Regional markets and inter-regional trade centres

The most striking feature of the economy of annual food and industrial crops in Indonesia is the high adoption and resulting dominance of improved varieties. In maize and soybean, improved, and for maize also hybrid varieties occupy by far the largest area planted. In East Java, the main regional market and production centre, local varieties occupy only 7%, while hybrid and improved varieties occupy 86% of area planted. The popularity of improved varieties varies among the regional markets. For example, in Aceh local varieties account for 90% of land. The major economic characteristic, however, is the variable size of current variety niches of the seed market. In East Java, the maize variety Arjuna is relatively sizeable with an annual market turnover of 37 billion rupiah, and 21 billion rupiah in hybrid varieties (Table 1). The other regions have far smaller variety niches, ranging from 3.8 billion for Arjuna in West Java to 2.7 for Arjuna in North Sumatra. Hybrids in North Sumatra turn over 10.7 billion and in West Java the hybrid seed turnover is 6.8 billion rupiah. In soybean, Wilis is the market leader in the eastern part of the archipelago with a 26.8 billion rupiah turn over in East Java and 8.2 in NTB. In West Java, the variety Lokon dominates with a turnover of 3.5 billion rupiah, whereas in Aceh the seed market of a local variety (Kipas Putih) reaches 11.2 billion rupiah.

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Table 1 Market niches by variety and geographic span (in billions of rupiah).

Variety	East Java	West Java	Aceh	N. Sumatra	NTB
Maize					
Arjuna	37	3.8	-	2.7	-
Hybrid	21	6.8	-	10.7	-
Local	2.4	-	-	0.5	-
Soybean					
Wilis	26.8	-	-	-	8.2
Local	-	-	11.2	-	-
Lokon	-	3.5	-	-	-

One can conclude that, although the turnover of the seed markets in the major production centres is relatively small at several millions of US$ in the smaller varieties to almost twenty million US$ in East Java, the current picture seems to confirm that investment in seed extends to many production centres in the archipelago.

It is necessary to continue with a very brief sketch of inter-regional trade, as it is the key towards understanding the interaction between demand and supply in Indonesia. The archipelago has distinct population and consumer centres, with concentrations on Java.

The main inter-regional trading centres for soybean, maize and groundnut are Surabaya in East Java, Jakarta, and Medan for the provinces Aceh and North Sumatra. Business is oriented towards these main trading centres and farmgate and collection prices depend on the actual wholesale market prices in these towns. This does not mean, however, that these inter-regional trading and urban consumer centres exert similar influence on trade.

Interviews and field observations showed that in Aceh and North Sumatra, traders at district and sub-district level were mostly active if orders for a certain quantity of these commodities were placed by regular business relations in Medan. This is usually done with a pre-arranged price so that the trader can calculate costs and can set the purchase (collection) price. Although Medan absorbs part of the production, most of the produce from these two provinces passes through Medan and is transported to and sold in Jakarta. It would appear that price formation is, at least partly, a function of inter-regional trade in the archipelago.

In East and West Java such a strong dependency of the trade in agricultural commodities on the market of Jakarta was not observed, although Surabaya in particular plays an important role in inter-regional trade in the eastern part of the archipelago. In Lombok, as is to be expected, the marketing of agricultural production is more oriented towards Surabaya in the province of East Java. It seems probable that, in densely populated East and West Java, a high proportion of the agricultural production is consumed locally or in smaller urban centres, and that single market dependency is not so high.

Soybean

The annual quantity of seed used for the different *palawija* crops can be derived from the annual planted area and the minimum required quantity of seed per hectare for the different *palawija* crops. It is obvious that broadcasting, sowing in rows and number of seeds per hole have a significant impact on the quantity of seed used per hectare. Although for soybean the recommended quantity is 40 kg per ha, farmers usually use more seed per hectare. Farmers do this to offset low germination of seed and to decrease the risk of damage by insects.

Based on the national total area planted (Table 2) of 1,319,755 and 1,509,782 ha in 1986 and 1994 respectively, we can calculate, the national seed use of soybean. Assuming a seed use of 50 kg per ha, aggregate use increased from 65,987.75 to 75,489.40 tons (Table 3). This reflects an increase of 14.40% over nine years.

Table 2 Planted area (in ha) of soybean in five project related provinces and nationwide from 1986 to 1994.

Province	1986	1987	1988	1989	1990	1991	1992	1993	1994	1986-1994 Increase
West Java	93,322	56,016	64,292	86,851	86,851	103,678	131,176	110,286	98,167	5.19%
East Java	433,562	400,919	408,827	410,966	410,966	414,219	471,842	456,347	452,605	4,39%
NusaTenggara Barat	97,334	81,841	104,022	111,663	111,663	118,929	127,825	136,767	138,225	42.01%
D.I. Aceh	101,041	106,371	113,907	179,231	179,231	192,905	109,135	180,098	166,442	64.73%
North Sumatra	23,121	27,378	31,004	30,804	30,804	39,089	190,135	54,088	51,944	124.66%
Total Five Provinces	748,380	672,525	722,052	819,515	819,515	868,820	1030,113	937,586	907,383	21.25%
National Total	1,319,755	1,156,384	1,239,308	1,404,316	1,404,316	1,440,209	1939,175	1,547,585	1,509,782	1440%

Source: BIMAS 1995

Table 3 Seed use of soybean (In tons) in five project related provinces and nation wide from 1986 to 1994.

Province	1986	1987	1988	1989	1990	1991	1992	1993	1994	1986-1994 Increase
West Java	4,666.1	2,800.8	3,214.6	4,34255	4,342.55	5,183.9	6,558.8	5,514.3	4,908.35	5.19%
East Java	21,678.1	2,0045.95	20,441.35	2,0548.3	2,0548.3	20,710.95	23,592.1	22,817.35	22,630.25	4.39%
Nusa Tenggara Barat	4,866.7	4,092.05	5,201.1	5,583.15	5,583.15	5,946.45	6,391.25	6,838.35	6,911.25	42.01%
D.I. Aceh	5,052.05	5,318.55	5,695.35	8,961.55	8,961.55	9,645.25	5,456.75	9,004.9	8,322.1	64.73%
North Sumatra	1,156.05	1,368.9	1,550.2	1,540.2	1,540.2	1,954.45	9,506.75	2,704.4	2,597.2	124.66%
Total Five Provinces	37,419	33,626.25	3,6102.6	40,975.75	40,975.75	43,441	51,505.65	46,879.3	45,369.15	21.25%
National Total	65,987,75	57,819.2	61,965.4	7,0215.8	7,0215.8	72,010.45	96,958.75	77,379.25	75,489.1	14.40%

For the same period in the five provinces Aceh, North Sumatra, West and East Java and Nusa Tenggara Barat, the planted area for soybean increased from 748,380 to 907,383 hectares. This means a seed use expansion from 37,419 to 45,369 tons, or an increase of 21.25% over nine years. This indicates that the area planted and the seed used in the five provinces is growing more rapidly than in the other 22 provinces of the country. The calculated growth for the five provinces is mainly due to a significant growth in the planted areas of the provinces of Nusa Tenggara Barat, Aceh and North Sumatra of 42, 65 and 125% respectively. Such high growth rates are not uncommon in initial expansions of crops. One should take into account that such rapid expansions usually only take place in areas with still small areas planted to the crop concerned.

The most important area for soybean, East Java with 452,605 ha in 1994, shows a growth of 4.39% over the last nine years. This is fairly high for such a densely cropped region.

Although the variety Wilis is grown in most areas, preferences exist for different varieties, for example Kipas Putih in Aceh, Orba near Bandung and generally Davros and Lokon in West Java.

Production of certified and labeled seed

Seed is produced by farmers, seed producers and government agencies such as PT Pertani and Perum Sang Hyang Seri (NSC). In cooperation with farmers working under their supervision as contract growers, NSC and PT Pertani multiply seed to safeguard the supply and the quality of seed for the final consumer.

Government regional and local seed farms, (BBIs and BBUs) under the Directorate of Seed Development of the Ministry of Agriculture have the task of multiplying breeder seed (BS) through different steps into stock seed (SS). This SS becomes available for multiplication by the above mentioned organizations.

From 1989/90 to 1993/94 total seed production of certified and labeled soybean seed increased from 3,555 tons to 10,608 tons (Table 4). This is a growth of 198% over these five years, and this means an increase in production from 5.06 to 14.05% of the total seed use. There was, however, a decrease in production in 1992/93, when production did not exceed 5,770 tons.

Table4. Total production of labeled soybean seed in tons in five project provinces and national total.

Province	1989/1990	%*	1990/1991	%	1991/1992	%	1992/1993	%	1993/1994	%
West Java	191.879	5.40	1,662.222	15.15	2,925.643	25.41	315.491	5.47	2,447.710	23.07
East Java	587.035	16.51	812.257	7.60	2,275.481	0.20	675.853	11.71	778.866	7.34
North Sumatra	645.690	18.16	581.725	5.44	623.332	5.41	377.980	6.55	432.930	4.08
D.I. Aceh	2.293	0.06	1,596.197	14.93	1,683.756	14.63	2,081.634	36.08	490.864	4.63
NTB	104.031	2.93	411.227	3.85	586.009	5.09	178.930	3.10	2,145.120	20.22
Total	1,530.928	43.06	5,063.628	46.97	8,094.221	50.74	3,629.888	62.91	6,295.490	59.34
Total National Labeled Seed Production	3,554.659	100.0	10,689.683	100.0	11,512.543	100.0	5,770.075	100.0	10,607.631	100.0

* Percentage of total yearly labeled seed production

Table 5 Soybean seed production in tons by NSC, 1990-1994.

	1990	1991	1992	1993	1994
Stock	713.60	605.710	227.0	310.0	258.670
Production	4,624.050	5,645.0	2,431.0	5,191.0	4,636.40
Production as % of total national seed use	6.59%	7.84%	2.51%	6.71%	6.14%
Total sales	4,732.146	5,722.506	2,339.704	4,988.533	4,496.494
Total sales as % of total seed use	6.74%	7.95%	2.41%	6.45%	5.96%
Delivery to government projects	4,100.767	5,142.658	1,721.924	3,283.290	1,534.670
Delivery to privat sector	631.359	579.848	617.780	1,705.243	2,961.624
Percentage of production dehvered to private sector	13.34%	10.13%	26.40%	34.18%	65.87%

Source: NSC, Direktorat Pemasaran 1995

Sales to the private sector

Most of the soybean seed produced by the seed farms and other agencies was sold to the government for government intensification projects, such as Supra Insus, Insus, Inmum and transmigration projects. Only a part of the seed production was sold to the private sector in the past. NSC increased its sales to the private sector from 13.34 to 65.87% of its total seed production in the years 1990 to 1994.

For several years NSC has based its activities in the private sector on the Jabal system (*Jabal = jalinan benih antar lapangan* = inter-field seed supply). This means that seed multiplication through SS no longer takes place. This Jabal seed with pink label is not channeled through its normal network of distributors, which handles rice and maize seed, but is sold directly to farmers through farmers organizations (kelompok tani).

PT Pertani sells a range of different farm inputs to farmers. It has only a small interest in the soybean seed business. PT Pertani (Table 6) claims that 25% of its production is channeled into the private market. Total sales of this company decreased from 4,533 to 2,675 tons in the years 1991 to 1994, a decrease of 40.99% over four years.

Table 6 Soybean seed production in Tons by PT. Pertani, 1990-1994.

	1990	1991	1992	1993	1994
Production	4,610.0	6,752.0	3,854.0	4,452.0	2,755.0
Production as % of total national seed use	6.57%	9.38%	3.97%	5.75%	3.65%
Total sales	4,533.0	6,679.0	3,712.0	4,210.0	2,675.0
Total sales as % of total seed use	6.46%	9.28%	3.83%	5.44%	3.54%

Source: PT. Pertani (Persero)

The shifts in trade within the small public proportion of the seed market show expansion of sales to private buyers of NSC and a decrease of PT Pertani's share. There are obviously differences in business strategy between the two major agencies, and it is worth noting that NSC, which expanded its share of sales of seed to private buyers, uses farmers to produce seed.

Quality of certified and labeled seed

Certification should indicate with reasonable exactness a quality, either through indication of origin, or through other description of characteristics. In Indonesia a distinction has to be made between labeled certified and labeled seed. Certified seed is seed of which the genetic heritage is known. It finds its origin in breeder seed (BS) which, through different stages of multiplication, has been transformed into extension seed (ES). In contrast, seed which is only labeled (pink label), but not certified, has unknown genetic or location origin.

Of the total quantity of certified soybean seed in the years 1989/90-1993/94 (Table 7) 86.26% to 98.25% was pink labeled seed. Some of the pink label seed has not undergone field inspection. This seed is called non-field inspected seed: Tidak Diperiksa Lapang (TDL) and TDL seed carries an indication of harvest time.

Table 7 Seed certification of soybean between 1989/90 and 1993/94.

	1989/1990	%*	1990/1991	%	1991/1992	%	1992/1993	%	1993/1994	%
Total yield in tons that passed laboratory test (BS FS SS ES)	488.480	13.74	701.165	6.56	356.062	3.00	865.847	15.00	185.172	1.75
Total yield in tons that passed laboratory test (ES, Blue Label)	357.090	10.04	572.679	5.36	190.786	1.66	664.833	11.52	69.991	0.66
Total yield in tons that passed laboratory test (Pink Label)	3,066.179	86.26	9,988.518	93.50	11,156.481	97.00	4,904.228	85.00	10,422.459	98.25
Total yearly amount of certified seed(all labels)	3,554.659	100	10,689.68	100.00	11,512.543	100.00	5,770.075	100.00	10,607.631	100.00

* Percentage of total yearly seed production.

Source: Sub Direktorat Pengawasan Mutu dan Sertifikasi Benih, Direktorat Bina Produksi Padi dan Palawija, Laporan Kegian Sertifikasi Benih, Tahun 90 1990/91, 1991/92, 1992/93 and 1993/94.

Because a large proportion of certified seed carries the pink label, it is not likely to be of a better quality than the seed farmers produce, since it is of the same origin. The assumption that inspected (labeled) seed carries specific qualities seems not well founded.

Only between 13.74% and 1.75% of the seed produced in the same period comes from an identified genetic source. These percentages include BS (breeder seed), FS (Foundation seed), SS (stock seed) and ES (extension seed). ES seed (known as blue label seed), which should be available for farmers, was not observed in the market during the survey. Production of ES was in the years 1989-1994 only between 10.04 and 0.66% of the total national seed production.

One can only conclude that the quality of certified soybean seed is not likely to exceed the quality of seed from other sources, and that its market share is insignificant.

It seems logical to make some inferences based on the above observations on the nature of certified seed, the very small proportion of palawija seed absorbed by private buyers and the stagnant proportion of government seed agencies of the national seed requirements for palawija crops. The most basic explanation is that the consumer does not acknowledge additional quality of certified soybean seed. The development of marketing activities with the objective of increasing sales will be in vain as long as the final consumer of seed does not recognize the quality of the marketed seed.

Interviews with traders revealed that they are simply not interested in handling inspected (certified and labeled) seed. They observe that there is no demand for this type of seed. The short validity of the label increases their financial risk and recertification of the seed is not the answer for them. It means only that their money is absorbed longer in this seed, which increases cost.

Trade inputs and farm produce

This section on soybean trade is based on the survey and connects this to earlier research reported by Altemeier et al. 1989.

Soybean grain traders sell significant quantities of soybean as seed to different stores and farmers' groups. The choice for the use of seed is based on the exterior of the grain. The criteria are colour, size and variety. Germination is not tested. The farmers and the distributors of the seed are convinced that the germination of the seed is good, because they trust the assurance that it has been harvested recently.

Soybean traders at village and sub-district levels also buy other agricultural commodities such as rice, maize, mungbean and they supply farmers with farm inputs such as fertilizers, chemicals, seed and sometimes equipment. Traders operating at district and provincial levels are more distant from farmers and to not supply inputs. Regional and inter-regional traders are usually specialized in one or two agricultural commodities.

Traders specialized in the trade of farm inputs, who sell rice seed from NSC and PT Pertani and maize seed (hybrids and composites) from different companies, are not interested in selling soybean seed which is labeled, although several are selling unlabeled soybean seed. They complain that there is no demand for labeled soybean seed and that their financial risk is too high. The risk is related to the short validity of the certification label of three months for soybean, which starts on the day of harvesting. Laboratory testing and administrative handling take about four weeks and consume at least 33% of the time of the valid period. This means that traders can have the seed for sale and in store for a maximum of only two months.

If one wants to develop a stronger distribution network through active participation of businessmen in the distribution of blue and pink label seed, the high financial risk for traders of soybean seed has to be reduced. This can only be done by changing the system of certification and by reducing the time necessary for laboratory tests and administrative procedures. To some extent, this already happens as shown by the seed which is certified "non-field inspected". It is questionable whether the efficiency of the market would benefit from participation by government agencies, leaving alone the direction of the current seed legislation.

Seed price

In East Java in 1995, soybean seed prices were between Rp 1100 and 1300 per kg. In Lombok prices for seed were slightly higher. Purchase prices for labeled seed were Rp 1250 - 1500 and sold by businessmen to farmers at prices ranging from Rp 1500 to 2000. For unlabeled seed, the purchase price per kg was Rp 1000 and the selling price Rp 1500. This means that the average gross margin is about Rp 500. In Aceh gross margins between purchase and selling prices were about Rp 300. Selling prices of seed were Rp 2000 for labeled and Rp 1200 for unlabeled seed. None of the traders interviewed during the survey of August/September had seen certified and labeled seed.

Quality standards of grain

Besides the importance of humidity, quality standards of soybean grain are strongly related to its use in the tempe and tahu industries. In Medan a trader came up with three normal classes and a super class of qualifications for soybean (Table 8).

This businessman sells grain to the tahu and tempe industries, but does not clean the grain himself. He explained that there is no incremental gain for him in cleaning. In the tempe and tahu industries, the grain is cleaned with water and thus, he would have to dry the grain before delivery. The tempe and tahu industries are therefore better placed to clean the grain because they do not have to dry it before use.

Table 8 Local qualities and prices of soybean seed.

Classification	Price (Rp/kg)	Quahty standard	Destination
A: Super class	1050-1100	- as for standard I but bigger seeds	tempe
I	900-950	- no foreign matter no dead seeds no broken seeds	tahu
II	800-850	- with foreign matter with dead seeds with broken seeds	tahu
III	600-650	- dead and infested seeds	feed industry

Use of imported soybean

Imported soybean is partly used in the tempe industry and only mixed with locally produced soybean if the above standard of grade A can be achieved. However, imported soybean is usually mized with locally produced soybean in the tahu industry. The mix depends on the availability of imported soybean. In Garut, inland West Java, the mix of imported and local soybean is 70 to 30. Processors say, that if 100% imported soybean is used, the tahu will break into pieces. Therefore the mix with local product is necessary. The presence of the Indonesian Cooperative of Tempe/Tahu Producers (Koperasi Produsen Tempe Tahu Indonesia, KOPTI) in Garut makes it possible to use large quantities of imported soybean.

The prices KOPTI charged in August 1995 to its members were Rp 1050 plus Rp 25 per kg. The Rp 25 is used to form working capital, and it is reimbursed at the end of the year. KOPTI obtains soybean from the Central KOPTI for Rp 810 per kg and further from the Kedele Assosiasi (Soybean Association) and from local farmers. In Cianjur the mix is 70% local and 30% import. In this region KOPTI is not present and the tahu manufacturers obtain imported soybean through local traders, who purchase their grain from different companies in Jakarta.

Quality rewards

Generally farmers do not receive rewards for better quality of soybean. The rewards are captured by the collection traders and district traders, higher in the trade, where grading will be economical and will have the advantages of economies of scale. Moisture content is the only standard at the farmgate level, meaning that farmers will receive a lower price if moisture is too high.

Altemeier et al. (1991) say that the factory gate prices of tempe and tahu show rewards for delivery qualities, which are, with the exception of variety choice, grain size for the tempe industry and soft skins for the tahu industry. It could not be discerned in the survey if preferences of local varieties by the local tahu industry are rewarded and whether the cultivation of these varieties constitute a financial gain for farmers.

This still unanswered question means that research is necessary. In conjuction with the observation by the tahu processors of the need for a mix of imported and local soybean, there might be either scope for processing technology improvement, and, if the observation is true, possible potential for breeding of use specific varieties.

Maize

Use of maize seed

Between 1989 and 1993 the harvested area of maize in Indonesia (Tables 9 and 10) increased from 2,944,199 to 3,312,408 hectares, which is an increase of 12.5% over five years. The companies producing hybrid seed recommend the use of 20 to 25 kg of seed per hectare, but the usual quantity is estimated at 30 kg per ha, since farmers habitually use more seed than recommended. The seed use per ha for composites is slightly higher than for hybrids. The total seed use in 1989 and 1993 can be calculated as 88,326 and 99,373 tons of seed.

Table 9 Harvested area in hectares of maize and groundnuts in five project related provinces and nation wide from 1989 to 1993

Province	Commodity	1989	1990	1991	1992	1993
West Java	Maize	118,605	126,691	103,713	136,670	155,540
	Groundnuts	102,576	107,050	98,191	122,159	94,584
East Java	Maize	1,112,391	1,122,900	1,063,976	1,304,036	1,126,618
	Groundnuts	142,226	139,862	136,615	149,075	154,057
West Nusa Tenggara	Maize	26,569	24,012	26,594	19,525	31,394
	Groundnuts	19,046	18,930	15,884	23,506	20,954
D.I. Aceh	Maize	11,829	27,854	17,023	15,217	20,810
	Groundnuts	16,922	26,703	18,374	20,310	17,899
North Sumatra	Maize	85,388	85,339	93,772	115,974	136,418
	Groundnuts	23,229	19,702	16,505	19,049	26,736
Total of 5 Provinces	Maize	1,354,782	1,386,796	1,305,078	1,591,422	1,470,780
	Groundnuts	303,999	312,247	285,569	334,099	314,230
National Total	Maize	2,944,199	3,158,092	2,909,100	3,629,346	3,312,408
	Groundnuts	620,817	635,014	628,456	719,703	654,778

Source: Statistik Pertanian Projek Penyempurnaan dan Pengembangan Statistik T.P.H. Directorat Jenderal Tanaman Pangan dan Horticultura Jakarta.
Biro Pusat Statistik, Agricultural Survey Production of Cereals in Indonesia 1993, Jakarta.

For the five provinces there was an increase from 1,354,777 to 1,470,780 hectare which, at 8.56%, is below the national average for the years 1989-1993. This smaller growth of the cultivated area of maize in the five researched provinces is due to the insignificant growth of only 1.28% in the province of East Java, which has 34% of the total national maize area. Growth in area planted in the provinces West Java, West Nusa Tenggara, Aceh and North Sumatra was 31.14%, 18.18%, 75.92% and 59.76%, respectively, for this period.

Table 10 Seed use in kg of maize and groundnut in five project related provinces and nation wide from 1989 to 1993.

Province	Commodity	1989	1990	1991	1992	1993
West Java	Maize	3,558,150	3,800,730	3,111,390	4,100,100	4,666,200
	Groundnuts	1,230,840	12,846,000	11,782,920	14,659,080	11,350,080
East Java	Maize	33,371,730	33,687,000	31,919,280	39,121,080	33,798,540
	Groundnuts	17,067,120	16,783,440	16,393,800	17,889,000	18,488,640
West Nusa Tenggara	Maize	797,070	720,360	797,820	585,750	941,820
	Groundnuts	2,285,520	2,271,600	1,906,080	2,820,720	2,514,480
D.I. Aceh	Maize	354,870	835,620	510,690	456,510	624,300
	Groundnuts	2,030,640	3,204,360	2,204,880	2,437,200	2,147,880
North Sumatra	Maize	2,561,640	2,560,170	2,813,160	3,479,220	4,092,540
	Groundnuts	2,787,480	2,364,240	1,980,600	2,285,880	3,208,320
Total of 5 Provinces	Maize	40,643,460	41,603,880	39,152,340	47,742,660	44,123,400
	Groundnuts	25,401,600	37,469,640	34,268,280	40,091,880	37,707,600
National Total	Maize	88,325,970	94,742,760	87,283,000	108,880,380	99,372,240
	Groundnuts	74,498,040	76,201,680	75,414,720	86,364,360	78,573,360

Maize seed production

From 1989/90 to 1993/94 the total production of certified maize seed went up from 2445 tons to 4380 tons (Table 11). This is equal to 2.77% in 1989/90 and in 1993/94 4.41% of the total seed use. The production of maize seed in the five provinces was in the years 1989 and 1994 respectively 93.91 and 93.71% of the total national seed production (Table 12). East Java, where the production of maize hybrids is concentrated, accounts for 83.93 and 89.58% of the total national production. The rather low production of certified and labeled maize seed means that most farmers use their own grain as seed in the next season. Only farmers using hybrids are more or less obliged to obtain new hybrid seed for the next season.

Table11. Seed certification of maize between 1989/1990 and 1993/94.

	1989/1990	%*	1990/1991	%	1991/1992	%	1992/1993	%	1993/1994	°As
Total yield in tons that passed laboratory test (FS,SS,ES)	1,107.981	45.31	1,514.669	43.21	812.088	42.17	1,026.238	24.38	1,289.887	29.45
Total yield of hybrids in tons that passed laboratory test (Blue Label)	1,294.670	52.95	1,798.966	51.32	913.941	47.46	2,630.996	62.51	2,905.733	66.35
Total yield in tons that passed laboratory test (Pink Label)	42.580	1.74	191.80	5.47	199.570	10.37	551.470	13.11	184.106	4.20
Total yearly amount of certified seed (all labels)	2,445.231	100	3,505.435	100	1,925.599	100	4,208.704	100	4,379.726	100

* Percentage of total yearly seed production.

Source: Sub Direktorat Pengawasan Mutu dan Sertifikasi Benih, Direktorat Bina Produksi Padi dan Palawija, Laporan Kegiatan Sertifikasi Benih, Tahun 1990/91, 1991/92, 1992/93 and 1993/94..

Table 12 Total production of labeled maize seed in kg in five project provinces and national total.

	1989/1990	%	1990/1991	%	1991/1992	%	1992/1993	%	1993/1994	%
West Java	205,697	8.41	206,438	5.89	286,150	14.86	206,268	4.9	109,710	2.5
East Java	2,052,195	83.93	2,789,733	79.58	1,236,466	64.21	3,258,532	77.42	3,923,330	89.58
North Sumatra	36,650	1.5	29,590	0.84	42,445	2.2	87,980	2.09	58,011	1.32
D.I. Aceh	485	0.02	64,980	1.85	4,000	0.21	4,200	0.1	400	0.01
NTB	1,250	0.05	33,569	0.96	13,530	0.7	22,713	0.54	12,666	0.29
Total in 5 Provinces	2,296,277	93.91	3,124,310	89.13	1,582,591	82.19	3,579,693	85.05	4,104,117	93.71
Total National Labeled Seed Production	2,445,231	100	3,505,435	100	1,925,599	100	4,208,704	100	4,379,726	100

Source: Sub Direktorat Pengawasan Mutu dan Sertifikasi Benih, Direktorat Bina Produksi Padi dan Palawija, Laporan Kegiatan Sertifikasi Benih, Tahun 90/91, 91/92, 92/93 and 93/94.

Others found average yields of 3,018, 3,566 and 2,330 kg per hectare for Arjuna, hybrids and local varieties, respectively (Roche et al. 1992). The use of F2 of hybrid seed gives a loss of about 10%. This could mean that F2 use is still economically interesting for farmers compared to the average production of local improved varieties.

Between 1989 and 1993, the quantity of certified hybrid seed produced increased from 52.95% to 66.35% of the total annual amount of certified seed (Table 13). However, the nominal volume pink label maize seed, compared to the volume of pink label soybean seed, is rather small. It was only 1.7 to 4.2% of the total production in the years 1989-1993.

Table 13 Comparison of seed use and seed production of maize and maize hybrids between 1989 and 1993.

	Year				
	1989	1990	1991	1992	1993
National calculated seed need (tons)	88,326	94,743	87,273	108,880	99,372
Seed production of certified + label seed (tons)	2,445	3,505	1,926	4,209	4,380
Seed production as percentage of total seed need (%)	2.77	3.7	2.21	3.87	4.41
Hybrid seed production (tons)	1,295	1,799	914	2,631	2,906
Hybrid seed as percentage of total seed production (%)	52.95	51.32	47.46	62.51	66.35
Hybrid seed as percentage of total seed use (%)	1.47	1.9	1.05	2.42	2.92

Hybrid maize seed

The main producers of maize seed in the country are NSC with the composite variety Arjuna and hybrids C-1, C-2, C-3, BISI with Arjuna, CPI-1 and CPI-2, PT Pioneer with the hybrids P2, P4 and P5 and the BBI-Bedali which produces the hybrids Semar I and II selected by MARIF, which were released two years ago.

The private company PT Pioneer is mostly active in the most important production centres of maize, such as East Java, North Sumatra, Lampung and South Sulawesi. BISI is reportedly active in all 27 provinces of Indonesia. In Java it supplies private buyers whereas in other provinces it delivers maize hybrids to government projects. Not much quantitative information could be obtained from PT Pioneer and BISI. The proportion of hybrid seed of the total amount of maize seed used, increased from 1.47 to 2.92% in five years. It is expected by the various companies that, after several years of introduction and extension, the demand for hybrids will rapidly increase. The production of hybrid maize is limited, due to constraints on the availability of land resources and the strict rules concerning multiplication and organization of contract growers.

NSC sometimes uses demonstration plots for promotion purposes. Where extension is concerned, it depends on the activities of the extension officers of the regional agricultural service (Dinar Pertanian).

PT Pioneer and BISI have a dynamic marketing approach. They have a large number of field staff, who supply farmers with technical information, organize farmers meetings, make farm visits and create demonstration plots. Support to the dealer network is sometimes given, and sometimes dealers travel abroad to receive training. Traders are interested in trading maize hybrids, because of low financial risks due to longer validity of the certification (6 months) and the continuity in sales.

Quality rewards and regional and local trade in maize.

Other than foreign matter in grain and moisture content, no quality standards are applied in the maize trade. Moisture has to be reduced to at least 18%. Small pieces of cob are permitted, but they are already taken into account in the price per kg that the collection traders pay to farmers. Size and colour of the grain are not of importance.

Maize not only supplies the feed industry, but is also sold to the food industry, where different standards are applied depending on the final product. It is also used as a substitute for coffee in the local coffee industry. Local use also reveals specific uses of maize varieties.

In Kediri, East Java, a town divided in two by a river, we find in North Kediri the use of local varieties and Arjuna. Traders buy mixes of varieties for the seed industry. In South kediri the hybrid CPI-1 is popular. Here traders keep the CP-1 maize separate, to process this in Kediri for the food industry in Surabaya. The processed maize is later transferred to Surabaya. Here we see a direct link between requirements in the processing and food industries and agricultural production.

The quality standards for human consumption of maize are more specific then those applied by the feed industry. Persons active in the processing of maize into food mentioned, besides moisture content, the following standards: dead grains, swelling capacity, aflatoxin content, colour (preferred is bright yellow), fat content, and protein content. The last two criteria for quality were given by the food industry to the processor of the half product of fine ground (not flour) maize.

Seed marketing of maize

Demand for maize seed, especially hybrids, depends on the importance of maize in the cropping pattern, in regions such as Kediri, where maize is the most important *palawija* crop, the use of hybrid seed is well advanced and the necessary techniques are well known to farmers. Hybrid maize seed producers are well represented in this area. They have their own dealer network and use their own extension officers to inform farmers about the cultivation of hybrids. Sometimes small traders at the village level sell hybrids of the different companies, but this does not cause a problem for the companies concerned. Retail prices of hybrid seed vary. Depending upon the company and the accumulated transport cost to the kiosk, they are between Rp 2500 and Rp 4600 per kg. In regions where groundnut is the main secondary crop and maize is only incidentally grown, local or composite varieties such as Arjuna are used.

Quality rewards

In general the quality rewards induced by the feed industry are absorbed by commissioned and collection trade. There are no discernible quality rewards for maize at the farm level. To some extent this observation is supported by the need for speedy harvest in those areas in Indonesia with a short wet season, such as East Java. The farmers there have likely benefited from the introduction of improved short duration landraces. Because the use of hybrid maize is still limited, it is difficult to say whether a real trend will occur towards the longer duration hybrids. It should not be forgotten that to some extend this may depend on availability of rural employment, enabling farmers to more optimally use their time during the growth season. Demand for hybrids is driven by their high production potential, and demand of this seed is related strongly to the place maize takes in the planting system.

Groundnut

Groundnut receives no specific mention for priority in Pelita V and VI, yet, judging by the area planted, it is a crop of significance. Between 1989 and 1993 the harvested area of groundnut increased from 620,817 to 654,778 hectares which is an increase of 5.57% over five years (Table 9). However, the average area planted over the years did not change much and stayed more or less stable. The growth of the planted area in the five provinces was only 3.37%. The reason for the small growth is the decrease in the area planted in the province of West Java with 7.79%. In East Java, West Nusa Tenggara, D.I. Aceh and North Sumatra, growth was 8.32, 10.02, 5,77 and 15.10% respectively.

With the application rate of 120 kg per hectare, the seed use can be calculated for the years 1989 and 1993 as 74,498 and 78,573 tons (Table 10).

The statistics of seed certification show that between 1993 and 1994 a total of 11,232 and 318,138 kg was labeled, which is for 1993/94 only 0.40% of the total seed use and is insignificant. PT Pertani and NSC did not play an active role in the multiplication of groundnut seed in 1993 and 1994 and have actually no commercial interest in the production of this seed.

Farmers mostly obtain seed from grain traders in their neighbourhood. A grain trader from Cianjur in West Java mentioned that he traveled to Tuban in East Java to buy seed to supply his buyers with fresh seed. This means that an inter-regional Jabal system also works for groundnut.

No significant seed multiplication of groundnut takes place. Traders in groundnut are very capable and willing to supply their clients with seed.

Quality rewards and local groundnut trade

At the farmgate level, groundnut is usually traded in the form of pods (kacang tanah kulit). At the district level, the groundnut is only processed into grain at the moment it can be sold higher into the marketing chain. The processing of groundnut from pods into grain is accompanied by about 35 to 40% weight loss. Quality standards for pods are i) moisture and density, ii) foreign matter, iii) size of the grain, iv) variety (colour), and v) taste.

The moisture content is checked by rubbing the skin of the grain. If it comes off easily, the moisture is good and is assumed to be around 9%. To check whether the grain is fully grown in the pod, one checks by hand as well as by measuring the density. Ten liters of groundnut should have a weight of 6 kg.

Purchase prices

In Meulaboh (West Aceh) the price paid for pods was between Rp 975 and 1050 per kg. Based on 65% of grain weight, the per kg price for grain comes, without processing costs, to Rp 1500. Processing costs were Rp 50 per kg. The price paid for grain was Rp 1550-1700 per kg. Selling prices of grain are based on size and colour, besides moisture. The selling prices of grain with different sizes in Tuban, the production centre in East Java were and for different colours of skin in Blang Pidie, South Aceh are show in Table 14.

Table 14 Groundnut purchase prices in relation to size and colour.

Location	Skin Colour	Price (Rp/kg)	Standard
Tuban,	pink	1,850	6.5 mm
East Java	pink	1,900	7 mm
	pink	2,000	8 mm
Blang Pidie,	white	1,700	
Sourth Aceh	pink	1,660	
	red	1,500	

Variety

The variety is checked by looking at the colour of the skin of the grain. The preferred variety has a rose colour (merah jambu). Businessmen in Tuban (East Java) and Tarutung (North Sumatra) claim that local varieties have a better taste and these groundnuts seem to get a better price than groundnuts produced somewhere else in the province of Aceh. Checks on this aspect gave the impression that the sugar content was slightly higher. If the existence of local preferences is correct, there may be a need for in-depth research and, eventually, breeding.

Seed trade

For groundnut a well integrated seed supply system exists, which is based on inter-regional trade. Tuban farmers buy their seed in Banjarnegara and Kutoarjo (Central Java) as well as in Cianjur (West Java). Seed for Cianjur is bought in Tuban. Grain traders at the district level also sell seed to farmers. Seed trade always takes place in the form of pods, because germination capacity diminishes rapidly after processing into grain. In Meukek (South Aceh) the purchase price of seed for farmers is Rp 925 per kg. Traders take a margin of Rp 50 per kg.

Processing

In Tuban there is competition between Kacang Kelinci, Kacang Garuda and Kacang Ose. The first two types of groundnut are sold on the consumer market in pods and the latter as grain. The first two types are harvested after 75 days, the latter after 90 days.

In Tarutung (North Sumatra) a family enterprise produces roasted groundnuts. The groundnuts are obtained from farmers in the neighbourhood directly before processing. They are soaked in water for one night, then heated in a drum with sand over an open fire, and roasted over three hours. The daily capacity is 100 kg. After processing they are divided by quality standard and packed. First quality is packed in bags of one kg and the second quality in bags of around 100 grams (between 80 and 95 grams). The first quality in sold for Rp 5000 per kg and the second quality Rp 100 per bag, which comes to an average of Rp 1145 per kg.

In Pematangsiantar (North Sumatra) the ASLI Food stuff Manufactory, which makes high quality snacks, requires a special quality of groundnut. They pay Rp 2350 per kg for locally produced full grown groundnut. Imported groundnuts are not wanted, because they are partly broken and because they have been stored and consequently lost their taste.

Quality awards

In the survey we did not discern rewards for better and use-specific quality at the farm level. This is so because most of the trade at the farmgate level is in pods. Usually contract harvesters make a transaction with growers. Another reason may be that traders, through the supply of seed, locally influence the varieties planted by farmers, which may enable them to exert some area-specific monopsonistic powers. Higher up in the trade chain, rewards for grain are captured.

General conclusions

With regard to the present trends in production and market share of certified seed in Indonesia, one has to conclude that only in the case of hybrid maize is there an existing, though small, market share. One cannot observe a clear trend as yet. The contribution of earlier released varieties however, has clearly set the market; local inquiries have revealed that there are local consumer preferences and entrepreneurial responses. Perhaps, the latter consideration is of more importance than the absence of quality rewards at the farm level. There is a need for in-depth local follow-up research, which could look at local initiatives to adapt production to consumption, either through choice of variety, as seen in groundnut, or through mixes of varieties as observed in the case of both soybean and maize.

It has become very clear that inter-regional trades, together with local trade, are essential in seed supply as well as in the product sales. Quality requirements are set by industries of varying scale. The feed industries are usually, but not always, large scale, whereas the tahu/tempe business is mainly carried out by small and cottage industry. The future of the palawija market for both seed and products depends on the continuity of business, with stability in manufacturing operation, farmers, trade and final product manufacturers depending on one another.

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Assessment of the Costs of Soybean Seed Production in Indonesia

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Introduction

The information used in the following analyses was generated from visits to agencies related to the palawija (secondary food crops) seed sector in five provinces: East Java, West Java, North Sumatra, Aceh (Daerah Istimewa Aceh) and NTB (Nusa Tenggara Barat). Many agencies in these provinces were included in the survey. In addition, visits were made to the Jakarta head offices of government departments and companies concerned with seeds and farm inputs. Research institutions were also visited. Soybean production in these five provinces represents approximately 60% of the national production, estimated at around 1.7 million tons in 1993. Approximately 30% of national production originates in East Java.

The information and analyses are presented in the following order:

- overview and general conclusions;
- seed certification, the responsibility of the government's *Balai Pengawasan dan Sertifikasi Benih* - BPSB (Seed Control and Certification Service - SCCS), facilities which are found in each province;
- soybean breeding and production of breeder Seed (BS), the responsibility for which lies with the government research institutions, primarily *Balai Penelitian Tanaman Kacangkacangan dan Umbi-umbian* - BALITKABI (Research Institute for Legume and Tuber Crops - RILET);
- production of foundation seed (FS) and stock seed (SS), funding for which mainly stems from central government to the *Balai Benih Induk* - BBI *Palawija*, (Central Seed Farm for *Palawija*), one of which is normally found per province, (around 17 ha), and from provincial or district government to the *Balai Benih Utama* - BBU (Main Seed farm) of which there may be many per province, (around 7 ha each);
- production of extension seed (ES) which is occasionally undertaken by the BBI and BBU, but more often by growers on contract to government owned enterprises, i.e. *PT Pertani* which has seed processing centres in most provinces, or *Perum Sang Hyang Seri* (Perum SHS or National Seed Corporation - NSC), which has centres in seven provinces. These agencies process the seed and arrange for its distribution to farmers. Most soybean seed at this level is, in fact, not ES but pink label seed (see below), and is generally unrelated to the BS, FS, SS chain;
- production of ES and pink label seed by private growers, processors and distributors, all of which are very small scale.

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Overview and general conclusions

Despite the importance of soybean production, which has increased from around 870,000 tons in 1985 to around 1.7 million tons in 1993, the use of certified seed appears to be of minor significance at the present time.

During 1993 and 1994, the government's annual purchases of seed through PT Pertani and NSC averaged around 8,000 tons, but since then there has been a sharp decline in requirements. Almost all of this was pink label seed which is produced from seed which can be of unknown origin, but which is of a known variety. It is sometimes field inspected and always tested for moisture content, germination capacity and purity, in terms of foreign matter content.

Reasons given for the low effective demand for certified seed include the following:

- good locally produced beans, used as seed, are as good, or possibly better, than certified seed, and that the locally produced product is generally cheaper;
- promotional efforts are inadequate;
- availability of the required variety at the time and of the quality required is poor.

There is no doubt the present informal system well serves the needs of most farmers and that, with good husbandry, many farmers achieve reasonable yields from locally purchased seed. Furthermore, many seed producers and distributors consider that soybean seed is difficult to handle, with its rapidly declining germination capacity when stored under normal conditions.

It is evident from the small quantities of seed, certified or not, which are sold by small scale seed growers, that some farmers are willing to pay prices up to twice the food bean price for a product that they trust. There is further evidence that farmers are willing to pay substantial sums for seed; from the Project survey, it was found that many farmers used seed rates far above the standard 40 kg/ha as their way of insuring against poor germination rates.

A detailed exercise, presented in Appendix 1, was carried out to determine the overall costs of the present soybean seed production system and to indicate what the potential could be, if a significant market for certified soybean seed were to develop. At the various assumptions applied, it is possible to estimate the total cost of the programme by stage in the multiplication chain, the net production cost of seed by unit weight and class, the total production of seed by class, and the production areas required. It describes six scenarios all based on the initial assumption that one ton of BS is made available for multiplication. The scenarios are as follows:

Scenario 1 describes what should happen if current government target yields were to be achieved, if FS and SS production stages are handled by the BBI and BBU and ES by contract growers, if current official prices are applied, and only direct costs are taken into account. It shows a theoretical profit and production of over 11,000 tons of ES.

Scenario 2 shows the impact, in terms of overall programme costs, of increasing the cost burden, by including all the costs, both direct and overhead incurred by SCCS, the producers of BS, and the BBI and BBU. It shows that what was a profitable venture can readily become a very high cost one. It assumes the same yield levels as in Scenario 1.

Scenario 3 indicates the impact on seed production and costs of using the yield levels and seed utilization rates which were found to be achieved in our survey in the analysis. This brings this scenario into line with the pattern of seed production, by class, of the actual national situation. It indicates that for one ton of BS currently placed in the system, total net development costs are of the order of Rp 350 million for the production of around 100 tons of ES, less than 1% of that which could be produced.

Scenario 4, using the same physical achievement assumptions as in 3, indicates at what prices the seed, at the various steps in the process, would have to be sold if each of the agencies concerned were to completely cover their costs. At present efficiency levels, it can be seen that ES would have to sell at over Rp 4,750/kg, a price far beyond that which any farmer would be willing to consider.

Scenario 5 attempts to bring hope back into the system, and using production targets which are realistically achievable, shows that the system could be brought to a break-even cost position if the full cost of seed were passed on to the next step and a market could be found for around 7,000 tons of ES, selling at around Rp 1,750/kg.

Scenario 6 is a modification of 5 and shows that a substantial profit could be made if an ES price of Rp 2,000/kg, approximately twice the food price, were to be applied and if the private sector were capable of handling the ES production. It assumes that it would be possible to find a market for most of the ES produced. It should also be appreciated that the price of Rp 2,000/kg for ES would, however, only be acceptable if real benefits from its use are forthcoming and if the present soybean price holds up.

Should soybean prices be allowed to approach border parity values, given the existing strong competition from alternative crops such as maize, vegetables and tobacco, interest in soybean could wane. The private sector, which currently comprises only small scale operators, is likely to take some time before it would be in a position to handle the volumes of seed indicated.

Certification

This section outlines the general activities of the seed certification agencies at the provincial level, the Balai Pengawasan dan Sertifikasi Benih (BPSB), and describes the various seed classes and the criteria applied, the extent of soybean certification undertaken in the study provinces and the budgets of these BPSB. It also attempts to estimate the approximate real cost of certification.

Introduction

Certification of seed is undertaken by BPSB; there are 13 such centres within the country and each of the five provinces studied has one. In the case of NTB, the centre also serves NTT and East Timor and the West Java BPSB covers DKI Jakarta.

Each BPSB normally comprise five sections, with one for administration and four covering technical aspects. These technical sections have the following duties:

- variety evaluation, (covering rice, palawija crops, vegetables and fruit), testing promising lines, testing existing improved varieties, identifying prospective mother trees, inventorising and evaluating local varieties and purifying local promising lines;
- seed certification, which includes field, harvesting, processing and storage inspection, taking samples, checking the packing and labeling, registration of seed producers and organizing varietal check plots;
- seed testing, involving routine tests (moisture content, seed purity, varietal purity, germination rates) and special tests (heterogenity, viability, vigour, seed weight and health);
- seed marketing control, involving the registration and inspection of seed merchants, collecting data on seed sales, and the checking of seed samples.

Whilst the main activity relates to the certification of rice seed, certification of palawija seeds is also significant. In some cases, fruit tree labeling is a substantial activity and makes a sizeable contribution to overall revenue.

Seed classes and the certification criteria are summarized in Tables 1 and 2.

Table 1 Seed classes

English Type	Abbreviation	Indonesian Type	Abbreviation	Label Colour
Breeder	BS	Penjenis	BS	none
Foundation	FS	Dasar	BD	white
Stock	SS	Pokok	BP	purple
Extension	SS	Sebar	BR	blue
Pink		Merah Jambu **	BBM *	oink

* BBM = Benih berlabel merah jambu.
** There are two types of Merah Jambu.

Although both are grown from seed of known variety, but maybe of unknown origin, one is both field tested and lab tested (for moisture content, seed purity and gemination capacity), whilst the other is only lab tested, and bears the suffix TDL, (tidak diperiksa lapangan), or not field tested.

Table 2 Criteria used for certifying various classes of soybean seed.

Seed Class	Moisture Content (% max)	Seed Purity (% min)	Foreign Matter (% max)	Other Variety (% max)	Germination Rate (%, min)
Foundation	11.0	98	2	0.1	80
Stock	11.0	98	2	0.2	80
Extension	11.0	97	3	0.5	80

Table 3 provides a summary of staffing, financing and seed certification activities for 1993/94 and 1994/95.

Each BPSB produces an annual report and these follow a fairly similar pattern. They are, however, not completely standardized. At the headquarter level, there is concern about the data recording capability, and a realization of the monitoring constraints that the present system imposes. Attempts are being made by headquarters to disaggregate the total costs and identify the real costs involved in performing its various functions, as a prelude to determining what would be a reasonable revised fee for seed certification.

The certification data for soybean were extracted from annual reports for the SCCS for the five study provinces for 1993/94 and 1994/95 (Table 4).

Table 4 Soybean seed certified in the five provinces in tons

Seed class	1993/94	1994/95
Foundation	17.4	20.2
Stock	39.6	54.4
Extension	38.6	167.0
Pink label	5.813.8	1.820.9

These data highlight the very limited production of extension seed and indicate low effective multiplication ratios between descending seed classes. It should, however, be appreciated that it can take several years to move from BS to ES.
The 1994/95 ES production was sufficient to plant around 4,000 ha, or 0.4% of the total soybean cropped area in the five provinces (907,000 ha in 1994).

Budgets

The various BPSB receive funds from a number of sources normally including:

- a routine budget, or DIK, which covers the basic salaries of civil servants, rice allowances. office operation, and some traveling allowances;

Table 3 Summary of BPSB financing and activities - project provinces.

	Budget Sources													
	Staff		Routine		APBN	APBN Breakdown:						APBD Total 2	Total	
	Permanent (No.)	Temporary (No.)	Salaries (Rp M)	Other (Rp M)	Total (Rp M)	Admin. (Rp M)	Varietal (Rp M)	Certification (Rp M)	Testing (Rp M)	Markets (Rp M)	Other (Rp M)	Total (Rp M)	Budget (Rp M)	Fees (Rp M)
D. I. Aceh														
1993/94	101	5	266.1	31.1	151.6	53.8	22.3	44.2	12.5	18.7	0.0	ND	448.8	7.5
1994/95	108	4	ND	ND	302.2	111.0	32.6	96.9	41.2	20.5	0.0	ND	ND	ND
North Sumatra														
1993/94	102	7	297.5	40.2	189.4	63.5	26.7	60.5	12.6	25.9	0.0	34.0	561.1	19.0
1994/95	103	7	300.6	46.2	286.4	63.1	31.1	121.2	39.0	0.0	31.6	44.0	677.2	21.5
West Java'														
1993/94	190	29	473.5	51.3	696.1	193.7	27.0	144.1	32.8	74.0	0.0	50.0	1,270.9	ND
1994/95	198	29	493.7	77.3	924.8	90.0	422.4	0.0	0.0	0.0	75.2	0.0	1,495.8	61.2
East Java														
1993/94	145	13	359.2	58/0	410.8	124.9	34.5	164.9	29.6	53.7	3.4	12.5	840.4	98.8
1994/95	150	15	397.8	93.8	578.3	79.3	33.7	297.6	47.2	52.0	66.5	20.1	1,088.0	102.9
NTB														
1993/94	128	28	305.0	63.0	373.1	239.4	27.3	63.0	15.5	28.1	0.0	36.6	777.7	15.0
1994/95	124	ND	340.8	9.6	600.9	ND	ND	ND	ND	ND	ND	45.4	996.7	15.6

	Activities												
	Padi Certification				Palawija Certification				Soybean Certification				Trees
	Certified		Pink Label		Certified		Pink Label		BD	BP	BR	Pink	Labeled
	Area 3 (Ha)	Passed (Tons)	Area 3 (Ha)	Passed (Tons)	Area 3 (Ha)	Passed (Tons)	Area 3 (Ha)	Passed (Tons)	Passed (Tons)	Passed (Tons)	Passed (Tons)	Passed (Tons)	('000)
D. I. Aceh													
1993/94	1,035.9	393.2	64.0	77.0	64.1	42.8	3,865.0	2,172.0	1.6	0.0	0.0	2,148.0	30.0
1994/95	1,088.1	802.5	118.0	0.0	369.0	189.5	1,145.0	625.0	3.8	0.4	3.6	595.0	252.5
North Sumatra													
1993/94	1,996.0	2,605.0	9.0	0.3	150.0	38.0	1,092.0	591.0	0.8	1.4	0.0	550.5	445.3
1994/95	2,328.0	4,314.0	20.0	9.5	169.0	36.0	664.0	316.0	2.5	2.3	0.0	248.0	579.9
West Java													
1993/94	8,092.0	13,142.0	4.0	13.0	101.0	42.6	1,159.0	1,490.0	2.1	10.3	9.9	1,490.0	533.2
1994/95	10,775.0	21,171.0	ND	NDO	301.0	117.2	ND	ND	2.0	7.3	16.7	ND	839.1
East Java													
1993/94	8,384.0	19,555.0	158.0	781.0	1,437.0	3,642.1	770.3	1,310.9	12.0	17.9	20.3	1,246.3	3,069.4
1994/95	10,027.0	23,737.0	161.0	1,569.0	1,650.0	6,147.0	28.3	1,020.7	7.6	12.5	62.9	900.3	1,562.8
NTB													
1993/94	1,121.0	3,176.0	138.0	220.0	192.0	80.0	442.0	663.0	1.0	10.0	8.4	379.0	233.7
1994/95	1,682.0	2,178.0	278.0	195.5	278.0	118.0	15.8	152.5	4.3	31.9	82.8	77.0	245.5

Source: BPSB Annual Reports 1993/94 and 1994/95. Notes: I Including DKI Jakarta; APBN breakdown incomplete; 2 Salaries, Other, ABPN and APBD; 3Area inspected.

a project budget, or APBN, which allocates specific amounts to each of the five sections mentioned above covering hired labour, materials, more travel costs and other operational costs; a contribution, or DIPDA, usually fairly small, from the provincial level, (APBD Tingkat I or APBD I).

The overall costs of these BPSB are very significant, ranging, in 1994/95 from around Rp 560 million for North Sumatra to almost Rp 1.5 billion for West Java (including DKI Jakarta). Generated revenues are very small in relation to overall costs and in 1993/94, for example, D. I. Aceh raised a total of around Rp 7.5 million, approximately 2% of its annual budget. In 1994/95 East Java, which generates the greatest revenue, raised earnings of around Rp 103 million, around 9% of its annual budget. It would be very difficult for the agencies to approach full cost recovery as, to achieve this, unit fee rates would have to be increased to unrealistically high levels.

Each BPSB has an asset inventory, but not all could provide a valuation. In East Java, however, this amounted to around Rp 450 million, presumably based on purchase prices. Of the total, approximately 35% was for office equipment, 23% for laboratory equipment, 18% for the land and buildings and 24% for transport facilities. The low valuation of land and buildings at around Rp 83 million presumably reflects the fact that the valuation was made in 1982.

The real cost of certification

The unit cost of seed certification was estimated, by taking those elements related to rice, palawija and vegetable seed certification within the budget allocations to the certification and standard laboratory analysis components of the APBN budget, (ie excluding the varietal evaluation, marketing and retesting components) and allocating the routine and APBD budgets on a proportional basis. This a fairly crude method, and those with a greater understanding of the procedures may well wish to modify this approach. Because the data from East Java are the most complete and because the biggest volume of certification takes place here, the estimations are based on data from this province.

Details of the costing exercise are given in Table 5, which shows that the calculated actual cost of seed certification is approximately Rp 33,000 per hectare, compared to Rp 1,500 which is the current official fee. With regard to analyses costs, the present level of Rp 2,000/ton certified appears to be about sufficient, assuming that the budget allocations for this activity do reflect the actual cost involved. Given that, on average, two sets of analyses are involved for every ton of produce certified, it would appear that budget allocation to this activity may well be rather tight.

These costs do not take account of any capital depreciation and, as mentioned earlier, the inventory for this province indicates a total original purchase value of assets at around Rp 450 million. Given that many of the items have a fairly long working life (buildings, office equipment, laboratory equipment), it would probably be reasonable to use an annual depreciation rate of around 8%. On a simple straight line basis, this would add an extra Rp 36 million per year. In relation to the overall annual cost of Rp 1,088 million, this would increase costs by around 3%.

For our costing purposes the real cost of certification has been estimated at Rp 34,000 per ha and the analysis cost at Rp 2,000/ton.

The above exercise relates to full certification. Where standard pink label is concerned. the costs would be lower because fewer field visits are involved, and a rate of say 75% of the full cost would probably be appropriate. With pink label, not field inspected, the costs would be substantially less, at, say, 30% of the full certification cost.

Table 5A Estimation of actual BPSB certification and analysis costs (based on 1994/95 East Java budgets and activities).

Component	Unit		
Total overall budget[1]	million Rp	1,088.0	
Total APBN budget [2]	million Rp	576.3	
		Certification	Standard Analysis
Total APBN allocation [2]	million Rp	222.0	40.0
% of overall APBN budget [3]	OA,	38.5	6.9
Total allocation, including share of other budget [4]	million Rp	419.1	75.5
% of certification budget for arable crops [5]	%	100.0	69.9
Budget allocated to arable crops [6]	million Rp	419.1	52.8
Area inspected for certification [7]	Ha	12,570.0	na
Average cost of certification	'000 Rp/ha	33.3	na
Standard analyses carried out [7]	No.	na	16,379.0
Average cost of analysis	'000 Rp/analysis	na	3.2
No. of analyses/ton certified [7]	No.	na	0.5
Analysis cost per ton certified	'000 Rp/t	na	1.6
Present Fees:			
- Certification	'000 Rp/ha	1.5	na
- Analysis	'000 Rp/t	na	2.0

Notes: [1]Inclusive routine, APBN and APBD allocations.
[2]As detailed in 1994/95 Annual Report
[3]Total allocated to certification or standard analysis as proportion of total APBN.
[4] APBN budget adjusted to include the non-APBN allocations on a proportional basis.
[5]Virtually all certification applies to arable crops. Standard analyses cover a range of activities: see analysis data below.
[6] Total adjusted budget available to arable crops.
[7] Refer to data below.

Table 5B 1994/95 Sununary of certification and analysis activities.

			Numbers of Analyses for:			
Commodity	Tons Certified	Ha Inspected	Certification	Market	Extension	Total
Padi	25,300	10,368	11,980	4,743	484	17,207
Maize	6,140	2,007	3,903	702	342	4,947
Soybean	984	176	414	49	302	765
Groundnut	68	8	41	0	5	46
Green gram	13	11	12	0	3	15
Vegetables	1	0	29	407	0	436
Total	32,470	12,570	16,379	5,901	1,136	23,416

These calculations reflect conditions in what is likely the most cost efficient BPSB and also reflect the relative advantage that East Java has over others, where traveling distances are much greater and crops are much more widely dispersed.

In the costing of seed production under present conditions, certification and analysis have been valued at Rp 17,000/ha for FS, Rp 15,000 for SS, and Rp 10,000 for ES/pink label, all inclusive. These rates which emerged from our survey include, presumably, the additional cost of assisting with the provision of transport to the fields requiring inspection. The logistic problems involved in visiting small areas of seed production, often in scattered and remote locations, with three or four visits per season, should not be underestimated.

Variety development and breeder seed production

This section comprise details concerning the current activities related to varietal development and breeder seed production at RILET, details of RILET budget and allocation to the soybean sector and an estimation of the cost of breeder seed production and the cost of new variety development.

National BS programme

The national breeding programme features around ten varieties. In 1994/95, for example, 6.2 tons of soybean breeder seed (BS) were distributed to the provinces. A breakdown of distribution shows that Wilis represented around 75% of the total and the remaining allocation was shared between Lokon, Lumajang Bewok, Cikuray, Malabar and six other varieties, including Krakatau, Dieng, Rinjani, Kipas Putih and Tampomas.

The dominance of Wilis as the most widely used variety of soybean is confirmed by the farmer survey undertaken by our Project, which covered five provinces. Of the seed purchased by farmers, Wilis represented 60%, Lokon, Orba (1974) and other improved varieties 5% each, and the remainder was described as local.

Taking BPSB varietal inventory data for 1994/95 for East Java, Wilis represented 70%, No 29 7%, Samarinda 4%, Orba 3%, Galunggung 2%, other improved varieties (12 types) 5% and local varieties 9%. For Aceh, in 1994/95, local varieties represented 70%, Kipas Putih 13%, Orba 9%, Wilis 4% and other improved (5 varieties) 4%.

Prospects for improved varieties

In Indonesia there are probably around ten scientists who are highly experienced in soybean breeding. Around five senior breeders are currently involved in a breeding programme. Apart from RILET, which is discussed below, it was mentioned that there was some soybean variety development activity at the Central Research Institute for Food Crops, Bogor, Bogor Agricultural University, Sudirman University, Purwokerto and Padjajaran University, Bandung. Scientists working at some of these institutions were involved in the development of the last three released varieties.

Discussions were held with RILET, the main institution now concerned with soybean, groundnut and green gram breeding, varietal preservation and the production of BS for existing varieties. They held out little hope of any significant breakthrough in terms of finding new varieties of these crops which would provide significant increases in productivity in the near future. It was also pointed out that the well established BS, FS, SS to ES chain was not really appropriate in the case of self pollinated species.

Others suggest that it could well be possible to develop new varieties of soybean for Indonesia, which could make a significant impact on productivity, through contact with other countries which are more active in breeding than Indonesia and through the strengthening of the present, rather limited, programme being undertaken here. In this connection, it may noted that the CGIAR system does not specifically include soybean in its crop package. Regional funding of food legume research networks through UNDP/FAO has recently been terminated.

It should be mentioned that, in Indonesia, soybean can yield in excess of two tons per hectare in farmers' fields where the agro-climatic conditions are ideally matched to the particular variety. There would appear to be some development potential still to be exploited in identifying which of the existing varieties produce best in particular locations.

Whilst the prospects for soybean were said to be rather poor, those for green gram and groundnuts were even less encouraging. Breeders held out little hope of any significant interest in new varieties, unless government policy changed and these two crops received higher priority in the extension and credit programmes.

Although green gram is certainly far less important than soybean, with a 1993 total production of around 320,000 tons and little relevance in international trade, this is not the case with groundnut. Total groundnut production in 1993 was around 640,000 tons with a market price virtually double that of soybean. Furthermore, there are significant imports; in 1993 around 110,000 tons were imported at a total cost of around US$ 60 million or US$ 546/ton. These should be seen in the context of soybean with a 1993 national production of 1,470,000 tons and imports of around 700,000 tons worth US$ 190,000 million or US $271/ton cif Indonesia. It should also be borne in mind that soybean meal imports were around 360,000 tons in 1993, worth US$ 92 million or US$ 254/ton cif. To produce this tonnage of meal would require almost 500,000 tons of soybean.

Breeder seed production at RILET

RILET, previously MARIF, comprises the main office and the surrounding Kendalpayak station, plus four other stations within East Java, Jambegede, Genteng, Ngale and Muneng. It has a total staff of just over 300 permanent members plus around 100 others who receive honoraria. RILET, with its satellite stations, produced and distributed significant quantities of seed for palawija crops in 1992/93 and 1993/94 (Table 6). Most of this was probably breeder seed. Other stations, outside East Java, also produced such seed but, since being granted its new status, from now on it is anticipated that MET will produce most legume BS.

Table 6 Production and distribution of seed by RILET.

Commodity	1992/93		1993/94	
	Production (tons)	Distribution (tons)	Production (tons)	Distribution (tons)
Maize	12.1	8.3	7.9	1.5
Soybean	6.6	4.6	3.7	1.3
Groundnut	5.2	2.7	1.2	0.6
Green gram	1.1	0.6	0.6	0.1

FILET budget

RILET had a total budget in 1995/96 of around Rp 2,400 million, comprising a routine budget, DIK, of around Rp 1,270 million and a Project budget, APBN, of Rp 1,130 million.
An asset valuation has yet to be obtained, and in its absence an approximate value has been proposed. Using the value of the facilities of BPSB, East Java, as a guideline, it is noted that the total asset value is approximately Rp 450 million. Given that RILET employs around 400 staff compared to the 165 at BPSB, it is suggested that the RILET asset value would be in the order of Rp 1,100 million. At an 8% annual depreciation rate, this would increase total annual expenditure by around Rp 88 million, or an extra 4%.

Allocation by research activity

Table 7 summarizes the present budget arrangements at RILET and attempts to apportion the unallocated part of the total budget by activity.

Work activities are planned in detail and for 1995/96 these were classified into 12 groups. Within each group specific topics are identified and, to facilitate planning and budgeting, the extent of activity within each topic is expressed in toms of numbers of research units. Some topics comprise one unit, some more. The total research units for 1995/96 were 386 of which the total number concerned primarily with soybean was 144 and another 34 were shared with other crops. It can be seen, if 30% of these shared units are arbitrarily allocated to soybean, that approximately 40% of RILET activities are concerned with soybean.

The APBN budget is broken down by group, but the routine budget is not. For calculation purposes, the routine budget has been allocated equally on a research unit basis and Table 7 indicates the total research unit cost by group, and the total allocation to soybean related activity. These data indicate that approximately 29 units are concerned with varietal preservation, development and breeder seed production, costing around Rp 177 million (US$ 80,000) and the remaining 127 units are concerned with improving technology, disease control and related issues, and are worth around Rp 832 million (US$ 380,000).

Table 7 RILET research programme 1995/96, million Rp.

	Research Units		Soybean Units		Budget (Total Programme)				Budgets (Total) Per Unit[6]			Budget (Soya Only) Total'		
	Total	%	100%	Part[1]	Rout[2]	APBN[3]	APBN[4]	APBN[5]	Rout.	APBN	Total	100%	Part	Total
Administration	0	0	0	0	0.0	90.1	0.0	0.0	00	0.0	0.0	0.0	0.0	0.0
Plasma Conservation	21	5	2	0	69.1	49.7	4.8	54.0	3.3	2.6	5.9	11.7	0.0	11.7
Breeding	69	18	27	0	226.9	178.2	17.2	193.7	3.3	2.8	6.1	164.6	0.0	164.6
Cassava/Sweet Potato	22	6	0	0	72.4	52.7	5.1	57.3	3.3	2.6	5.9	0.0	0.0	0.0
Biological Improvements	17	4	7	0	55.9	42.2	4.1	45.9	3.3	2.7	6.0	41.9	0.0	41.9
Soya Management	40	10	40	0	131.6	167.4	162	182.0	3.3	4.5	7.8	313.5	0.0	313.5
Plant/Environment	56	15	0	0	184.2	1465	14.1	159.2	3.3	2.8	6.1	0.0	0.0	0.0
Biological Control	52	13	32	0	171.0	125.6	12.1	136.5	3.3	26	5.9	189.3	0.0	189.3
Epidemiology	37	10	16	3	121.7	102.6	9.9	111.5	3.3	3.0	6.3	100.9	18.9	119.8
Post Harvest	15	4	0	2	49.3	35.8	3 5	38.9	3.3	2.6	5.9	0.0	11.8	11.8
Green Gram/Tubers	17	4	0	0	55.9	40.9	3.9	44.5	3.3	2.6	5.9	0.0	0.0	0.0
Soya/Padi	20	5	20	0	65.8	43.9	42	47.7	3.3	2.4	5.7	113.5	0.0	113.5
Dryland Palawija	20	5	0	7	65.8	50.4	49	54.8	3.3	2.7	60	0.0	42.2	42.2
Total	368	100	144		121,269.6	1,126.0	100	1.1260				935.4	72.9	1,008.3

Source: of budget/research unit data: FILET, Malang Notes:

1Assumed 30% soybean. 4 % of total APBN (excluding APBN admin) allocated by group.

2 Routine budget, salaries etc 5 APBN, by group, including allocation from APBN admin.

3Development budget, APBN. 6 Unit routine and APBN budgets by group. ' Total allocation to soya related units.

The cost of this research should be seen in the light of the overall gross value of total current soybean production, at approximately 1.7 million tons x Rp 1 million/ton. A 1% increase in this production would be worth Rp 17 billion or US$ 7 million.

Cost of breeder seed production

Of specific concern to the current exercise is the production cost of BS, which in this year has been allocated, in overall terms, to two research units worth approximately Rp 12.2 million. It is estimated that RILET would produce around two tons of BS, giving an average cost of production of around Rp 6.1 million per ton.

In addition to this cost should be added an allowance to cover the depreciation of the capital cost of the substantial infrastructure and equipment stock which has been developed over the years. As discussed above, this could increase these costs by around 4%, making the overall cost around Rp 6.3 million/ton; this value has been applied in the overall analysis.

Cost of new variety development

To provide an indication of the cost of new variety development, it is suggested that a simple measure would be to take current annual expenditure at RILET. In this year the total of 27 research units earmarked for this work are worth approximately Rp 165 million. Allowing for a further 4%

for capital depreciation, a total of Rp 172 million has been used in the overall analysis. Spread over two tons of BS production, the unit cost of development per ton of BS produced is thus around Rp 86 million/ton.

Foundation and stock seed production

This section comprises a discussion of study province and national production of FS and SS, the present data collection system, the funding systems which apply to the BBI and BBU and the productivity of these stations. Also discussed are the specific findings of our survey and the calculated costs of soybean FS and SS.

National production of PS and SS

Within the whole country there are around 26 BBI (palawija) and more than 44 BBU (palawija), with a potential seed production area of over 1,I00 ha. In 1992/93, the last year for which fairly complete records are thought to exist, the total cropped area for palawija crops was around 1.450 ha. There is probably a total potential cropped area of at least 2,500 ha. During 1993-1994 palawija cropping intensity was around 127% plus further areas devoted to rice. Over the 1991-1994 period, soybean represented around 55% of total palawija cropping. Seed yields were very low, and for soybean were less than 300 kg per ha during I99I-1993.

Data on the planned and actual national production of foundation seed (FS), from the distributed BS (6.2 tons), and production of SS from the previous year's FS for 1994-I995 are shown in Table 8:

Table 8 Planned cropping area (ha) 1994/95 and actual production (tons) 1994/95.

Seed Production	Planned Cropping Area (ha)		Actual Production(t)	
	National	5 Provinces	National	5 Provinces
BS to FS	224	82	21.4	13.1
FS to SS	425	182	13.8	10.2

Sources: Laporan tahunan, Pengadaan dan Penyaluran Benih Sumber, TA 1994/95, Subdit Benih Tanaman Pangan 1995.

At a very modest yield assumption of 800 kg cleaned seed per hectare. the planned national production BS to FS area should have yielded approximately 180 tons and the planned FS to SS area around 340 tons. The above data appear to indicate, in the case of FS, achievement was around I2% and, for SS, it was around 4%. It should be mentioned that NTB was responsible for a substantial proportion of the combined total national production for the two seed types.

It is believed that the 1994/95 data somewhat understate actual achievement, as a study of the BPSB reports for the same year for the five study provinces indicates total FS production of around 20 tons, SS of 54 tons and ES of I66 tons for these provinces. In that year, these provinces received around 30% of the total BS distributed. Based on the production from these five, it could be estimated that national production of FS would be around 65 tons, SS around 180 tons and ES around 550 tons. At present we are not sure what the real situation is. The staff involved in seed production data monitoring are aware of the problems in securing reliable and complete information, and confirm the view that totals are probably underestimated.

Data recording and availability

For the BBIs there is a standard procedure, whereby their activities are reported back to the Jakarta head office. It does not, however, cover all aspects of their activities and records on-station appear to be less formally structured. Experience in the field was that, whereas most of the data required by the surveyors was available, it came in a variety of formats, some of which were not part of a standardized system. For BBUs, which are generally answerable to the district level, data recording is less structured. Furthermore, production reports are not normally sent to the provincial level, and much of the information is not included in the national statistics.

Data on budget allocation, cropping patterns, production, staff numbers and salaries, were generally readily available. The actual breakdown of the way the budget funds were utilized was generally not available. Whilst most stations had an inventory of buildings and equipment, there was little information on the capital value or the means required to calculate capital depreciation charges.

Physical inventories are available for the BBIs at the national level; there are, however, no values given and the data are not sufficiently detailed to enable, for example, the identification of shortfalls in the capital requirements of the stations.

Funding systems

Despite their generally small size in terms of hectares and budget allocation, activities are often very complex, with more than one budget source and objective. Funds maybe provided from national project, APBN, regional project, APBD, and routine sources.
Sometimes the total funding available is insufficient to allow cropping intensities to match the full potential of the station; in some cases the land lies idle for part of the year or it is used for income generation purposes by the station staff or by local farmers. According to our survey, overall cropping intensities were, however, quite reasonable, and with one or two exceptions it appeared that only minor increases in intensity could be expected. Natural conditions dictated that on several stations they were unlikely to be able to achieve intensities much in excess of 200%. Probably as a partial consequence of the high cropping intensity, some of the crop yields were very poor, with crop inputs spread rather thinly.

While seed production is the declared aim, station managers find themselves in a dilemma, and it is not always clear whether their main priority is seed production, the creation of revenue or pendapatan ash daerah (PAD) or the overall efficiency of the station. These objectives need not necessarily be mutually exclusive. It is suggested that the satisfaction of the PAD requirements tends to take priority.

It is noted that the provincial government of West Java is currently organizing training for BBI and BBU managers, with a view to changing the current funding system to one where there is a revolving fund and where, presumably, station managers have a freer hand in planning the cropping activities on their stations. The outcome is awaited with interest.

Productivity

Productivity levels between stations are very variable and on many they are very low; sometimes this is because of natural conditions, such as lack of water or pest and disease attack and sometimes because the allocated budget is insufficient to cover the costs of providing a full technical package. Whilst the crop condition on some stations was good, there were also some very poor examples. Not all stations are situated in locations which are ideally suited to their role.

Several stations are heavily over-staffed and many have equipment which is old or unused; on the other hand, many lack the equipment and facilities which are required. It appeared that all struggled to find ways of managing their budgets to satisfy their role as seed producers and to keep their facilities and equipment in good working order. Whilst the APBN palawija budget of around Rp 1.2 million/ha appeared to be generous, (and sometimes significantly larger than that allocated through APBD), it has to be appreciated that such budgets are often needed to cover part of the indirect costs incurred at the stations. In some cases, specific budgets are provided for such activities, sometimes not.

So far, the general conclusion for the BBIs is that only where they have access to year round irrigation sources, or where rainfall is adequate to support round-the-year cropping, is there a chance for them to be successful. It would appear that combined rice-palawija seed stations are generally more appropriate than purely rice or purely palawija ones. There seems little point in operating stations at levels below full potential capacity. Where they are used to full capacity, the heavy fixed costs are spread wider, weed and pest build-up is minimized and more efficient use is made of residual fertility.

Many of the BBUs are very small and where there are more than two or three permanent staff, it is difficult to envisage how they could ever hope to be efficient in real cost terms.

Soybean FS and SS production at BBI and BBU

Cropped area and production

On the eight stations surveyed, there was a total farmland area of 106 ha. Allowing for those locations where the potential cropping intensity was less than 300% because of insufficient water supplies in the dry season or because of high altitude, the total potential on-station cropping area was calculated at around 267 ha providing a potential cropping intensity of around 253%.

Total actual cropped area was 321 ha, consisting of 246 ha on-station for soybean BS to FS and FS to SS, and 75 ha off-station for soybean FS to SS production. The actual on-station cropped areas, where palawija and rice seed production were financed by government funds of various sources, indicated an overall cropping intensity of around 233%. At about 92% of the theoretical cropping intensity, the utilization rate was very high. Some of the remaining areas, for which no funds were made available, were in fact used by employees and others for cropping. Three stations organized contract growers to produce soybean seed FS to SS, most operating on a production share basis. In 1994/95 such schemes covered 75 ha.

Of the total on-station cropped area, approximately 53% (131 ha) was sown to soybean. Of this, 33% was BS to FS and the remainder was FS to SS. Five stations grew rice, usually in the wet season (46 ha); the remainder confined their interests to palawija crops. All stations visited grew soybean (131 ha on-station and 75 ha off-station cropped areas), seven grew maize (47 ha on-station cropped area), three stations grew groundnut (12 ha on-station cropped area), and three stations grew mungbean (10 ha on-station cropped area).

Of the total soybean production of 135 tons, 94 tons were classified as seed, which consisted of 19 tons of FS (21%) and 75 tons of SS (79%); 41 tons were disposed of as non seed quality beans. The quantities of FS and SS declared do not match very well with the BPSB records; this may partly be because some seed produced in one year is not certified until the following year.

Overall yields of soybean were very variable, ranging from 396 kg/ha to 1,300 kg/ha, and averaging 654 kg/ha, while the yields of crops classified as seed ranged from 323 kg/ha to 915 kg/ha and averaging 456 kg/ha (Table 9). Overall seed output was 70%, ranging from 45% to 85%. The average yield of soybean seed at the government seed stations seems to be extremely low.

Production costs

The government contribution towards the direct production costs, excluding seed which is believed to be provided without cost, ranged between Rp 945,500 and Rp 1,225,000 from APBN sources (APBN - Murni and APBN - MEE) and between Rp 753,750 and Rp 975,000 from APBD I and routine budgets. Details of the actual costs incurred were also obtained and, in general, costs matched fairly closely the allocated budgets. The following discussion will deal mostly with the actual costs rather than with the official budget allocation, since our main concern is the actual cost of seed production.

Table 9 Per hectare average yield of soybean seed production at BBI/BBU, 1994/1995.

	North Sumatra		West Java		East Java		NTB		Average
Description	BBI Gabe (I + II)	BBI Tanjung Selamat	BBI Plumbon	BBU Karang Pawitan	BBI Bedali	BBU Labruk	BBU Kejayan	BBI Puyung	BBI/BBU of Study Area
A. Soybean Seed									
1. By Season: MH	320	279	318	500	568			-	361
MK I	486	382	402	411	581	1,050	-	543	469
MK II	300	480	210	-	-	855	785	509	546
Average (by season)	423	381	323	423	574	915	785	517	546
2. By Fund : APBN - Mumi	-	410	337	423	572	852	785	545	467
APBN - MEE	331	-	260	-	578	1,084	-	536	442
APBD I	667	325	-		-			445	404
Routine	-		-	-	-		-	372	372
Average (by Rind)	423	381	323	423	574	915	785	517	456
3. By Seed Class: BS - FS	-	352	260	-	568	1,073	-	529	442
FS-SS	423	394	337	423	588	905	785	513	459
Average (by seed class)	423	381	323	423	574	915	785	517	456
B. Soybean Non-Seed	134	175	73	203	712	367	515	93	198
C. Total Average Yield	557	556	396	626	1,286	1,282	1,300	610	654

The study has classified seed production costs into direct and total real costs; both can be stated in terms of per ha of cropped area and per kg of seed produced. Direct costs cover all actual expenditure for cropping (from land preparation to threshing), seed processing and certification. The real cost is the total of direct and indirect costs, with account taken of revenue from the sale of non-seed beans (per ha or per kg basis). The total indirect cost, which consists of overhead and management costs and depreciation of fixed assets, was distributed proportionally across all BBI and BBU seed production activities, including soybean, maize, mungbean, groundnut and rice production.

The per ha average direct cost of soybean seed production for 1994/95 was Rp 1.02 million/ha, whereas the per ha average indirect cost was Rp 1.84 million/ha and revenue from sale of non-seed quality beans was Rp 0.12/ million/ha. The net average real cost was thus Rp 2.74 million/ha (range Rp 2.1I to Rp 5.24 million/ha).

The per ha average direct and real costs were slightly higher in the dry season than in the wet, due mainly to the increased demand for labour in land preparation and in providing irrigation. The cost of soybean grown.was the greatest for those crops nominally grown under the APBD banner and suggests some reallocation of funds from crops grown under other banners. The average direct cost of producing FS was around 10% greater than for SS, because of the higher seed valuation and the higher cost of seed processing.

Using the yield data from Table 9, the per kg seed production costs were calculated and the results are given in Table 10. The average direct seed cost was Rp 2,236/kg, the average indirect cost was Rp 4,031/kg, the average contribution from non-seed sales was Rp 416/kg, making a net total real cost of Rp 5,851/kg (range Rp 2,525 to Rp 7,733/kg). The average cost of FS was Rp 6,088/kg whilst that of SS was Rp 5,790/kg.

Even if only the direct costs are taken into account, the seed production costs are substantially above the standard prices for seed which are set by the governors for various provinces. If yields of seed were to approach those achieved by the private sector, the direct costs would be reasonable. However, once the indirect costs are added, even if yields were acceptable, there is no way that these huge costs can be accommodated. Until ways are found of reducing these costs very substantially, the BBI and BBU will be unable to compete with what the private sector would be capable of achieving; until then, the seed price would have to be heavily subsidized.

Table 10 Per kilogram average direct and real expenditure at BBI/BBU based on production per hectare actual, 1994/1995.

	Per kilogram and real costs production of soybean seed at BBI/BBU(Rp/kg)								
Description	North Sumatra		West Java		East Java		NTB		Average
	BBI Gabe (I+ II)	BBI Tanjung Selamat	BBI Plumbon	BBU Karang Pawitan	BBI Bedali	BBU Labruk	BBU Kejayan	BBI Puyung	BBI/BBU of Study Area
A. Direct Cost of Seed									
1. By Season: MH	3,521	4,340	2,448	1,911	1,993	-	-	-	2,528
MKI	2,421	3,175	2,451	2,374	1,844	1,063	-	1,903	2,274
MK II	3,920	2,525	4,593	-	-	1,382	1,509	1,972	1,972
Average (by season)	2,755	3,184	2,571	2,299	1,929	1,269	1,509	1,954	2,236
2. By Fund APBN - Mumi	-	2,955	2,381	2,299	1,919	1,377	1,509	1,862	2,129
APBN - MEE	3,504	-	3,731	-	1,960	1,043	-	1,840	2,416
APBD I	1,764	3,739	-	-	-	-	-	2,248	2,879
Routine	-	-	-	-	-		-	2,689	2,689
Average (by fluid)	2,755	3,184	2,571	2,299	1,929	1,269	1,509	1,954	2,236
3. By Seed Class: BS - FS	-	3,438	3,731	-	1,976	1,077	-	1,984	2,473
FS - SS	2,755	3,081	2,381	2,299	1,815	1,285	1,509	1,945	2,175
Average (by seed class)	2,755	3,184	2,571	2,299	1,929	1,269	1,509	1,954	2,236
B. Indirect Cost	3,579	3,585	5,297	5,504	8,063	1,496	2,808	2,246	4,031
C. Revenue from Non Seed	152	220	135	265	869	240	456	108	416
D. Real Cost of Seed									
1. By Season : MH	6,948	7,705	7,610	7,150	9,187	-	-	-	6,143
MKI	5,848	6,540	7,613	7,613	9,038	2,319	-	4,041	5,889
MK II	7,347	5,890	9,755	-	-	2,638	3,858	4,110	5,587
Average (by season)	6,182	6,549	7,733	7,538	9,123	2,525	3,858	4,092	5,851
2. By Fund : APBN - Mumi	-	6,320	7.543	7,538	9,113	2,633	3,858	4,000	5,744
APBN - MEE	6.931	-	8,893	-	9,154	2,299	-	3,978	6,031
APBD I	5,191	7,104	-	-	-	-	-	4,386	6,49
Routine	-	-	-	-		-	-	4,827	6,304
Average (by fund)	6,182	6,549	7,733	7,538	9,123	2,525	3,858	4,092	5,851
3. By Seed Class: BS - FS	-	6,803	8,893	-	9,170	2,333	-	4,122	6,088
FS - SS	6,182	6,446	7,543	7,538	9,009	2,541	3,858	4,086	5,790
Average (by seed class)	6,182	6,549	7,733	7,538	9,123	2,525	3,858	4,092	5,851

Some steps could be taken to increase cropping intensity, but as stated earlier, there would be limited opportunity in the survey BBI and BBU. On the national level, there would appear to be more opportunity. Greater use could be made of off-station production under supervision by the BBI/BBU, where indirect costs could be spread over a large volume of seed production. Unfortunately, some of the examples encountered indicated that by the time the farmer had been compensated in produce payment for the use of his land, his irrigation supplies and his supervision, the proportion of seed remaining for distribution by the BBI/BBU could be rather small.

Extension seed production

Although small quantities of ES are sometimes produced by government owned seed stations, most production is organized through contract growers working for the two national seed companies. Small quantities are also produced by private seed growers who either produce it themselves or, again, contract out to nearby farmers.

The first part of the section deals with the background, the infrastructure, seed production and distribution activities, and seed procurement and processing procedures of the two national companies. It carries on to describe their accounting procedures and the estimation of unit production costs for soybean seed. The final section deals with small scale seed producers.

Background

PT Pertani (Persero) and *Perum Sang Hyang Seri* or National Seed Corporation (NSC) are involved in seed production and marketing, with rice being the most important product. Whereas PT Pertani has a range of activities, NSC has, until now, only been concerned with seed production. It is reported, however, that NSC is also planning to diversify into activities beyond seed production and distribution.

PT Pertani (Persero) was originally established in 1959 and acquired its current status as PT (*Perseoan Terbatas* - limited company) in I984. It has its main office in Jakarta, and six area offices, in Medan, Palembang, Bandung, Semarang. Surabaya and Ujung Pandang. It has around 23 branch offices under the control of the area offices, from which most of the country's provinces are served. In a few provinces there are crop input managers only.

It has a range of activities, including selling agricultural inputs such as fertilizer, lime, pesticides, seeds and seedlings, agricultural machinery and veterinary products, rice milling, storing rice and sugar, and producing seeds.

NSC was established in 1971 and is a state-owned company (Badan Usaha Miiik Negara - BUMN) under the jurisdiction of the Department of Agriculture. It is proposed that the company will change its status to a PT before the end of 1995. It has its headquarters in Jakarta and has branch offices in seven provinces, West Java , Central Java, East Java, Lampung, North Sumatra, West Sumatra and South Sulawesi. It extends its activities into some other provinces from the branch offices.

Seed production facilities

PT Pertani produces seeds in 19 provinces, in all of those in Java, Sulawesi and Sumatra, except Jambi, in South and West Kalimantan, Bali and NTB. It operates, in 1995, 33 centres, with eight of 500 ton capacity, six of 750 tons, three of 1,000 tons, four of 1,500 tons, nine of 2,000 tons and three of 3,000 tons.

NSC produces seeds in seven provinces and operates 19 seed processing centres (SPCs) with a total nominal seed processing capacity of around 48,000 tons. There are five centres with 750 tons capacity, eleven with a capacity of 2,000 tons, two with 2,750 tons and one, based in Sukamandi, West Java, with a capacity of 16,500 tons.

Whereas the total capacities of the two companies are fairly similar, PT Pertani is involved in a significantly larger number of units spread over a much wider area.

Seed production

Total quantities of seed sold in 1993 and 1994 are presented in Table 11.

PT Pertani's production is substantially less than that of NSC. NSC covers several other palawija crops, apart from soybean, but maize is the only one of significance. NSC started producing hybrid maize in 1986 (IPB 4), and in 1989 starting producing C 1 and C2. In 1981 only rice was produced, at around 9,000 tons; since then production has risen steadily.

Details of the provincial pattern of the 1994 soybean production are given in Table 12. Most of PT Pertani's production stems from Sumatra and Sulawesi, whereas NSC produced almost 60% on Java. Several plants are very heavily utilized. Apart from those plants in Sulawesi and NTB, which all appeared to be somewhat underutilized, there was no particular provincial pattern of capacity utilization. NSC mentioned that, in general, its plants in Java and Lampung were fully utilized, whereas those in Sulawesi, and North and West Sumatra tended to be less heavily utilized.

Table 11 Seed sales in tons of PT Pertani and NSC, 1993 and 1994.

Seed	PT Pertani	NSC	Total
1993 Rice	22,181	41,023	63,204
Soybean	4,088	4,969	9,057
Maize - hybrid	0	489	489
Maize - composite	0	129	129
Groundnut	0	12	12
Green gram	0	11	11
1994 Rice	27,903	43,122	71,025
Soybean	2,674	4,496	7,174
Maize - hybrid	0	404	404
Maize - composite	0	413	413
Groundnut	0	28	28
Green gram	0	4	4

Table 12 Soybean production in tons by PT Pertani and NSC, 1994.

Region	PT Pertani	NSC
Northern Sumatra	817	670
Southern Sumatra	486	448
West Java	144	437
Central Java	60	954
East Java	87	1,178
NTB/NTT	255	0
Sulawesi	743	809
Kalimantan	82	0
Total	2,674	4,496

Seed type

Most of the soybean seed production carries the pink label, although small quantities of blue label (ES) are produced. Data for the study provinces taken from the BPSB provincial records show that ES production for the two companies during the period 1992/93 to 1994/95 was 3.6 tons in Aceh (1994/95), 9.5 tons (1992/93) and 36 tons (1994/95) in East Java, all for PT Pertani. Very small quantities of foundation seed and stock seed were also certified for the two companies, totaling less than 0.5 tons.

Destination of soybean sales

Almost all soybean seed production has been to supply government sponsored schemes; very little has been sold on the open market. During 1995, with an apparent falling off of government sponsored programmes, the quantity of soybean seed production has declined dramatically. PT Pertani indicated that approximately 90% of its soybean sales went to government projects. NSC provided a breakdown indicating the destinations (Table I3).

Seed source

Virtually all the rice and soybean seed produced by the two agencies is grown by farmers, mostly on a contract basis. NSC produces some of its own supplies on its farm at Sukamandi, West Java. With regard to soybean, this was insignificant, with only 4 tons per year of such production in relation to the 4,272 tons purchased from farmers in 1993 and the 3,643 tons in 1994.

Where extension seed is being produced, contracts have to be made with the growers in advance, and the necessary procedures related to the seed certification process have to be followed. Where pink label seed is produced, the procedure can be less stringent, particularly where there is no field inspection.

Table 13 Destination of NSC soybean sales in tons per year.

Year	Private Fammers*	Government Projects**	Total
1990	631	4,101	4,732
1991	580	5,143	5,723
1992	618	1,722	2,340
1993	1,706	3,283	4,989
1994	2,961	1,535	4,496

*. Calculated from total sales minus sales to government. Subsequent discussion with NSC indicated that the actual quantities sold on the free market were less than these.

** Government projects include national, provincial and kabupaten level programmes where the expansion of soybean production areas is sponsored by public finds. Some relate to transmigration settlements, some to the follow up of forest clearance and others to the promotion of increased cropping intensities on existing sawah and dryland cropping areas.

Targets for annual seed production programmes are issued by the head otlice to the provinces after mutual discussion. In some cases, where specific government requirements needed to be met, seed production would be undertaken in one province for delivery to another. There are no rigid guidelines concerning the types of contracts entered into between the companies and their contract growers. Both organizations gave the provincial level offices some freedom to work out arrangements which were most appropriate to their circumstances.

In the field it was generally found that seed, and sometimes fertilizer and agro-chemicals, were provided on credit, the original cost, without interest being recouped after harvest. In some cases the fertilizer inputs were organized through farmers groups (KUD) and did not directly concern the company. In these cases, interest charges would be incurred. The cost of any field inspections related to the seed certification process are borne by the companies.

The companies generally purchase the seed crop from the farmer at prices of between 5 and 10% above the prevailing market price for the crop as a food product. Both companies mentioned instances where they found that they had difficulty obtaining what they believed to be all the farmer's production. In such instances the supposition is that the farmer would sell to the company a proportion of his total production to cover any outstanding debt, whilst some production would be sold elsewhere. It is believed that some farmers are aware of the enhanced value of their product and are by-passing the system and selling directly to buyers as seed. Whilst this is a problem for the companies concerned, at least it is an indicator that the private sector is aware of the fact that better class seed is worth paying a premium for.

Procurement and processing procedure

With soybean, it is normal for the farmer to manually harvest, thresh, winnow and bag his product. In some instances, blowers or winnowers belonging to the company were placed at the point of production to assist farmers to produce a clean sample. Sometimes the crop is partially dried by the farmer. The companies usually organize transport to the processing centre and pay the cost of transport from the farmers' fields. At this point the product is described as Calon Benih Kering Sawah (CBKS). In some instances seed is collected, dried, processed and bagged in locations away from the main centre, sometimes using hired drying floors and storage. Once this crop reaches the centre, it is then dried down to around 10 to 12% moisture content. Some plants have operational artificial drying facilities which are particularly useful in periods when there is rainfall, but the majority of the crop is sundried, using labourers to spread the crop on drying floors within or near the centre. The seed is then described as Calon Benih Kering Kantong (CBKK).

The handling hereafter differs from centre to centre. The options include passing the seed through the same processor as used for paddy (having made the appropriate changes to the internal plates), using a specialist soybean processor (generally unsuccessful), or hand sorting. Prior to these steps, it is sometimes passed through a simple blower. The extent of mechanical handling and bagging depends on the availability of equipment. In general the extent of mechanical processing is very limited and most plants rely on manual processing, with labourers working on a piece-rate basis. The product is then ready for testing and certification and is packed in woven plastic bags weighing around 50 kg. Waste material and beans which are not suitable for seed are removed. After processing the seed is called Calon Benih Bersih (CBB) or cleaned seed.

Samples are taken from the CBB and sent away for analysis by the certification authorities. and when the results are known, with periods normally ranging from around two to three weeks, that seed which passes scrutiny is classified as Calon Benih Lulus (CBL), certified seed. This would then either be repacked into smaller plastic bags (usually I0 kg) and sewn, or kept in the woven bags, and after bringing to a standard weight, also sewn. This is called, Calon Benih Kantong (CBK) bagged certified seed. The bagged certified seed is then either stored or delivered to seed dealers or directly to the end consumers in the case of much of the government purchased seed.

Total losses, in terms of moisture and foreign material are generally in the range of 15 to 20%. Whilst, normally, of the 80% remaining, most would be classified as certified seed, this is not always the case. Where there are significant numbers of damaged or diseased grains, this would reduce the production of certified seed and increase the proportion of poor quality grain that would be disposed of or sold at reduced prices.

Seed centre facilities and operation

The designs of the centres vary considerably and it is evident that in some centres the equipment installed is excessive and/or not entirely appropriate for the quantities of rice and soybean they handle. This was a particular problem in plants which were handling only small overall tonnages. Equipment and facilities have been provided under a number of assistance packages. and some of the equipment has apparently not been entirely satisfactory. On the other hand, there are clearly several plants which would benefit from the provision of additional equipment and improvements in the facilities related to drying and occasionally processing.

Several plants required more extensive drying floors and on many the artificial drying systems were by no means adequate. Many lacked a fork lift truck and, given the tonnages of produce handled and the number of times that the product was handled, it would appear that handling efficiency could be substantially improved with such a vehicle.

General comparison of accounting procedures

Both agencies use accounting systems which provide sufficient information to enable them to calculate the unit costs of producing rice and soybean seed. The accounting systems identify direct and indirect costs related to the centres. Whilst the direct costs presumably reflect the actual costs involved, it is normal for the proportion of indirect costs related to capital depreciation and to other fixed costs (both on-station and off-station) allocated to soybean or rice to be determined by higher authorities. It is evident that the basis for allocation of these costs is a somewhat arbitary exercise.

Both NSC and PT Pertani use a standard production chain of five classes (Table 14).

Table 14 Seed classes in the production chain.

Class	Description	Step
CBKS	uncleaned, undried seed	production
CBKK.	uncleaned, dried seed	drying
BB	dried, cleaned seed	processing
BU	dried, cleaned, certified seed	certifying
BK	dried, cleaned, certifmed, packaged seed ready for sale	packaging

Costs are allocated according to the crop class, with details of total quantities, unit and total costs involved at each step. Whereas in a simple system it would be expected for the original volume of CBKS to gradually reduce as moisture, foreign matter and non-seed quality products are removed, this is not necessarily the case here. Additional quantities of seed can enter the stream at any point, when supplies are bought in from outside, are transferred from other branches or are brought in from previously held stocks. Similarly some volumes can leave the system, by being transferred to other centres or by being put into storage. Some stocks change status and revert to a class further back in the process. Both companies accommodate these additional movements in their systems.

For example, in 1993 total direct procurement by NSC of GKP was 4,276 tons of soybean. However during the year, it also purchased 662 tons of BB, 773 tons of BL and 6 tons of BK. Self consumption accounted for almost nothing, but use of old stocks included 114 tons of BB, 63 tons of BL, and 132 tons of BK. Placement into store involved 2 tons of BB, 12 tons of BL and 344 of BK. Declared losses/sales included 344 tons of moisture, 258 tons of waste material and 77 tons of second quality grain. This resulted in the net total production sold of 4,989 tons.

Unit costs: PT Pertani

Unit costs of seed production for rice and soybean are compiled at the national level from the records submitted from the area (wilayah) offices. The field offices, in turn, collect the costings prepared at the seed centres, either directly or through a branch (cabang) office and here the overall figures are upwardly adjusted to take account of the direct overhead costs related to the processing centres.

For 1994 the national weighted average cost of soybean seed was approximately Rp 1,470/kg, with costs at individual seed centres ranging from around Rp 1,260 to, in one case, over Rp 3,000. These costs, it is understood, included, in most cases, delivery to the final consumer, which in the most part was the village (desa) level delivery point for farmers' groups. National level data on the average unit values of the soybean product as it moved its way through the process are given in Table 15 in rounded terms.

The overall cost of around Rp 410/kg is broken down roughly as follows; moisture/foreign matter, Rp 165, other losses Rp 80, direct costs, Rp 45, indirect costs, Rp 40, depreciation, Rp 50 and marketing Rp 30. No additions were included to cover national overheads.

The average procurement price, delivered to the factory, of around Rp 1,060 can be compared with price levels for soybean which prevailed in 1994. The average wholesale price in the main production areas of East and Central Java was Rp 1,1I5 in 1994 and a markup between farmer and wholesale market of 10 to 15% could be considered conservative. Whilst it might have been possible to have acquired some supplies at lower prices, for example approximately almost 30% of total seed acquisition was made in South Sulawesi where prices tend to be a little lower than average, it should be appreciated that acquisition cannot always be undertaken at times when prices are favourable. Furthermore, it would be reasonable to expect to pay a little above the average bean price for a crop which has been grown with the first intention of being used for seed, and, indeed, it is part of the contract the agencies make with the contract growers that the price will exceed the local price by a nominal 10% or so.

Table 15 Value of soybean seed classes

Seed Class	Status	Total Value (Rp/kg)
CBKS	delivered	1060
CBKK	dried	1155
CBB	cleaned	1260
CBL	tested	1270
CBK	bagged	1345
CBK	including overhead costs	1440
CBK	at consumption point	1470

The physical weight reductions, representing around 14% in terms of moisture and foreign matter and 2% in terms of unsuitable material, are to be expected, if the product is to satisfy the certification criteria. All the other cost components, apart from the overhead cost, are easily justified in terms of the costs of labour and materials involved in sundrying, cleaning, processing, testing, bagging, storing and transporting.

Taking an example from the Kediri seed centre, NTB, in 1994, according to the calculations included in the standardized reporting system, the total cost of producing soybean seed was Rp I.340/kg whilst the projected cost, prior to the season, was around Rp 1,370/kg. It is clearly quite a difficult task to estimate costs with any degree of accuracy as it is not possible to predict what prevailing prices will be at harvest time or what weight losses will be incurred between the receipt of the freshly harvested product and the production of dried, processed seed. This centre, for example, predicted for 1994 a purchase price of Rp I,060/kg and an 85% turnout of BB from CBKS. In reality, this was a very accurate estimate, with an average procurement price of Rp I,081/kg and with around 11.9% moisture removal, I.9% foreign matter and a I.4% failure to pass certification. It was not clear if the failed material was of any value or not (Table 16).

It is, presumably, easier to predict processing and other related costs as they are mostly incurred on a unit weight basis. The main areas for inaccuracy relate to the costs of drying, which vary according the initial moisture content and to the weather conditions at the time when the grain is delivered to the centre, and to sorting. The poorer the crop, the longer it takes to sort.

Returning to the national level data, the overhead cost comprises staff salaries and transport (around 30% or Rp 30/kg), office expenditure (around 15% or Rp 13/kg), and depreciation (around 55% or Rp 50/kg). The first two elements appear reasonable and it was noted that the numbers of permanent staff number at the seed centres were very small.

Table 16 Estimated and actual direct costs, Kediri, 1994.

Activity	Projected (Rp/kg)	Actual (Rp/kg)
Drying	7.0	7.2
Sorting	6.5	9.6
Certification	6.5	4.3
Bagging	21.0	18.4
Fuel	2.5	0.0
Other	6.5	0.0
Subtotal	50.0	37.5

The depreciation element is one which requires an understanding of the accounting procedures of the company. It is understood that the company has considerable assets in terms of the land, buildings and equipment at the seed centres and possibly elsewhere, and that the network of supporting staff and facilities is substantial. The extent to which depreciation allowances should be added is an issue of major significance and one which is the most difficult to assess. On the one hand, it is suggested that the overall allowance for depreciation is somewhat low. An inspection of some sample seed centres' asset valuations indicated a very wide range of total values in terms of installed capacity; in some cases very significant items were not valued at all at the area (wilayah) level. Annual depreciation allowances were included in the calculation of unit costs for rice and sometimes for soybean and the amounts included tend to reflect the declared asset value, even though this value may not have been a very accurate reflection of its true value. The total depreciation allowance is then shared between rice and soybean and an inspection of the sample seed centres accounts indicates that there is no direct relationship between the way the depreciation is shared and the relative quantities of rice and soybean which are processed. In general rice tends to be more heavily charged, on a weight basis, than soybean.

As an example of total capital value of three seed centres in Aceh and North Sumatra with a present capital value of around Rp 1,150 million and a 1994 throughput of 2,250 tons of produce, it would be reasonable to offset say 10% of capital cost or Rp II5 million, equivalent to Rp 50/kg. In fact, the actual allowance made was Rp around 70 million, or Rp 30/kg. These allowances apply only to the capital value of the seed centres themselves and have not been loaded with the additional costs of branch or area office infrastructure, nor do they allow for any interest repayments.

On the other hand it could be argued that the soybean enterprise is being too heavily penalized. Whilst it was not the team's concern to delve into the agencies' accounting systems, it was noted that on many stations the actual costs of soybean seed processing were primarily related to the hiring of labour working on a piece-rate to dry, to sometimes sort and to package the product. Little use was made of the installed machinery; the main use of fixed assets related to the use of drying floors and storage facilities. Our impression would be that that the actual costs of soybean seed production might, on certain stations, be less than the agencies' unit costings indicate at first sight.

It is, however, appreciated that the accounting systems must allocate depreciation and it is understandable that the soybean enterprise would be charged accordingly.

Unit costs: Perum Sang Hyang Seri (NSC)

Whilst the team was able to visit a number of NSC seed centres and to discuss the costs and practicalities of soybean production at these centres and at the headquarters, access to detailed cost information was somewhat restricted. National level data for 1994 are provided in Table 17.

The overall cost of around Rp 405/kg is broken down roughly as follows: moisture/foreign matter/other losses, Rp 200, direct costs, Rp 70, indirect costs, Rp 75, depreciation, Rp 30, marketing, Rp 65, headquarters overhead, Rp 20 and revenue from non-seed sales, Rp 50.

The overall cost was marginally lower than that of PT Pertani, although the allocation of costs between heads is substantially different. It is anticipated that this is partly due to the use of different cost accounting systems. It should be appreciated that stock movements and internal stock valuations complicate the picture; the almost zero per kg value change between CBB and CBL should not be interpreted as meaning that testing cost almost nothing. It will also be noted that the average purchase price from the farmer is around Rp 120 greater, presumably reflecting the fact that much of the NSC soybean production takes place in Java, where soybean prices tend to be higher.

Table 17 National level unit costs for NSC soybean seed, 1994

Seed class	Description	Total Value (Rp/kg)
CBKS	delivered	1,180
CBKK	dried	1,320
CBB	cleaned	1,410
CBL	tested	1,410
CBK	bagged	1,470
CBK	including overhead costs	1,500
CBK	at consumption point	1,565
CBK	including national overheads	1,585

As data from centres were not readily available, it was not possible to make comparisons between the national average and the actual situations encountered in the field. The one example where data were made available indicated higher costs than those at the national level.

The subsidy

It is understood that government awards a subsidy of Rp 260/kg of soybean seed. Although this not is included in either company's unit costings. It is not totally clear how this operates, but presumably, this transfer payment is used to offset losses incurred by these state owned companies in their soybean trading activity. Sale prices for soybean, sold primarily to government, averaged around Rp I,400 delivered. Production costs are virtually the same or higher than the average sale price; without the subsidy, it would not make business sense to continue trading in soybean seed under present conditions and using the present accounting system. If a major part of the indirect and overhead costs were to be excluded from the assessment of overall cost, this could reduce unit costs by around Rp 100/kg and could just make soybean trading worthwhile, even without the subsidy. The margins are, however, very tight and the risks substantial, unless a guaranteed market is assured.

General observations

Some centres are well utilized and their annual though puts, primarily of rice, macth or exceed their declared capacity. Other are underutilized, and a number of the reason for this were mentioned. Some centres said that local demand for the final product was a limiting factor; others mentioned the problems of securing sufficient, timely supplies of seed grown by contact farmers. The agencies are in competition with local buyers and the price incentive paid by the agencies is often quite small. It appears that the quality standards in contracts are not very binding on either side and that the assistance provided to the fanners by the agencies is minimal. Farmers seem more willing to supply seed during the wet season when it has a high moisture content than in a drier season when the product is easier to dispose of to private buyers. This leaves the seed centres with the problems of handling substantial quantities of dirty or damp produce. All costs appear to be very reasonable and it is difficult to identify any component where any major cost savings could be made.

Whatever system is used to cost out the production of soybean seed, the additional costs incurred beyond the point when the seed is purchased from the grower are not excessive. One of the biggest costs is the unavoidable 15 to 20% loss (of moisture and waste material) between the weight of the original ex-field product and that of the final product at the moisture content which has to be achieved if the seed is to satisfy the certification criteria. Whilst the moisture content criterion is appropriate if the seed is to be stored for several months, it is, in fact, unnecessary to reduce the content so rigorously if it is to be used in the short term.

Although any measures taken to keep the costs of seed production as low as possible would be advantageous, either in terms of reduced consumer prices or increased profits to the agencies concerned, our view is that it is not the cost which is of prime concern. Evidence from field surveys suggests that the cost of seed was not a major consideration; many fanners use up to 80 kg of seed per hectare to compensate for low germination capacity. Where fanners have access to seed guaranteed to be of high germination capacity, they are willing to pay up to Rp 2,000/kg. Their main concern is germination capacity and there is little interest if it is certified or not. On occasions it was mentioned that the existence of a label was a negative factor; to obtain a label meant that the seed was, by definition, not fresh, as several weeks have to elapse between the time the seed is harvested and when it is finally certified.

Involvement in the Jabal system

There is a limited involvement by these agencies in buying soybean grain and selling it again quickly in areas where there is a shortage of seed. This is essentially an entry into the traditional jabal system by the national seed agencies. Whereas, in the past, if these supplies bore a pink label they would attract a Rp 260/kg subsidy, it is understood that this will only apply to blue label according to proposed policy.

It is difficult to envisage how the national companies will be able to compete with the traditional system which is unburdened by such constraints. They are not, it is believed, planning to produce seed which is of significantly better yield capacity than farmers' own production, but are simply wishing to have a product with good germination capacity available at the right time at the right place. Given that most farmers appear to have few problems obtaining reasonable quality seed through existing suppliers, unless these two agencies have some advantages over these suppliers, it would appear that the extent to which they will be able to enter into the jabal system will be limited.

It is suggested that there could well be a place for a more intensive study of the possible advantages of using particular varieties, apart from the few well known ones, in specific locations. In this way, the agencies could use their infrastructural network to move seed over wider distances than those normally covered by the traditional suppliers.

It would also appear that the widely quoted problems related to the short life of soybean seed are not as difficult to overcome as they are made out to be. Some farming communities, private seed producers and some BBIs have found that it is possible to keep seed in good condition for many months, if the seed is carefully dried down to around 8% moisture content and is then stored in air tight containers. The cost of providing air tight storage is not excessive. If the agencies were to master the techniques involved, they would then be in a position to have stocks available for sale when there is a shortage of seed. The time when seed is in shortest supply in most areas is after the main wet season during which little soybean is grown, but at the end of which farmers wish to grow a soybean crop after the rice crop.

Other seed producers

The extent of involvement by the private sector working on its own initiative in soybean seed production is extremely limited within the five study provinces, according to our information. Most seed growers were, in fact, working on contract for the two large national companies and mainly concerned with pink label production. Data from the BPSB for East Java in I994/95 show that out of the total of 984 tons of soybean seed which was certified, including pink label, 177 tons was for the private sector. To what extent some of this ended up with the big seed companies is not easy to determine.

There were, however, a few individuals producing seed for direct sale to their customers. Some of their seed was grown on their own land and sometimes they used neighbours to produce for them. Several of these went to the trouble of presenting their material in plastic bags marked with their own company logo. Most producers seemed to have several common features:

- they were small scale, selling between I0 and 50 tons of seed per year; there was a reluctance to expand the level of business in recognition of the limited market and the risks involved in handling a crop with a short shelf life. One producer, however, has already mastered the technique of controlling the rate at which germination capacity deteriorates and was able to store for up to one year without significant reduction;
- they did not always sell certified seed, and the stock of seed which they used was often retained from their own crop, but originating from purchased SS;
- they relied almost exclusively on their personal reputation with local farmers for their business, and traded directly with them;
- they used simple drying and processing procedures, usually threshing manually, sundrying and winnowing. The seed was manually sorted;
- production approaches differed between growers and between seasons, and the main features on a per ha basis, in physical and cost terms are listed in Table I8:
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Table 18 Basic features of other seed producers.

Input	Unit	Units used	Ave. Cost ('000 RP)
Seed	kg	25 - 80	60
TSP	kg	150	70
Chemicals	RP	50 - 75	65
Tractor hire*	ha	1	200
Labour			
- up to harvest	days	95 - 115	350
- post harvest	days	25 - 30	90
Processing			
materials	Rp/ha	20 - 25	23
Certification	Rp/ha	0 - 7	7
Total costs of minimal tillage			660
* Total costs of normal tillage			860

- most production was on irrigated land as part of a padi: palawija cropping pattern;
- yields of dried cleaned product lay between 1,400 and 1,750 kg per hectare, of which between 60 and 85 % was of seed quality; the remainder was sold as low quality food beans, and the return from these sales often made a significant contribution towards defraying the average production costs of the seed;
- their prices were around Rp 1,500/kg.

One of the large private maize seed companies informed us that they had started to venture into the soybean seed business in 1994; subsequent discussions revealed that the plan for further development had been shelved.

A fairly large scale seed production business in West Java, which controls production over an area of 240 ha of irrigated land and which adopts a rice: palawija cropping plan, informed us that they were planning in 1995 to produce around 1,000 tons plus of certified rice seed and around 25 tons of soybean seed. Whilst part of the reason for this rather low production of soybean seed was the fairly small area actually suited to soybean production, the limited anticipated demand for certified soybean seed was a more important consideration.

Summary

This paper presents the findings of a survey into the costs of producing certified soybean seed in Indonesia. The aim of the analyses is to determine the real cost of certification and seed production at the various stages in the production chain and to gauge the potential for cost recovery.

The analyses cover the breeding and production of breeder seed, the growing of the various classes of seed by government agencies and private individuals and its processing and distribution by the national seed companies and by private individuals. Also covered is the involvement of the national seed certification agency.

For each government agency at each step in the system, the revenues generated, whether from actual payments or from paper transfers, are less than the total costs incurred. The paper attempts to determine the real costs and to indicate at what prices seed would have be transferred to the next step down the chain, if the whole system were to be self financing. It shows that, at present productivity and cost levels, to achieve, this objective extension seed would have to sell at around three times its official price. If quite conservative productivity levels were achieved and if seed prices were around twice the food bean price, the prospects for a viable industry would be good. The constraining factor is persuading farmers to purchase around 7,000 tons of seed, (around 9% of annual seed requirement) at the price mentioned, when the evidence to date is that they are satisfied with the present system, where the vast majority use their own supplies or purchase other farmers' seed at, or a little above, its price as food.

Appendix Summary of certified seed production costs, theoretical and actual.

Item	Scenario:	1	2	3	4	5	6
- Seed Utilization %		100	100	Actual	Actual	> 90	> 90
- BS Seed Price		Official	Offmcial	Actual	Actual	Actual	Actual
- FS & SS Seed Price		Official	Offmcial	Official	Actual	Actual	Actual
- ES Seed Price		Official	Official	Official	Actual	Actual	Rp 2,000
- Yields		Target	Target	Actual	Actual	Target	Target
- Cert. Cost Actual/Breakeven		Actual	Break	Break	Break	Break	Break
- BS Development Cost Included		No	Yes	Yes	Yes	Yes	Yes
- BBI Overheads Included		No	Yes	Yes	Yes	Yes	Yes
- ES Through NSC/PTP or Private		NSC/PTP	NSC/PTP	NSC/PTP	NSC/PTP	NSC/PTP	Private
1. Breeder Seed Used	Kg	1,000	1,000	1,000	1,000	1,000	1,000
2. Seed Utilisation Rate							
- BS Seed	%	100	100	100	100	95	95
- FS Seed	%	100	100	25	25	90	90
- SS Seed	%	100	100	12	12	90	90
- ES Seed	%	100	100	100	100	90	90
3. Seed Rate	Kg/ha	40	40	40	40	40	40
4. Seed Production (Yield)							
- FS From BS	Kg/Ha	800	800	440	440	800	800
- SS From FS	Kg/Ha	900	900	460	460	900	900
- ES From SS	Kg/Ha	1,000	1,000	1,000	1,000	1,000	1,000
5. BS Development Cost	Rp M	0	172	172	172	172	172
6. Total BS Produced	Tons	2	2	2	2	2	2
7. Net BS Dev't Cost	Rp M/ton	0	86	86	86	90.5	90.5
8. Total BS Production Cost	Rp M	12.6	12.6	12.6	12.6	12.6	12.6
9. Seed Price Applied							
- BS	Rp/Kg	2,250	2,250	92,300	92,300	101,922	101,922
- FS	Rp/Kg	2,000	2,000	2,000	56,272	9,686	9,686
- SS	Rp/Kg	1,750	1,750	1,750	83,376	3,773	3,773
-ES	Rp/Kg	1,500	1,500	1,500	4,761	1,741	2,000
10. Marketing Transport Cost							
- FS	Rp/Kg	50	50	50	50	50	50
-SS	Rp/Kg	40	40	40	40	40	40
-ES	Rp/Kg	30	30	30	30	100	100
11. Direct Production Costs/Ha							
- BS to FS	Rp '000/Ha	729.0	729.0	729.0	729.0	729.0	729.0
- FS to SS	Rp '000/Ha	668.0	668.0	668.0	668.0	668.0	668.9
-SS to ES	Rp '00011a	1,155.0	1,155.0	1,155.0	1,155.0	1,155.0	450.0
12. Seed Costs/Ha							
- BS to FS	Rp '000/Ha	90,0	90.0	3,692.0	3,692.0	4,076.9	4,076.9
- FS to SS	Rp '000/Ha	80.0	80.0	80.0	2,250.0	387.5	387.5
- SS to ES	Rp '000/Ha	70.0	70.0	70.0	3,335.0	150.9	150.9
13. Certification Costs/Ha							
- BS to FS	Rp '000/Ha	17.0	35.6	34.9	34.9	35.5	35.5
- FS to SS	Rp '000/Ha	15.0	35.8	34.9	34.9	35.7	35.7
- SS to ES	Rp '000/Ha	10.0	36.0	36.0	36.0	36.0	36.0
14. Processing Costs/Ha							
- BS to FS	Rp '000/Ha	138.0	138.0	138.0	138.0	138.0	138.0
- FS to SS	Rp '000/Ha	116.0	116.0	116.0	116.0	116.0	116.0
- SS to ES	Rp '000/Ha	155.0	155.0	155.0	155.0	155.0	113.0
15. Indirect Costs/Ha							
- BS to FS	Rp '000/Ha	0.0	1,668.9	1,838.0	1,838.0	1,668.9	1,668.9
- FS to SS	Rp '000/Ha	0.0	1,668.9	1,838.0	1,838.0	1,668.9	1,668.9
- SS to ES	Rp '000/Ha	0.0	5,030	50.0	50.0	50.0	40.0
16. Total Cost/Planted Ha							
- BS to FS	Rp '000/Ha	974.0	2,661.5	6,431.9	6,431.9	6,648.3	6,648.3
- FS to SS	Rp '000/Ha	879.0	2,568.7	2,736.9	4,907.8	2,876.0	2,876.0
- SS to ES	Rp '000 Ha	1,440.0	1,466.0	1,466.0	4,731.0	1,546.9	789.7

Appendix Summary of certified seed production costs, theoretical and actual (continued).

17. Total Planted Area							
- BS to FS	Ha	25	25	25	25	24	24
- FS to SS	Ha	500	500	69	69	406	406
- SS to ES	Ha	11,250	11,250	95	95	7,648	7,648
18. Area Harvested (%)							
- BS to FS	%	100	100	100	100	95	95
- FS to SS	%	100	100	100	100	93	93
- SS to ES	%	100	100	100	100	100	90
19. Total Area Harvested							
- BS to FS	Ha	25	25	25	25	23	23
- FS to SS	Ha	500	500	69	69	378	378'
- SS to ES	Ha	11,250	11,250	95	95	7,648	6,884
20. Ave. Seed Yield/Planted Ha							
- FS	Kg/Ha	800	800	440	440	760	760
-SS	Kg/Ha	900	900	460	460	837	837
- ES	Kg/Ha	1,000	1,000	1,000	1,000	1,000	900
21. Seed Cost (Production Point)							
- FS	Rp/Kg	1,218	3,327	14,618	14,618	8,748	8,748
- SS	Rp/Kg	977	2,854	5,950	10,669	3,436	3,436
- ES	Rp/Kg	1,440	1,466	1,466	4,731	1,547	877
22. Seed Cost (Consumption Point)							
- FS	Rp/Kg	1,268	3,377	14,668	14,668	8,798	8,798
- SS	Rp/Kg	1,017	2,894	5,990	10,709	3,476	3,476
- ES	Rp/Kg	1,470	1,496	1,496	4,761	1,647	977
23. Gross Programme Cost							
- BS Breeding	Rp M	0.0	86.0	86.0	86.0	90.5	90.5
- BS Production	Rp M	6.3	6.3	6.3	6.3	6.3	6.3
- FS Production	Rp M	24.4	66.5	160.8	160.8	157.9	157.9
- SS Production	Rp M	439.5	1,284.4	188.2	337.4	1,168.0	1,168.0
- ES Production	Rp M	16,200.0	16,492.5	139.1	448.9	11,831.5	6,040.2
24. Gross Marketing Cost							
- FS Production	Rp M	1.0	1.0	0.6	0.6	0.9	0.9
- SS Production	Rp M	18.0	18.0	1.3	1.3	13.6	13.6
- ES Production	Rp M	337.5	337.5	2.8	2.8	764.8	688.4
25. Cost Recovery							
- BS Breeding	Rp NI	0.0	0.0	0.0	0.0	0.0	0.0
- BS Production	Rp M	2.3	2.3	92.3	92.3	96.8	96.8
- FS Production	Rp M	40.0	40.0	12.1	161.3	158.8	158.8
- SS Production	Rp M	787.5	787.5	28.9	338.7	1,181.6	1,181.6
- ES Production	Rp M	16,875.0	16,875.0	142.3	451.7	1,296.4	12,941. 0
26. Net Programme Profit							
- BS Breeding	Rp M	0.0	-86.0	-86.0	-86.0	-90.5	-90.5
- BS Production	Rp M	-4.1	-4.1	86.0	86.0	90.5	90.5
- FS Production	Rp M	1437	-27.5	-149.2	0.0	0.0	0.0
- SS Production	Rp M	330.0	-514.9	-160.5	-0.0	-0.0	-0.0
- ES Production	Rp M	337.5	45.0	0.4	0.0	0.0	6,212.5
- Total	Rp M	678.1	-587.4	-309.4	-0.0	-0.0	6,212.5
27. Total Seed Produced							
-FS	Tons	20	20	11	11	18	18
-SS	Tons	450	450	32	32	340	340
- ES	Tons	11,250	11,250	95	95	7,648	6,884
28. Total Seed Utilized/Sold							
- FS	Tons	20	20	3	3	16	16
-SS	Tons	450	450	4	4	306	306
-ES	Tons	11,250	11,250	95	95	6,884	6,195
29. Seed Sold For Grain							
- FS	Tons	0	0	8	8	2	2
- SS	Tons	0	0	28	28	34	34
- ES	Tons	0	0	0	0	765	688

Appendix Summary of certified seed production costs, theoretical and actual (continued).

30. Value of Seed Sold For Grain							
-FS	Rp M	0.0	0.0	6.6	6.6	1.4	1.4
- SS	Rp M	0.0	0.0	22.3	22.3	27.2	27.2
- ES	Rp M	0.0	0.0	0.0	0.0	611.9	550.7

Notes to appendix:

1. All scenarios trace the fate of 1 ton of breeder seed.
2. % of seed available actually used for planting Allows for wastage discards etc. See notes 28 to 30 for details of non-seed sales.
3. Standard seed rate applied throughout. For soybean seed with 100 seed weight of 10 grams, and an 80% germination rate, produces 320,000 plants/ha.
4. Production of dried/cleaned seed/ha. Target yields from Dit. Gen. Tanaman Pangan. Actual taken from consultant's survey. Value of non-seed production deducted from production. Allowance for destroyed areas made below, Note 18. For ES bought by NSC/PT Pertani, assumes 1 ton dried, cleaned seed/ha.
5. Current annual soybean variety development budget at RILET.
6. Assumed level of current annual BS production.
7. Net soybean development cost allowing for utilization factor item 2.
8. Current annual soybean BS production budget at RILET.
9. Seed prices used in analyses. Official taken from RILET 1994/95. Actual prices represent breakeven price, all costs and other revenues having been accounted to BS actual includes variety development cost, where applicable.
10. Unit delivery costs to next user. Allows for full marketing/promotion in Scenarios 5 and 6.
11. Total production costs/ha for BBU/BBU or private grower, excluding seed, certification, processing, indirect costs. Allowance for net cost saving from sale of non-seed products. For ES bought by NSC/PT Pertani, assumes equivalent cost of purchasing 1 ton cleaned seed from a contract grower at Rp 1,060/kg less Scenario 1 seed cost (next line) plus value of moisture and foreign matter (Rp 165/kg).
12. Seed rate X seed price.
13. Certifmcation charges - Actual as reported by BBU/BBU and PT Pertani. Breakeven calculated at Rp 34,000/ha certification plus Rp 2/kg.
14. Processing costs include all stages after threshing. For BBU/BBU and private growers, costs from Consultant's survey. For NSC/PT Pertani, estimated cost from survey, after accounting for weight losses, certification, depreciation and marketing costs which are included elsewhere.
15. For BBU/BBU total cost of salaries, overheads, depreciation spread over whole station cropping For intensive seed production scenarios BBI/BBU indirect costs at Rp 1.67 m/ha. At lower intensities, Rp 1.88 m/ha. Covers both production and processing For NSC/PT Pertani standard depreciation allowance estimated from Consultant's survey. Their indirect costs included in processing This has been assumed not to change with volume.
16. Total of production, seed, certification, processing and indirect costs.
17. Area planted, assuming 40 kg seed rate, x utilization factor (item 2) and the amount of seed available (item 27) % of planted area harvested. Scenarios 1-4 already take this into account.
18. Item 17 x item 18.
19. Item 27 divided by item 17.
20. 21 Item 16 divided by item 20.
21. Item 10 plus item 21.
22. Overall programme cost (excluding delivery), by stage before cost recovery.
23. Total delivery costs.
24. Theoretical revenue accruing to the various production stages, assuming they sell their seed at the prices indicated.
25. llowance made for unsold seed sold as food.
26. Net deficit/surplus by stage (item 25 - item 23 - item 24).
27. Seed produced
28. Seed actually passing onto the next stage or sold as seed to the farmer.
29. Quantity of seed, sold as food. Not to be confused with production which is never classified.
30. Value of item 29, assuming Rp 800/kg.

Seed Quality of Secondary Food Crops in Indonesia

Udin S. Nugraha, H. Smolders and Nassir Saleh[*]

Background

Seed certification is generally considered the perfect vehicle to ensure the genetic integrity of new breeding products between seed production and farm production. Standard certification procedures and labeling guarantee the genetic and physical quality of seed. Through its label, certification represents an added value of seed. Certified seed is generally expected to increase income and welfare of farmers, and at the same time to increase national production. Based on these considerations and principles, seed quality control and certification have become integral parts of national seed policies and programs worldwide.

In Indonesia, seed certification was initiated by exercising some seed quality control in rice up to 1971 in Java and Bali. With the presidential decree on seed policy in 1971 and in the years that followed (Seed I project, 1971-1979), a start was made to develop a more modern seed program. Seed related agencies were established i.e. the National Seed Board, Sukamandi Research Institute for Food Crops (SURIF), the Seed Control and Certification Services (SCCS) and the National Seed Corporation (NSC, Sang Hyang Seri) to give structure to the new system. ISTA's international rules for seed testing were adopted for seed certification. Up to 1979, the testing and certification was limited to Java and to rice only. Since that year, small quantities of secondary food crops were tested and labeled. During the period 1978 - 1987 (Seed II project), SCCS received various equipment and incremental operational expenses, and expanded to 13 provinces; it established sub-units in the remaining 14 provinces. At the same time, new seed production centers and a seed training centre were established in Bogor. Existing seed farms were strengthened and many training courses were conducted.

Nowadays, all SCCS laboratories have the skills and capability to conduct standard tests for seed quality analysis and many can conduct additional tests such as seed health analysis (Table 1). Mini laboratories have recently been established in several provinces to minimize the distance from the laboratory to the farmers' seed fields. Besides staple food crops, commodities tested include seeds of vegetable crops and fruit trees.

In seed production, the following multiplication stages in Indonesia are distinguished: breeder seed (BS), foundation seed (FS), stock seed (SS), and extension seed (ES) (Table 2). Current seed regulations in Indonesia allow each seed stage to be multiplied up to five times, in order to guarantee sufficient source seed. One more seed class (pink-label or regulated seed) has been adopted with standards below that of ISTA, primarily to simplify and boost (government) seed supply programs. The important distinction between certified seed and regulated seed is that the latter does not require proof of origin of the seed. SCCS quite recently also recognized two categories of pink label seed: LMJ and TDL, of which TDL (*Tidak Diperiksa Lapang*)

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indicates that there was no field inspection involved, but stipulates the time of harvesting.

Table 1 Locations and capacity of SCCS stations in five provinces in Indonesia.

SCCS	Province	HQ	Staff District	Samples/Yr	Samples of Secondary Crops	Standard Analyses/Yr
SCCS III	East Java	68	66	6,453	19%	22,711
SCCS X	NTB	73	26	1,595	16%	5,924
SCCS I	West Java	120	51	3,276	14%	15,624
SCCS IV	N. Sumatra	56	27	2,168	13%	8,607
SCCS XII	D.I. Aceh	39	40	2,290	41%	9,322
SCCS	Indonesia	1,696	-	43,249	23%	151,661

* Secondary crops maize, soybean, mungbean, and groundnut. Source: SCCS, Directorate of Seed Development 1994/1995

Table 2 Quality standards for certified and pink labeled seeds of secondary crops.

Crop	Variable/Seed class	FS (white/purple)	SS (purple)	ES (blue)	ES (1-4) (green)	LMJ/TDL (pink)
Maize	Germination, min %	80	80	80	70	70
	Moisture content, max %	12	12	12	12	12
	Pure seed, max %	98	98	98	97	97
	Inert matter, max %	2	2	2	3	3
	Off-types, max %	0	0.1	0.2	0.5	1
	Off-colored seed, max %	0.5	0.5	1	1	2
Soybean	Germination, min %	80	80	80	70	70
	Moisture content, max %	11	11	11	11	11
	Pure seed, max %	98	98	97	97	97
	Inert matter, max %	2	2	3	3	3
	Off-types, max %	0.1	0.2	0.5	0.7	1
Groundnut	Germination, min %	80	80	80	70	70
	Moisture content, max %	11	11	11	11	11
	Off-types, max %	0.1	0.2	0.5	0.7	1
	Other seeds/weeds, max %	0.5	0.5	1	1	1.5
Mungbean	Germination, min %	80	80	80	70	70
	Moisture content, max %	11	11	11	11	11
	Pure seed, max %	98	98	97	97	97
	Inert matter, max %	2	2	3	3	3
	Off-types, max %	0.1	0.2	0.5	0.7	1

Source: Guidelines for Certification, Directorate of Seed Development 1988, 1989

National efforts to increase adoption of new varieties have been quite successful, especially in rice, soybean and maize, but less so in mungbean and groundnut, which have so far received little attention. Among these three crops, however, there are significant differences in the rate farmers replace their seed with certified or pink label seed. The annual seed replacement rate by farmers in Indonesia with certified seed use as a proportion of total seed use is 24% for rice, 4% for maize, 1% for soybean (6% including pink label), and <0.1% for mungbean and groundnut. The exceptional high replacement rate in rice, the highest in Asia, contrasts with the low rate in soybean and maize. Although one would not expect high levels of replacement in secondary food crops similar to rice, the low replacement levels clearly signal difficulties with the supply of certified seed to farmers in secondary food crops.

The difficulty of supplying certified seed to small farmers is a complicated issue, which is widely acknowledged. New approaches to enhance farmers managed seed systems are being studied (Almekinder et al. 1994; Tripp 1995). For Indonesia, some have argued that certification procedures are too rigid and standards too high to facilitate cost-effective services. Lower standards, such as the quality declared seed (FAO 1993), are less demanding on government resources and facilitate availability. The recent introduction of pink labels is a step toward greater flexibility. It is maybe too early to conclude, but so far, lower standards in Indonesia have done little to fuel demand for certified seed in secondary crops. Possibly, the reputation of the state seed companies has been affected, because of the generally low physical quality of the (pink label) seed supplied. To encourage the use of extension seed, the government is now planning to withdraw subsidies to pink label seed.

Thus, it is important that farmer seed systems be thoroughly studied to evaluate the impact of organized seed supplies. Various factors determine the financial benefit of improved seed to the farmer. Whether certified seed is really an improvement depends largely on the genetic potential of the seed supplied, the farmer's cropping environment, and the quality of the farmer's own seed resources. This paper presents preliminary results of two seed quality surveys conducted in the crops soybean and maize in Indonesia in 1994/95.

Survey objectives and methodology

Evaluation of seed quality in soybean and to a lesser extend in maize was undertaken using a two stage analysis (Figure 1). In the first step, the identification stage, an objective analysis of soybean seed quality in Indonesia was carried out. In this survey, farmers' seed was analyzed in terms of genetic and physiological quality using laboratory and field techniques. In the second part, an attempt was undertaken to assess the incremental net benefit of improved seed as compared to farmers' seed. This was done by using the quality levels found in the first stage as a reference in on-farm trials. The surveys were implemented from August 1994 to October 1995.

The specific objectives of the first survey were:

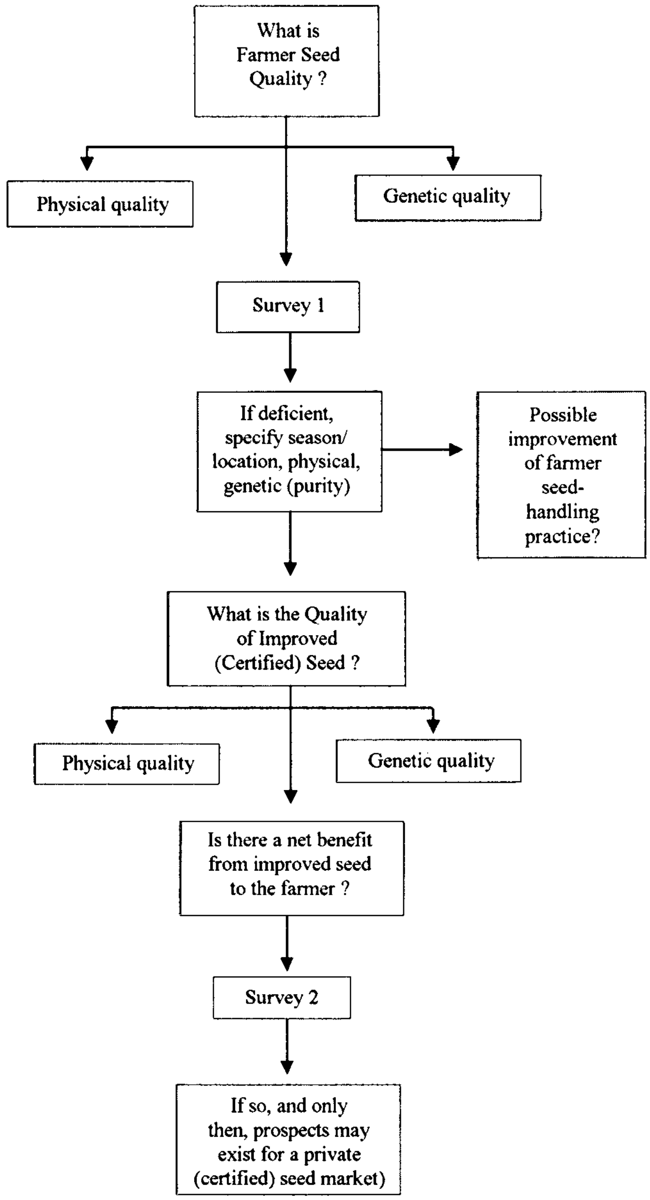
- to determine the quality of soybean and maize seed at the farmer level;
- to identify location specific and season specific seed quality deficiencies;
- to evaluate seed quality of certified seed and assess differences with farmer seed.

This survey was carried out in cooperation with the SCCS in five provinces, NTB, East Java, W. Java, N. Sumatra and D.I. Aceh. Field inspectors took seed samples from farmers at planting in major districts of the commodities concerned. At the same time farmers were queried regarding farming practices and seed source. Each sample was submitted to the main provincial SCCS laboratory and analyzed using standard ISTA tests on viability (sandtest), analytic purity, and 1000 seed weight. In addition, soybean seed coat discoloration (mottling) was determined and seed health analysis (seedborne fungal diseases only) carried out in a few provinces. In addition, SCCS routine test data were compiled to obtain data sets on the pre-market quality of certified seed.

The specific objectives of the second survey, which began halfway the first survey were:

- to determine the actual on-farm yield increase and net economic benefit of quality soybean seed to farmers;
- to obtain data on how farmers assess soybean seed quality in relation to their cropping pattern and farming practices.

Figure 1 Seed quality evaluation model.



This survey was carried out in the provinces of East Java and NTB, in cooperation with the BPTP (Assessment Institute for Food Crops) and the Dinas Pertanian Propinsi (Provincial Agricultural Services). Four villages were selected in East Java and two villages in NTB, each representing major soybean cropping systems. In each village, one farmer group was choosen, and, within these farmer groups, 7 to 10 farmers randomly selected. Each farmer received a set of three samples with respectively high, medium and low quality seed, enough to plant 50 m2 from each sample. Farmers planted the seed along with their own field crops and were requested to apply their own farming practices. Seed was also sampled from the farmer's field at planting and sent to the SCCS laboratory for analysis. Survey staff monitored the planting, and determined the seed rate (from the balance seed), plant density and yield from each plot, including that of the farmer's field. Data were analyzed using each farmer as one replication. Farmers subsequently were interviewed to obtain information on seed source, farm inputs, prices and to assess the farmer's perception of seed quality.

Results

This section provides wherever necessary an interpretation of the survey data based on farmer interviews, personnal observation and available literature. In addition, farmer soybean storage techniques are discussed, since farmer seed is believed to be vital when seed supplies become unreliable.

Physiological quality of farmer's soybean seed

Seed longevity of soybean poses a particular problem. In humid tropical conditions, seed maintains viability only for three to four months, beyond which viability of a particular seed lot rapidly decreases to unacceptable levels, to hit zero viability after 10 months open storage. Seed supplies are usually limited to the three month period following harvest. This is not sufficient for farmers to retain their soybean seed up to the next soybean planting, which is usually at least four months away. Many farmers, therefore, purchase new seed at the beginning of the new soybean planting season; preliminary data from field surveys indicate that 70% of farmers purchase seed at least once a year. The time of purchase varies per location and cropping pattern. Because many regions in Indonesia have both upland, rainfed lowland, and irrigated sawah located within 25 km, a movement of soybean seed between farmers, hamlet and village collectors, and district traders results. Typically, the distinction between grain and seed is not clear, because operators mostly handle both at the same time. The quality of seed found in the hands of farmers just before the time of planting provides a good indication of the efficiency of local seed systems.

Individual results from viability testing of farmer's soybean seed, sampled in 10 districts at roughly three different planting seasons in the province of East Java, are presented in Figure 2. Viability in these 142 samples ranged from 55% to 98%. Of these seed lots, 92% was found to be above the pink label minimum standard of 70% viability, and 71% even above the 80% minimum level for extension seed. Marked differences in viability appear to exist between the rainy planting season (mostly upland) and the first and second dry planting seasons in lowland sawah. In the rainy planting season, average viability was 83%, which dropped to 75% in the first dry planting season, to subsequently reach a peak of 88% again in the second dry planting season. This reduction of viability is presumably caused by adverse wheather conditions during the harvest of the previous rainy season crop. Soybean is known to be extremely vulnerable to wet conditions during harvest. Little variation was observed between the districts: lower quality of seed was especially noted from the districts of Jember and Lumajang (Table 3).

In the province of NTB, seed was sampled in two consecutive years, 1994 and 1995, both during the second thy planting season. In 1994, 61 samples were collected from all six provinces, and in 1995, 18 samples were collected from farmers from the West Lombok district only. Soybean in the latter well irrigated district is planted after two crops of paddy. The expectation was, therefore, that most seed would be purchased, which would give a good indication of the seed quality in the market. Results of viability testing from the farmer seed samples in NTB are very similar to those obtained in East Java. Most of the seed was found to have a viability above the 80% standard. Little difference in viability was found among the districts observed, and between the two years, which indicates that the farmer seed supplies are efficient and well organized.

Figure 2 Seasonal fluctuation in viability of farmer soybean seed in East Java.

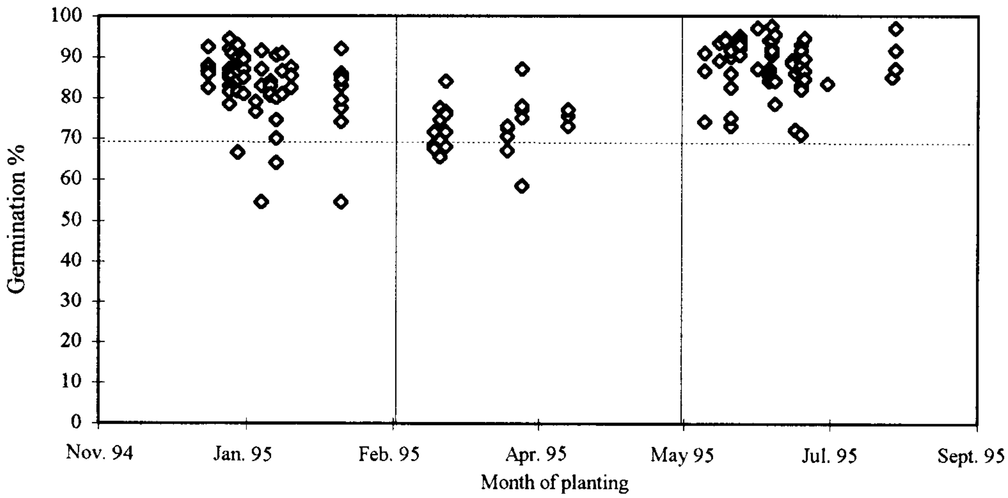


Table 3 Results of laboratory analysis of soybean seed sampled from farmers before planting.

Province	District	Samples total	Samples certif. seed	Average % Germination	Germ freq. >70%	Normal	Damaged	Other seed	Inert matter	Moisture	Mottled	1000 seed weight	Season sampled
NTB	Bima	4	4	83.1	75	99.60	0.18	0.00	-		0.34	98.7	DS2
	Sumbawa	3	1	79.2	100	97.00	0.61	0.00			0.07	100.3	DS2
	Lombok Timur	13	3	77.9	77	97.42	0.34	0.00			1.26	106.6	DS2
	Lombok Tenggah	18	4	83.7	83	96.29	0.44	0.00		-	3.12	88.6	DS2
	Lombok Barat '94	18	3	81.4	72	96.64	0.84	0.00	-		1.40	93.3	DS2
	Lombok Barat '95	18	0	79.4	83	98.60	0.50	0.10	0.80	-	1.90	97.8	DS2/95
	Mataram	5	0	85.3	100	98.40	0.64	0.00	-	-	2.02	101.4	DS2
	All	79	15	81.7	85	97.06	0.54	0.00	-		1.79	96.1	
East Java	Banyuwangi	10	0	85.2	90	96.97	1.49	0.00	1 54	11.60	2.21	85.0	RS
	Bojonegoro	11	0	90.3	100	99.46	0.12	0.02	0.40	12.35	0.40	87.3	DS2
	Jember	19	1	76.8	89	98.10	1.18	000	0.72	11.48	7.61	88.1	RS,DS1, DS2
	Jombang	15	1	866	100	95.46	3.31	0.04	1.00	10.42	2.29	90.8	RS,DSI
	Lumajang	18	0	79.4	72	96.49	1.22	0.06	2.23	12.27	0.75	93.1	DS I ,DS2
	Madiun	6	0	76.2	83	98.21	1.17	0.00	0.62	13.18	0.22	90.3	DS1
	Nganjuk	20	0	82.7	90	96.45	2.26	0.01	1.29	13.01	1.03	84.3	RS,DS2
	Ngawi	7	0	81.9	100	83.16	13.06	0.05	3.73	12.11	0.07	107.0	RS
	Pasuruan	15	0	85.0	100	97.02	2.15	0.01	0.81	10.61	4.44	105.2	RS,DS2
	Ponorogo	21	0	87.4	100	97.08	1.53	0.02	1.38	11.94	1.86	84.9	RS,DS1,DS2
	All	142	2	83.3	92	96.44	2.21	0.02	1.31	11.88	2.69	90.5	
Aceh	Aceh Utara/Pidie	50	0	75.2	74	98.66	0.48	0.00	0.86		2.69	111.3	DS2
	All	50	0	75.2	74	98.66	0.48	0.00	0.86		2.69	111.3	

Planting season: RS rainy season; DS 1 first dry season; DS2 second dry season

In contrast, results from samples in the province of D.I. Aceh indicate a much lower viability, especially in the district of East Aceh. Seed in these areas was sampled in the month of June and July, when farmers plant soybean in upland rainfed areas. Time did not permit investigation of the reason for the low germination; however, other data suggest that low input management and farmer inexperience with soybean may have caused the low viability.

Very little certified seed was found at the farmer level in East Java and Aceh. Of the two samples found, one sample was pink label, the other stock seed, and average viability was 79.5%. On the other hand, in the 1994 survey in NTB, 24% of the samples were found to hold a label; however sampling in this survey was not completely random. Most of the certified seed samples were found among seed growers, and had either a FS or SS label. Of the five farmers that used commercial seed, two purchased ES and the others pink label. The average viability of the certified seed (87%) was better than the survey average (81%).

Analytic purity of farmer's soybean seed

With regard to analytic purity, there were few problems found in farmer's seed. Only in the districts of Ngawi, Lumajang and Pasuruan, some samples contained relatively high levels of damaged seed and/or inert matter. This may have been caused by mechanical threshing. Paddy power threshers used for soybean threshing operations are known to cause much damage, especially when cylinder speed is not adjusted.

Quality of pre-market certified seed

Official figures (1994) indicate that in the province of East Java about 900 tons of commercial soybean seed is produced annualy, yet very little certified soybean seed was found in the hands of farmers. To investigate whether there is a quality problem with commercial seed, seed certification test data for soybean from January to August 1995 were compiled from routine testing at the SCCS in Surabaya. Similar data were also collected from maize (Table 4).

Individual results of the soybean seed analyses indicate a fairly wide variation in viability, between 70.5% and 95%, with an average of 83.9%. Analytic purity of the seed is adequate. Typically, there is a tendency for seasonal fluctuation similar to the non-labeled farmer's seed in the survey. This, after all, may not be surprising considering that the seed is harvested at the end of the same rainy season and therefore equally affected by adverse weather conditions.

It is important to know that these data concern pre-market seed quality. After harvest, seed is dried, processed and sampled for certification. Certification procedures usually take a few weeks from the date of sampling until the label is issued. From then on, the producer can start with the distribution of seed and sale to the farmer via, for example, regional wholesaler and kiosk. All together, after harvest it may take up to three months or longer for the seed to reach the farmer. There is therefore good reason to expect that the seed viability at this point is below the level indicated on the label. Therefore, a significant amount of commercial certified seed presumably does not match up with fresh farmer seed, which may explain why so little labeled seed is found in the hands of farmers.

Table 4 Quality of certified seed from maize and soybean at the date of issue of the labeL

Destined for	Soybean		Maize	
Planting season	March-April '95	June-Aug '95	March - Aug'95	June-Dec '95
Germination %	80.8	85.8	96.7	97.4
Normal seed %	99.7	99.3	99.8	99.9
Inert matter %	0.3	0.7	0.2	0.1
Other seed %	0	0	0.1	0
Seed moisture %	10.1	9.9	11	9.7
Samples certified	14	24	153	248
Quantity certified (ton)	126.5	168	926	1241
% Extension seed	17%	3%	100%	100%
% Pink label	83%	97%	0%	0%
% Composite	-	-	37%	41%
% Hybrid	-	-	67%	59%
Date of harvest	Febr-Mar '95	May-June '95	Febr-May '95	Apr-Aug '95
Producer	Private	NSC, Private	Pt Pioneer, Govt Pt. Bisi	Pt Pioneer, Pt Bisi

Source: SCCS certification data 1995.
Planting season: DS 1 first dry season; DS2 second dry season; RS rainy season

Regarding maize, virtually all commercial seed samples submitted to SCCS for certification and analysed for this survey (representing roughly 2,100 tons) were found to have excellent physiological quality with a 97% average viability. Most of this seed was produced by the private sector.

Choice of varieties

In the survey, 79% of the farmers in East Java and 60% in NTB indicated that they plant the Wilis variety, while in D.I. Aceh farmers grow mostly local varieties. There is as yet little understanding why farmers choose and stick with varieties. The relationship between locations and varieties found in the various surveys (including the annual SCCS survey, Table 5) cannot be explained from the description of the variety alone. Sometimes, it appears that once a variety is introduced, it starts to lead its own life within the restrictions of the local seed system, until a better variety is introduced.

Patterns in the use of varieties in soybean started to change dramatically with the introduction of the Wilis variety. After its release in 1983, large quantities of this variety were produced at government farms, and supplied by state seed companies to government intensification and extensification projects all over the country. In addition, farmers, traders and the processing industry for tempe and tahu seem to be well satisfied with the yellow small-seeded variety. The high frequency of Wilis found in East Java and NTB is unmistakably the combined result of bulk government supplies combined with rapid inter trader and farmer dissemination.

Although the area planted to soybean is decreasing, soybean farmers in Indonesia still grow many local genotypes, which are a good source for national breeding programs because these varieties often are more adapted to local situations and have developed tolerance to drought, pests and diseases. Black soybean, for example, supplied exclusively for the kecap industry is still largely of local origin. This soybean is grown in East Java, mostly in the eastern districts of Banyuwangi and Jember. Also, local varieties such as No. 41, Gepak, Sinonya, No. 29 and Kipas putih seem to be popular in various regions in Indonesia. In some areas, improved varieties other than Wilis are grown, such as Orba and Davros in the uplands of West Java, and Lokon, a short maturing variety, in the drylands of NTB and West Java. Farmers evidently are constantly looking for other varieties. The surveys indicated that although a number of new varieties have been released, farmers have difficulties in obtaining them, which may show a lack of effort on government's side, but similarly might indicate that the local dissemination system is fairly slow to react to farmers' requirements, or that the genetic potential of the new varieties is not sufficiently attractive to farmers.

Table 5 Varieties of secondary food crops planted by farmers in Indonesia.

Crop	Variety	N.T.B.	East Java	Province West Java	N. Sumatra	D.I. Aceh
Maize	Arjuna	24%	44%	33%	27%	3%
	Hybrid C-1/C-2	27%	5%	4%	42%	5%
	Hybrid CPI-	-	5%	10%	-	-
	Hybrid Pionee	-		17%	16%	1%
	Genjah Kerta	-	20%	2%	-	-
	Other improved	7%	15%	22%	1%	1%
	Local	42%	7%	12%	14%	90%
Soybean	Wilis	79%	73%	9%	79%	5%
	Orba	3%	1%	24%	< 1%	4%
	Lokon	2%	2%	48%	<1%	-
	Lumajang Bewo	-	-		-	-
	Galunggung	< 1 %	2%	-	4%	-
	Other improved	9%	14%	9%	-	1%
	Local	6%	8%	(-)	16%	90%
	Kidang	-	9%	21%	< 1%	-
	Schwarz	—	< 1%	6%	-	-
	Other improved	-	13%	22%	1%	1%
	Local	78%	60%	(?)	95%	99%
Mungbean	No.129	-	13°/o	41%	14%	-
	Merak		11%	21	-	1%
	Bhakti	-	3%	2%	25%	—
	Betet	90%	2%	< 1%	-	-
	Other improve	-		29%	1%	
	Local	10%	53%	6%	60%	99%

Source: SCCS provincial annual reports 1993/94

Genetic purity of farmer seed

Generally, it is assumed that grain yield is negatively affected by varietal impurities because of yield potential differences of the varieties in the mixture and/or because of genetic segregation. As soybean is a strict self-pollinator, the latter aspect is negligible.

Genetic purity analysis was undertaken to investigate the impurity level of each sample. The variety name indicated by the farmer was used as reference. For this purpose, a number of samples from East Java, were planted in field checkplots at two stations of the Research Institute for Legumes and Tuber Crops. Preliminary results of the frequency distribution for hypocotyl and flower color of Wilis off-types (Wilis: purple color) are presented in Table 6.

These data indicate that at least 40% of the Wilis seed found among farmers is genetically impure, although 13% contains only slight quantities of off-types. Seed densities in Wilis samples averaged only 8.9 grams per 100 seeds, which is markedly below the official description characterizing Wilis as having a density of 10 grams per 100 seeds. This may be an indication that the variety is mixed with smaller seeded local varieties. However, it could also point to the stress related low-input environment of soybean, which typifies so much the cultivation of secondary food crops in Indonesia. Farmers in the survey were conscious of the fact that their seed was not a pure variety, but indicated that they did not mind admixtures provided this remained below 20%. However, the check-plot revealed that many farmers have seed with a much higher proportion of genetic impurity.

Table 6 Frequency distribution of Wills off-types.

% Off-types (white color)	Frequency (% of samples)
0	60 %
1-5	13 %
6-20	4 %
21-80	22 %
>80	1%

Total Wilis seed lots: 79

A previous study on the effect of mixtures in Indonesia showed that varietal blends of soybean varieties can yield significantly more than pure line stands (Arsyad et al. 1986). Probably, because of complications with certification procedures, this issue has not been further pursued. However, as soybean in Indonesia is prone to heavy pest pressure and drought stress, better yield could be expected from mixtures. Therefore, further research is strongly advocated.

Seed health quality

Soybean is affected by a number of diseases which are seed-borne in nature. Based on surveys in Java and Bali, Yamaguchi et al. (1982) arranged these in the order of occurrence and importance as follows: Xanthomonas campestris (bacterial pustule), soybean stunt virus (SSV), Cercospora kikuchii, (purple leafspot) and Colletotrichum dematium (anthracnose). Other pathogens such as soybean mosaic virus (SMV) and Macrophomina phaseolina may be capable of seed borne infection in Indonesia. Seed samples were analyzed for the presence of seed-borne fungal diseases using the blotter test. The provincial SCCS is yet not capable of testing for bacterial and virus diseases.

The incidence of seed-borne fungal pathogens on the seed in the East Java samples is presented in Table 7. Most diseases appear to have a very low incidence, except for Fusarium moniliforme and Phomopsis spp. These are common diseases that thrive in humid rainy conditions and are the main cause of the so-called weathering disease, reduced seed germination which is caused by delayed harvest in wet conditions. Fusarium, mostly a soil-borne disease, also causes damping off. The high incidence of Fusarium in the March planting season proves that the seed is harvested under humid conditions, probably around February, which could be the main cause of the lower seed viability observed.

Fungal seed-borne disease incidence was markedly lower in farmers' seed in December, which was probably harvested somewhere in October at the end of the dry season. This points to an interesting feature of the local seed system in East Java and NTB where soybean seed is alternately produced in the rainy season and in the dry season, the latter sometimes in two successive seasons. It appears that this flow of seed reduces the level of fungal (and possibly bacterial) infection in the seed. Levels of fungal seed-borne diseases in more humid areas such as West Java and North Sumatra could be markedly higher.

Table 7 Incidence of seed-borne fungal pathogens in soybean seed planted by farmers in East Java.

No.	Pathogen	Planting season		
		RS (n=51)	DS1 (n=21)	DS2 (n=9)
1	*Collefotrichum dematium*	+/-	+	-
2	*Cercospora kikuchii*	-		+/-
3	*Corynespora casiicola*	+/-	+	+/-
4	*Macrophomina phaseolina*	+/-	+/-	+
5	*Phomopsis sojae*		+	+/-
6	*Rhizoctonia solan*	-	-	-
7	*Botryodiplodia theobromae*	+1-	+/-	+
8	*Fusarium solani*	+/-	+/-	+/-
9	*Fusarium equiseti*	'	-	-
10	*Fusarium semitectum*	+/-	+/-	+/-
11	*Fusarium moniliforme*	+	+++	++
12	*Fusarium oxisporum*	-	-	+/-
13	*Phoma sp.*	-	-	-
14	*Peronospora manchurica*	-	-	-

- zero incidence
+/- spores
+ more than 1% less than 5% ++ more than 5% less than 20% +++ more than 20%

Virus diseases

To assess the incidence of seed-borne viruses in the farmers' seed, the percentage of seed coat mottling was used as a parameter. Mottling is defined as the presence of patches, blotches or bands of black or brown pigment, irregular in outline on yellow or green seed coats. Other seed-borne diseases may also cause the formation of pigment in the seed coat, such as purple seed stain caused by the fungus Cercospora kikuchii. The incidence of this disease, as indicated above, appears to be low in the provinces studied.

The frequency distribution of mottling in the farmers' seed samples in the survey is presented in Figure 3, which shows that farmer's seed frequently contains mottled seeds, but the average level is fairly low. Some samples had high levels of seed coat mottling. None of the districts in the provinces analyzed seems to be free of mottling. The worst affected areas are the districts of Jember (7.6%), Pasuruan (4.4%) in East Java and Central Lombok (3.1%) in NTB. It appears therefore that seed-borne virus is a fairly common phenomenon in Indonesia. The question arises to what extend mottling relates to virus infection and whether the observed levels of mottling endanger the quality of the seed and reduce the farmers' grain production.
Research shows that mottled seed can indeed lead to a fairly high degree of infection of virus in the seedlings grown from these seeds. Associations between seed coat mottling and seed transmission of SMV and SSV, however, vary largely per location, season, variety and strain of virus (Table 8). Unmottled seed is also reported to transmit the virus, however usually at a much lower rate.

The immediate effect of mottling on seed viability is, however, limited. Correlation between the percentage mottled seed and the germination rates of the farmer's seed in the survey was low, which indicates that mottling does not or only slightly reduces germination. This is confirmed by other research (Harnowo and Baliadi 1995). The extent of mottling on the seed coat, which was not examined in this survey, appears to be decisive in this matter:

seedling vigor of seeds with 30% or more mottling on a single seed was less than unmottled or lightly mottled seed. In interviews, fanners consistently indicate that they are not much concerned about mottling of the seed, provided this does not exceed 20%.

Figure 3 Mottling incidence in farmer seed in East Java.

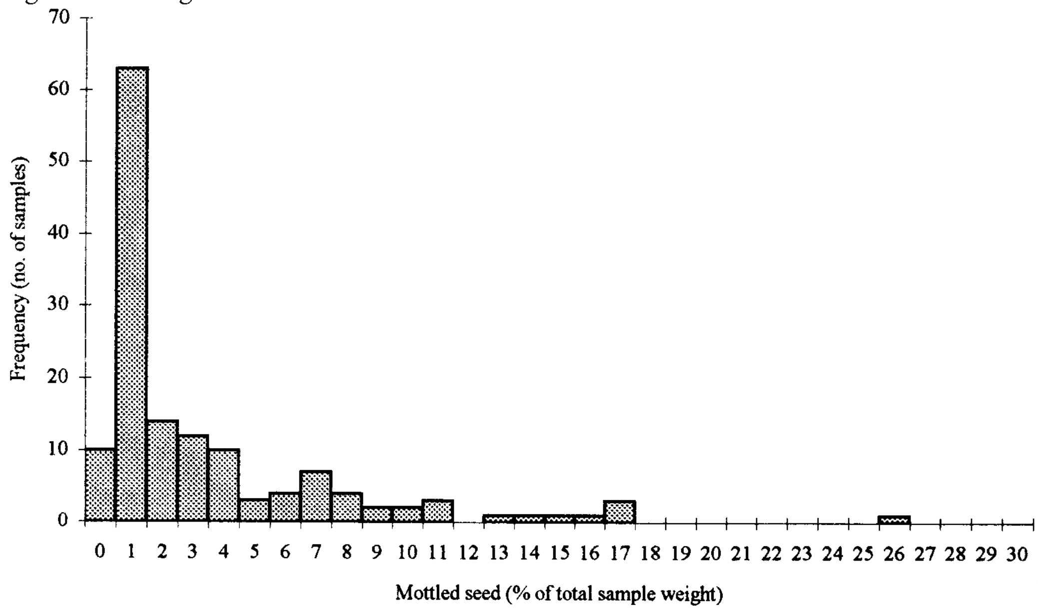


Table 8 Association between seed coat mottling and transmission of SMV and SSV.

Virus	Variety	Seed Transmission (%)		Reference
		Mottled	Unmottled	
SMV	Orba	80.0	35.3	Roechan 1992
	Galungung	25.0	16.7	
	Ringgit	75.0	72.7	
		21.2		
	Orba		1.2	Rahamma 1995
SSV	Wilis	16.4	3.3	Saleh et al. 1987

Data on the effect of seed-borne virus infection on the grain yield in Indonesia are still limited. The time of infection appears to be essential, since early infection can cause significant yield loss (Table 9). Introduction of the virus in the field by planting virus infected seeds may therefore have a significant effect on yield. SMV as well as SSV infection reduce plant height, stem and internodes, pod numbers and pod seed weight.

Table 9 Relation between soybean grain loss and time of virus Innoculatlon.

Virus	% Yield Loss	Time of Inoculation	Reference
SMV	51, 43, 24, 12	10, 20, 30, 40 DAP	Rahammaand Hassanudin1989
	57, 12	10, 60 DAP	Burhanudin 1995
SSV	37,0	15, 45 DAP	Muchsin 1995

DAP= days after planting

In the farmer's field, many environmental factors influence the spread and infection level of the disease, not least of all the population dynamics of the vector (aphid). The abundance of aphids in Indonesia and their efficiency in transmitting the disease determine their important role in the spread of virus in soybean fields. Also, common weeds in Indonesia such as Tridax procumbens and Centrocema pubescens have been shown to serve as a virus inoculum source for SSV (Roechan 1992). In contrast, SMV is almost solely restricted to soybean, although the virus has been found experimentally to infect other food crops. The influence of farmers' practices on the environment is most significant. In virus prone areas of East Java and NTB, farmers traditionally plant soybean before the end of July, beyond which growth of the plant is said to be severely affected. High levels of mottling (up to 70%, caused by SSV) have been observed by the authors in late planted soybean fields in 1993 in Lumajang, East Java. However, in 1994, planting and aphid infestation levels were similar but the aphid build-up started much later than in 1993, and only low levels of mottling were observed in that year. This indicates that farmers are well aware of this interaction. Their planting practices prevent the spread of the disease and cause virus infection levels to stay below the economic damage threshold. However, high levels of mottling in farmers' seed occasionally were observed, which causes some reason for concern as yield levels might be affected.

The solution is simple and cost effective. If farmers would start to remove mottled seed from their seed lot, this would have a major impact on infection levels of seed-borne viruses, thus limiting the rate of transmission of the virus in the field by the seed.

Farmer perception and benefit of improved seed

Farmers usually find their own way to solve seed quality deficiencies. They may test the seed before planting, adjust their seed rate, and/or increase number of seeds per plant hole. Technically, seed quality, and even vigor can be measured in the laboratory and in checkplots, but how big a deficiency will actually have an impact on the farmer's yield and, more important, on the farmer's net income is a question one would like to answer. This was the objective of the second survey. Thus far, data from 40 out of 55 on-farm trials have been analyzed and are presented below.

With an average of 0.51 ha, farmers in the districts of Pasuruan and Jombang in East Java are typical farmers for lowland sawah in Java. Soils are fertile Regosols. Cropping patterns are simple: where irrigation is sufficient, two crops of rice are grown followed by soybean; where this is not sufficient, rice is followed by two crops of soybean. Planting practices vary per season and per cropping pattern:

- Following paddy, soybean seed is planted broadcast (in the first dry season) or dibbled (second dry season) within one week after harvest in between the rice stubble. Before planting, no tillage is applied; after planting, the field is covered with rice-straw mulch to protect the emerging crop against bean fly and to prevent early weed competition;
- Following a previous soybean crop, the soil is tilled by hand or by simple ox-driven plough and soybean seed is dibbled in the field.

The latter planting system was recorded in 50% of the on-farm trials in Jombang and in 85% of the trials in Pasuruan. All farmer trials were planted by the end of June or early July.
Most farmers in Pasuruan reported that they usually purchase seed in the first soybean season, and use their own seed in the second season. Some farmers changed their variety and again purchased in the second season. In the Jombang area, however, rainfed sawah land is

virtually non-existent. As a result, many farmers (60% of respondents) used their own seed year round. Certified seed was found at two farms in Jombang and none in Pasuruan.

Results from the East Java trials are presented in Table 10. Clearly, almost all 40 farmers possessed seed with excellent viability, mostly at par or slightly below the high quality control. Seed rates differ little within, but large differences are found between, the two areas. Very high seed rates are found in Pasuruan, up to 77 kg/ha. However, plant densities in Pasuruan, counted at 6 weeks after planting, were only slightly higher than in Jombang because of reduced field germination. Pasuruan fields experienced more pest infestation and drought stress, which may explain the lower yields.

Table 10 Soybean yield benefit from different qualities of seed tested under farmer conditions

Province/District/ Village	No. of Fanners		Seed Quality A*	B*	C5	D5 (Farmer seed)
East Java/Jombang/ Mentaos	10	Variety	Wills	Wills	Wilis	100% Wilis **
		Germination % (lab)	91	80.8	58.2	87.5***
		Seed rate (kg/ha)	55	59	63	-
		Field germination%	90	83	61	-
		Average plants/hill	2.6	2.3	1.9	2.8
		No. of plant hills/ 10 m2	120	110	91	130
		Plant density (pl/ha)	509,000	412,000	283,000	597,000
		Yield (kg/ha)	1,625	1,331	1,027	1,745
East Java/Jombang/ Krembangan	10	Variety	Wilis	Wills	Wills	90% Wilis**
		Germination % (lab)	91	80.8	58.2	85.4***
		Seed rate (kg/ha)	50	52	57	-
		Field germination %	91	82	61	-
		Average plants/hill	2.4	2.2	1.6	2.4
		No. of plant hills/10 m2	118	115	109	120
		Plant density (pl/ha)	459,000	414000	288,000	450,000
		Yield (kg/ha)	1478	1069	817	1569
East Java/Pasuruan/ Kluwut	10	Variety	Wills	Wilis	Wills	100% Wills**
		Germination % (lab)	91	80.8	58.2	69.2***
		Seed rate (kg/ha)	75	75	75	76
		Field germination %	82	78	59	-
		Average plants/hill	2.2	2	1.8	2.2
		No. of plant hills/10 m2	253	251	248	253
		Plant density (pl/ha)	549,000	502,000	442,000	547,000
		Yield (kg/ha)	946	928	809	1142
East Java/Pasuruan/ Karangasem	10	Variety	Wilis	Wills	Wills	30% Wills**
		Germination % (lab)	91	80.8	58.2	85.8***
		Seed rate (kg/ha)	73	74	76	77
		Field germination %	86	78	59	-
		Average plants/hill	2.2	2	1.8	2.2
		No. of plant hills/10 m2	252	251	251	251
		Plant density (pl/ha)	523,000	514,000	439,000	507,000
		Yield (kg/ha)	1284	1378	1067	1327

* Treatments consist of : A: high viability, B: medium viability, C: low viability, all pure Wills, and D: farmer's own seed, plot-size/treatment: 50 m2.

** Percentage refers to the proportion of fanners using the variety Wills.

*** Farmer's seed might have been damaged while bringing the samples from the field to the SCCS. laboratory in Surabaya.

Significant differences in yield were found between the plots in the Jombang farmer's fields. A grain yield increase of more than 600 kg/ha was recorded between the lowest and highest seed quality from certified origin. Farmers' seed out-yielded the highest seed quality from certified origin by 100 kg/ha approximately, which was significant (p = 5%) in the two Jombang locations. In Pasuruan, seed quality differences seem to affect yields only slightly, as might be expected at such high seed rates.

Government recommended optimum plant density for Wilis is 360,000 to 400,000 plants per ha (seed rate of 40 - 45 kg/ha; 90% germination), which would indicate that above this density no higher yields are expected. However, plant densities in Jombang were, except for the lowest seed quality, well above 400,000 plants per ha. Nevertheless, marked yield differences were recorded even between plots with higher densities. This indicates that the optimum plant density of Wilis under the prevailing farming conditions was not yet reached. The belief, therefore, that farmers use high seed rates because of low seed quality has to be rejected. Farmers in Pasuruan, obviously, applied seed rates proportionally higher than in Jombang because of stem-borer (Melanagromyza sojae) prevalence. As such, seed rates of 60 kg/ha are found to be not exceptionally high in these areas.

Farmer's storage techniques

How do farmers obtain viable seed, when the market cannot provide sufficient quality? The Jombang farmers provide a good example. More than 60% of the farmers in the area save their own seed, and hardly ever purchase new seed. The technique used is quite simple: after harvest farmers clean the grain they intend to take as seed and (re-)dry it in the sun for about 23 days. Moisture content is determined by cracking the seed in the mouth. When the seed is sufficiently hard, they place the seeds with some ash in metal bins of 15 kg capacity and close it with a lid. Some also store the seed in simple tightly closed double plastic bags.

The on-farm trials demonstrate that the farmer seed which was stored sometimes up to nine months could retain viability well. In storage trials conducted recently by the RILET in cooperation with the Palawija Seed Project, in which low cost packing materials were tested, similar low losses of viability are recorded. These trials indicate that viability can be maintained even for up to 12 months, provided the seed is dryed below 8% moisture and packed in a vapour proof container (Figure 4).

The situation in Jombang is not uncommon in Indonesia. Similar techniques are found in other parts of East Java, NTB, and West Java. Yet, although the benefits may be clear, and the technology widespread, a majority of farmers still purchase their seed.

The reason for this behavior is probably found in the low incremental value of seed compared to grain. The incremental value of seed in the surveyed areas ranged from Rp 155 to Rp 444 per kg. Fluctuations seem to occur more between sources and types of seed (kiosk vs hamlet; certified vs non-certified), than between locations and over seasons. Farmers who decide to store their seed between October and March of the next year could also receive a small incentive from the price fluctuation that occurs between the seasons (approximately Rp 100 for East Java). As indicated in Table 11, the farmers' net benefit from storing soybean seed is very little. However, such storage is invaluable, when high quality seed is not available in the market place.

Figure 4 Soybean seed viability: comparison of open storage and farmer vapour proof storage.

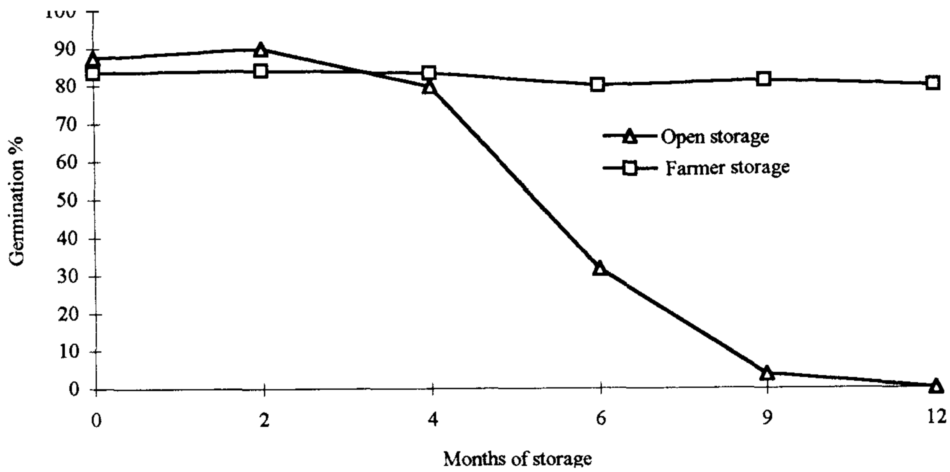


Table 11 Costs and net benefit of farmer saved soybean seed.

10 kg grain @ Rp 800 (October 1994)	-Rp 8250
Loss of 7% seed moisture (0.7 kg)	-Rp 560
Labour for cleaning/drying/packing	-Rp 2250
Packing material (tin or plastic)	-Rp 500
Loss of interest (6 months, 1.5%/month)	-Rp. 740
Save cost of 10 kg seed @ Rp 1250 (March 1995)	+Rp12500
Net financial benefit to farmer (per 10 kg seed)	+ Rp 200

Conclusions

The lesson learned from these surveys can be summarized as follows:

- It appears that the local seed system for soybean in Indonesia is working fairly well. It provides acceptable levels of quality in terms of viability, analytic purity and seed health, which gives no reason so far to believe that there is a structural problem in soybean seed quality.
- Soybean seed quality does occasionally show deficiencies depending on location and season. Farmer's practices however, appear to largely overcome or prevent quality deficiencies through increased seed rates, time of planting and prolonged storage.
- Such farmer practices or cultivation knowledge may not be widespread in new soybean production areas, such as Aceh province. The use of paddy threshers, for example, for soybean could reduce seed quality significantly. Also, there are indications that farmers could still learn from improved storage techniques, as described in this paper. Further research is needed to investigate farmers' post harvest seed handling practices.
- Although there are some slight problems with seed health, including widespread seed-borne virus, there is yet no proof that these diseases at the observed levels pose a real threat to production in the provinces. Further research should determine whether the high seed-borne virus level indicated in certain districts is detrimental to farm yields. Provinces with high rainfall such as West Java and N. Sumatra, from which data were

not received in time for this analysis, might have even higher levels of fungal and bacterial seed-borne infection.

- With regard to genetic purity, there is so far no evidence that yields are negatively affected by impurities. As some farmers' seed out-yielded the highest quality seed, this could indicate that impurities might even be beneficial to the farmer. It is strongly suggested that the effect on yield of varietal blends, multilines and farmer seed be compared with pure lines in fanner managed conditions be investigated.
- From the survey data, it can be concluded that there is yet no proof that certified seed, equal to the A and B qualities in the on-farm trials, is better than farmer seed. The present seed produced by the formal sector, though more expensive, is not better in terms of physical and genetic quality. The contribution of certification programs to national soybean production at this moment therefore is considered insignificant. This could change when new varieties with significantly higher yield potential appear on the market, as in the case of Wilis a decade ago. However, the government should seek justification, considering the high cost of maintaining a certification program for a product like soybean. It appears, that the local farmer/trader system in soybean can well take care of distribution of improved varieties within certain areas, thus opening the way for a truly integrated system.
- With regard to maize, the high yield potential of improved varieties, especially hybrids, and the fact that this crop is open pollinated and therefore more prone to degeneration could make the contribution of certification very significant. So far, little data are available on local farmer seed supplies in maize, the yield potential of improved varieties under farmer stress environments, and farmer seed quality, which indicates the need for additional surveys in this field.

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Seed Supply of Palawija Crops: The Experience of the National Seed Corporation

*M Sujud**

Introduction

The National Seed Corporation (Perum Sang Hyang Seri), a state owned company (BUMN) within the Ministry of Agriculture, was established based on government regulation No. 22 of 1971 and modernized with government regulation No. 44 of 1985.

The objectives of establishing the National Seed Corporation are as follows:

- to contribute to general economic development of the government and government income in particular;
- to provide services to the public in the form of proper and qualified goods for public needs;
- to act as a pioneer in business activities which the private sectors and cooperatives have neglected;
- to participate actively in supporting the implementation of government programs and policies in economy and development, in general;
- to enlarge the field of endeavor for Indonesian citizens to make a career in the agricultural sector and to make national development successful.

The main tasks of the National Seed Corporation are food crops seed production, processing, storage, distribution and marketing activities, and research, education and extension activities on seed and other activities which support the seed business. The objectives and main tasks indicate that the National Seed Corporation has a core business in food crops seed.

Sales of rice seed started in 1972 at 675.90 tons and increased from year to year, reaching 43,137.58 tons in 1994. Therefore, over the last ten years, the average increase of sales volume has been 16.9% per year.

The development of sales volume of seconday food crop (palawija) seed has not stabilized yet. The data for the last five years indicate considerable fluctuation. Sales of palawija seed started in 1982 at 19.34 tons. There has been a great increase since 1990 because of the programmed market. As an example, in 1991 soybean seed sales reached 5,722.51 tons, consisting of 5,142.66 tons in the programmed market and 579.85 tons in the free market, while the average sales per year from 1985 to1994 was 2,412.93 tons.

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Seed marketing development of the National Seed Corporation from 1985 to 1994

Sales realization

Seed sales over the last ten years are shown in Table 1.

Table 1 Seed sales in tons from 1985 to 1994.

Year	Rice	Soybean	Hybrid Maize	Composite Maize
1985	16,029.00	299.84	-	113.71
1986	22,908.00	408.82	-	171.00
1987	29,332.00	198.04	-	108.50
1988	29,009.17	261.76	92.66	104.63
1989	33,526.10	681.46	281.91	206.93
1990	35,503.35	4,732.15	458.29	236.66
1991	38,556.07	5,722.51	426.58	254.92
1992	41,390.46	2,339.70	631.39	277.23
1993	41,023.41	4,988.53	489.01	129.02
1994	43,137.58	4,496.49	406.12	404.94

Sales of rice seed from 1985 to 1994 increased gradually with an average 16.9% annual increase. The greatest increase of sales volume occurred in 1985-1986, i.e. 143% and in 1986-1987 i.e. 128%. This increase in sales volume might be due to the government Supra Insus program.

The seed sales in 1994 of 43,137.58 ton was sufficient for planting 1,725,503 ha. Assuming that the production increase was 0.4 ton per ha for blue label rice seed, the total additional increase of production was estimated to reach 690,201,280 kg, equivalent to Rp 276,080,512,000 while the subsidy for the seed sold in 1994 was Rp 11,431,458,700 or only 1.14% of the value of additional yield obtained by farmers.

Soybean seed sales volume increased sharply from 1990 because of the support of the programmed market. The highest sales occurred in 1991, i.e. 5,722.51 tons consisting of 5,142.66 tons (89.87%) through the programmed market and 579.85 tons (10.13%) through the free market (Table 2).

Table 2 Soybean seed sales in programmed and free markets in tons, 19854994.

Year	Realization	Programmed	Free
1985	299.8	-	299.84
1986	408.8	-	408.82
1987	198.0	-	198.04
1988	261.7	-	261.76
1989	681.4	-	681.46
1990	4,732.15	4,100,79	631.36
1991	5,722.51	5,142.66	579.85
1992	2,339.71	1,712.92	626.78
1993	4,988.53	3,283.29	1,705.24
1994	4,496.49	1,534.67	2,961.82

To increase sales in the free market at reasonable price which farmers can afford, a production and marketing system of soybean seed through field to field interchange (Jabal) system has been followed since 1993. Soybean seed sales through the free market have been increasing since the *Jabal* System was implemented.

Sales of composite maize seed started in 1981 at 101.00 tons, with average sales of 230.49 tons per year from 1985 to 1994. Sales of hybrid maize seed started in 1988 at 92.66

tons, with average sales of 397.98 tons per year from 1988 to 1994. Sales of composite maize have not shown much progress during 1985-1994. There was an increasing trend of seed sales of both hybrid and composite maize until 1992, but in 1993 sales decreased because of competition with other products, especially in quality and price.

Establishment of seed price

Although seed is urgently required by farmers who have low buying power, seed prices should be attractive to producers/growers. At the same time, the establishment of seed prices is influenced by other factors such as:

- the purchase price of candidate seed and other costs covering costs of production, processing, testing, packing and marketing which contribute to the cost price of the company's seed for sale;
- provisions on seed prices established by the local government which influence the market price;
- the distributor's price and margin and conditions and method of payment;

competition with other producers.

Based on experience, the selling price of rice seed ranges from 160% to 180% of the market price of candidate seed (GKP), while the selling price of soybean seed ranges from 120% to 146% of that of the candidate seed (WKP). These price ranges do not cover the overall cost price, therefore a subsidy from the government is still needed. The range of selling price of seed, related to the price of candidate seed, cost price to the company and subsidy are shown in Table 3. The government has subsidized rice seed since 1981/1982 and soybean seed since 1989.

Table 3 Rice and ssoybean candidate seed prices, actual costs, selling prices and subsidies, in rupiah/kg 1989-1995.

							Subsidy	(SK Min. of Finance)	
	1989	1990	1991	1992	1993	1994	1992	1993/94	1995
Rice									
GKP* price	239.52	264.89	294.66	296.92	288.16	375.7	-	-	-
Cost price	597.75	613.80	662.91	693.15	742.50	692.93	698.05	750.00	850.00
Selling price	411.71	450.19	502.64	533.92	520.33	592.14	527.65	540.00	650.00
Ratio (%) of selling P/GKP	171.89	169.95	170.56	175.45	179.95	157.58	-	-	-
Selling P/HPP	68.88	73.34	75.52	75.59	70.08	85.45	-	-	-
Subsidy	247.72	215.86	215.52	234.72	275.00	280.71	235.40	275.00	265.00
Soybean									
WKP* price	768.40	382.38	925.02	947.49	994.95	1,118.53	-	-	-
Cost price	1,135.58	1,344.24	1,447.58	1,501.10	1,523.34	1,464.98	1,534.99	1,560.00	1,700.00
Selling price	978.18	1,173.38	1,351.35	1,351.66	1,334.97	1,352.49	1,360.69	1,360.00	1,500.00
Ratio (%) of selling P/WKP	127.30	132.98	146.09	142.66	134.17	120.92			
Selling P/HPP	86.14	87.29	93.35	90.04	87.63	92.32			
Subsidy	195.42	211.02	126.06	217.83	265.00	274.50	239.30	265.00	265.00

* GKP and WKP candidate seed for rice and soybean, respectively.

The volume of sales of rice and soybean seed within the last ten years indicates that the sales of rice seed have been greatly increasing with the selling price of 160-180% of the price of candidate seed (GKP). This means that the selling price is in general within the limit of the farmers' buying power. For soybean seed, the large volume of sales in 1990 was caused by the programmed market, while the free market volume was lower and the price was only 120146% of the candidate seed price (WKP). This means that the selling price of soybean seed is still above the buying power of farmers.

The selling price of soybean seed in the Jabal system is lower, based on the buying power of the farmers; it might range from 106 to 110% of the candidate seed price (WKP) and could fluctuate in a shorter period compared to rice.

Considering the development of increase in selling price (6.2% for rice seed and 3.2% for soybean seed), the subsidy can be said to be controlled. There was a slight increase in subsidy (2.2% for rice seed and 5% for soybean seed) due especially to an increase of price of candidate seed, a matter that cannot be controlled by management.

Seed quality required by farmers

From the sales development of rice seed which is greater than that of soybean seed, it is concluded that farmers are becoming more aware of the quality of blue label rice seed. However, the low development of sales of soybean seed (especially for free market) and lower selling price, show that the awareness level of the farmers concerning the quality of blue label seed is still low.

The quality characteristics of soybean seed used by the farmers in the Jabal system are as follows:

- soybean seed newly harvested;
- germination rate of at least 85%;
- variety is according to farmers' preference;
- grain size is uniform;
- no inert material included;
- water content 14-15% ;
- requirement regarding mixture with other variety (CVL) is not really a matter of concern.

To fulfill the market's requirements based on farmers' preferences, a method of seed production and marketing using the Jabal system (field to field interchange) was started in 1993. It aims to decrease the production cost to levels close to the farmers' buying power (106110% of WKP), shortening the time between production and distribution, and improving the seed quality gradually.

Problems in marketing of palawija seed

Problems faced by the company in seed marketing can be classified according to whether they are related to supply aspects or to demand aspects. Problems related to supply aspects include:

- the supply of rice and palawija seed is greatly influenced by season.
- the supply of seed in pioneering areas does not meet the farmers' needs.
- there are still obstacles in source seed for the production of palawija seed (composite maize and soybean), so the company is starting to multiply BS, FS and SS.
- farmers can produce seed for their own need, except for hybrid maize seed.
- seed has a limited lifetime.
- seed, especially soybean is very sensitive to the environment, weather, pests and diseases

- variety cycles to control pest and disease outbreaks and quick changing of farmers' preferences on a variety make the arrangement of estimated variety composition difficult.
- there is a very short period between production in a location and marketing demand in another location, especially in supply of soybean seed. Thus, the market price of candidate seed of soybean (WKP) can fluctuate rapidly.
- the time of seed testing, i.e. from sample collection to lab testing, is considered very long.
- label extension in re-testing of soybean seed is only given for 1 month.

Problems related to demand aspects include:

- the major seed consumers have limited buying power, mobility and educational background.
- seed consumers are geographically spread in the remote villages, so long distribution channels are needed to connect the producer and the consumers.
- the farmers' awareness about seed quality, especially for palawija seed, is still low and variable.
- the farmers' preference is still to plant rice rather than palawija.
- the seed market is not a monopoly (captive market).
- seed marketing depends on the season so the sales time is limited.
- the seed business is more a buyers' market rather than a sellers' market, therefore the bargaining position of distributors is stronger than that of producers. Although seed is an important factor in the farm business, it has a lower commercial value than the fertilizer and pesticide businesses; therefore, for distributors the turnover value of seed is lower than that of fertilizer and pesticide. There are only 269 distributors in Indonesia.
- the market price of soybean seed is more labile than that of rice seed.
- In fulfilling their needs, farmers are influenced by their awareness of seed quality, the availability of the seed at the right time, and price considerations. Therefore, they have five choices, i.e.: use their own seed; barter for seed; consumption material selected for seed; pink label seed; and blue label seed (ES).

Seed demand and market competition

Potential demand based on the planting area is 260,000 tons of rice seed (10.40 million ha), 95,000 tons of maize seed (3.15 million ha), and 40,000 tons of soybean seed (1.35 million ha). The National Seed Corporation fulfills 17% of the potential demand for rice seed, 1% for maize seed and 14.3% for soybean seed.

The effective demand is influenced by several variables, including farmers' buying power, price level, farmers' awareness on quality, season, pest and disease as described previously. Therefore, the effective demand is difficult to predict.

The seed business is not a monopoly, so competition in price, quality and service can exist between producers. For rice seed, competition exists especially in price and service. With the relatively short period of sales, and seasonality, seed producers compete in entering the market and then face distributors who mostly determine the outcome of competition.

Competition in maize seed is more in terms of quality and price. The distrbutors' margin is included in competition of price and quality. Because of their position, distributors can press the producers for a bigger margin.

Competition in the soybean seed market has not emerged yet, but there is a difference in quality and price between certified seed and Jabal seed which is produced by local traders.

Conclusions

- The selling price of rice seed ranges from 165 to 180% of the price of candidate seed; and the selling price of soybean seed is from 120 to 146% of the price of candidate seed. However, the selling price of both rice and soybean seed cannot cover the cost price, so subsidies for rice and soybean seed are still required to support the seed production and marketing business.
- The selling rice of soybean seed at present is too expensive for farmers. In the field the price of soybean seed ranges only from 106 to 110% of the price of the candidate seed (for the quality preferred by the farmers in the Jabal system). This situation encouraged the National Seed Corporation to implement the Jabal system.
- Seed distributors expect sufficient margin to cover at least the interest and distribution costs. A low distributors' margin is not attractive and does not support smooth seed marketing. Therefore, margin and seed quality can be good means of competition.
- Seed supply is greatly influenced by seasonal/natural factors. There are still problems in the availability of seed sources. Seed has a limited timelife, especially soybean seed which easily deteriorates. These factors, in addition to the low farmers' purchasing power and awareness, support the need for government subsidy in the development of rice and soybean seed businesses.
- The subsidy for rice and soybean seed should be maintained because the benefits are greater than the value of the subsidy given. If the subsidy for rice and soybean seed were terminated, the private sector might not be ready to take over the role of assuring seed supply.
- Hopefully, by implementing the Jabal system for soybean seed and improving the extension activities, the National Seed Corporation can improve awareness on the part of farmers of the quality of soybean seed, which will finally encourage further development of soybean seed business.
- Laboratory testing of soybean seed, especially the germination test, should be done by rapid methods and the extension of the label in retesting should be valid for at least one month or longer, based on the condition of the seed.
- The seed business is not a monopoly; competition among producers exists in price, quality and service, including the distributors' margin. In rice seed, competition occurs especially in price and service. In maize seed, competition is more in terms of quality and price, while in soybean seed, competeition has not emerged yet, but there is a difference in quality and price between certified seed and Jabal seed which is produced by the local traders.
- The effective demand is unpredictable because there are too many uncontrollable variables which are difficult to reconcile.

Soybean Variety Development in Indonesia

Soemarno[*]

Introduction

Soybean is an old crop in Indonesia. Its introduction dates back to the early eighteenth century. However, the role of improved cultivars in crop production was not apparent until the 1980s, when an intensification program on soybean was launched. Before independence, several cultivars had been released, the names of which were known by agriculture officers, but soybean farmers did not know the names of the soybean strains they grew. Local cultivar names were more popular during the period until 1980, such as Presi, Si Nyonya, Lumajang Bewok, Petek, Genjah Slawi, etc.

Release of new cultivars derived from a breeding program started in 1974 and followed by a dozen new cultivars in the 1980s. Of the 18 cultivars released from 1974 to 1995, was only four cultivars were widely planted by farmers, namely Wilis, Lokon, Raung and Dempo. According to a survey conducted by the National Logistics Board in 1987, about 60% of the soybean area was planted with improved cultivars. Among those cultivars, Wilis was (and still is) the most popular, due to its good adaptation in various agro-ecological areas.

Considering the diverse characteristics of soybean areas in Indonesia, too few soybean varieties have been recommended to match the whole range of agro-ecology. There are various factors constraining the adoption of the released cultivars, including :

- the cultivar was not targeted to a specific environment; thus its adaptation and performance were not optimal for a specific environment.
- new cultivars were not much better than the existing cultivars commonly planted by farmers.
- release of new cultivars was not accompanied by seed production and seed distribution seeds of the newly released cultivars were not available during the planting season.

The present breeding program is confined to varietal releases, without an active program for seed production and distribution.

Present system of variety development and its limitations

Up to April 1995, four out of six research institutes within the Central Research Institute for Food Crops (CRIFC) were engaged in soybean breeding programs, and each program was aimed at developing soybean varieties suitable for a specific region. Sukarami Research Institute developed soybean varieties for acid soil in Sumatra; Sukamandi developed soybean varieties suitable for lowland rice fields in West and Central Java; Bogor developed soybean varieties for the uplands; and Malang developed soybean varieties suitable for the uplands and lowlands in eastern Indonesia. The national soybean genotype adaptation trial,

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organized by the Directorate of Food Crops Production in Jakarta, was conducted throughout Indonesia. Genotypes to be evaluated were supplied by the above four research institutes.

With the above procedure, yield data to be considered for releasing new cultivars were derived from the average of all locations. The yield average for genotypes exhibiting strong genotype x environment interactions would be penalized, to the advantage of those lines which did not indicate genotype x environment interaction. Lines producing particularly well in specific environments, but less well in other locations, could not be eligible for varietal release due to lower yield average. Soybean cultivars released based on the average yield of the overall locations generally conformed to criteria of yield stability, as was indicated by the analysis of yield stability of Orba cultivar. Undoubtedly, there is always genotype x environment interaction with regard to yield. Therefore, the previous release procedure could not identify most suitable cultivars for specific environments.

Despite the involvement of the four research institutes in the soybean breeding program, there were some deficiencies with regard to the national soybean variety development, which stemmed from:

- inactive national coordination, resulting in isolated activities of each program.
- lack of working cooperation between soybean breeders - plant pathologists, breeders - entomologists, or breeders - plant physiologists. Soybean breeding was carried out as an individual effort, rather than as an interdisciplinary team work.
- the size of the breeding population generally was too small to provide segregating genotypes suitable for particular breeding objectives.
- lack of highly trained staff to carry out the soybean breeding program.
- funding for soybean breeding generally was insufficient to conduct intensive selection and yield testing over various environments.
- production of breeder seed was insufficiently funded, which hampered the supply of seeds of newly released cultivars.
- seed growers were not eager to produce seed of the newly released cultivars due to the slow seed sale.

In summary, major factors which limit the progress of soybean cultivar development included: limited manpower, budget, and collaboration. For optimum results, a soybean breeding program needs to be organized nationally, and those constraints should be minimized.

Genotype testing and varietal releases

Genotype testing followed sequential steps, observation of homozygous lines, preliminary yield test, advanced yield test, and multilocation yield test, as listed below.

Observation of homozygous lines

Homozygous line (F6 or beyond) observation was conducted by the breeder at the experimental farm. Selected homozygous lines were planted, two rows of each, and observed for their homogeneity, seed quality and agronomic value, by visual rating. Around 100 lines or more were selected for the preliminary yield test.

Preliminary yield test

The preliminary yield test of about 100 lines included check varieties at the experimental farm (one site with two replications). Plot size was small, four rows five metres long. Selection was based on yield, maturity, general agronomic performance (lodging score, plant height), reaction to rust, bacterial pustule, Xanthomonas blight, and seed quality. Trials might be repeated for one more season at two locations (experimental farms). Selection intensity was 25 to 30%.

Advanced yield test

Around 25 entries (lines) were tested at three or more sites in the first year. Plot size was 3 m x 5 m, and the trial was managed with optimum agronomic treatments. Selection of lines was based on yield, maturity and agronomic values. In the second and third year, the tests were conducted at the experimental farm and farmers' fields. Usually eight or ten sites were considered sufficient to test the yield potential. Outstanding lines, termed promising lines, were further tested at in the multilocation yield test.

Multilocation yield test

Promising lines were yield tested at soybean production centers, in cooperation with the district agricultural offices, or with the sub-district extension offices. Data collection included seed yield, maturity, lodging, and plant height. The tests were repeated for two seasons. When promising lines out-yielded the check variety, those lines were submitted for varietal releases. Generally, data on 24 environments (excluding the preliminary yield test) were required to decide whether or not promising lines would be released as new varieties. The yield potential of lines was determined based on the overall average of yields from all environments. Thus, varietal release for specific agroclimatic adaptation was not considered.

Seed certification

Regulations for seed certification were written in the early 1970s, and the present regulations are based on a decree by the Minister of Agriculture (SK Mentan No. 460/Kpts/Org/XI/1971: Table 1). Considering the infancy of the soybean seed industry, the regulations seem to be too rigid to promote development of the seed business. The regulations state that the breeder seed (BS) which is produced by the breeder, should be multiplied into foundation seed (FS) and stock seed (SS), before it is produced by seed growers into commercial extension seed (ES). All seed generations (FS, SS, ES) must be inspected and certified, for which the purity requirement is very high (99.5%).

To comply with the Agriculture Law No. 12, 1992, where all seed to be marketed must bear a seed certificate, it is suggested that the regulations regarding seed certification (SK Mentan No. 460/Kpts/Org/XI/1971) should be updated.

To alleviate the short supply of seed, each seed generation, except for the ES, could be reproduced for four generations. This practice is termed the polygeneration seed flow. While this regulation could facilitate the availability of seed, the quantity of certified seed at the soybean growing centers remains scarce.

Some suggestions for promoting the adoption of seed certification follow:

- The seed certification regulation (SK Mentan No. 460-1971) should be amended for more practical use, especially with regard to the field isolation and percent mixture of other varieties, which should be less strict.
- Seed certification should be applied only to SS and ES production.

Table 1 Requirements for soybean seed certification based on the Ministry of Agriculture decision (SK Mentan No. 460/Kpts/Org/XI/1971).

Component for seed certification	Requirement for Each Seed Class			
	BS	FS	SS	ES
Field isolation (m)	8	8	8	8
Mixture of other variety (%)	0	0.1	0.2	0.5
Noxious weed seeds	0	0	0	0
Germination test (%) min.	80	80	80	80
Mixture of other species seeds (%) max.	0	0.1	0.2	0.5
Dirt (%) max.	1.0	1.0	2.0	2.0
Seed moisture (%) max.	14.0	14.0	14.0	14.0

BS = breeder seed. FS = foundation seed. SS = stock seed. ES = Extension seed

While this suggested modification may not instantly increase the availability of the certified soybean seed, it is expected to simplify the certification procedure. Agricultural Law No. 12, 1992 required that any seed to be marketed must bear a seed certificate. At present, seed producers may be discouraged from producing soybean seed for the market.

Suggested improvements for the soybean breeding program

Germplasm management

Soybean germplasm management should be centralized at one institute, preferably at the Research Institute for Legume and Tuber Crops (RILET) in Malang. At present the mandate of RILET as the center for soybean germplasm maintainance has not been stated clearly, and soybean germplasm management at RILET is only a minor activity in the whole RILET mandate.

The complete soybean germplasm management center should ideally be furnished with the following facilities: (1) individual cold storage at minus 18° C for long periods of storage (10-15 years); (2) individual cold storage, at 0° C for 2-5 years storage; (3) drying room, with low air humidity (20-30%) and low temperature (10-15° C); (4) screen houses (2 to 4 units) for insect or disease screening; (5) glass houses (I or 2 units) for disease screening; (6) seed lab, where seed preparation and seed characterization could be carried out; (7) suitable farm land, at three or four sites, where seed rejuvenation and germplasm evaluation could be conducted; (8) soybean thresher, seed cleaners, seed sieves, weighing balances, seed counter, seed moisture tester; (9) seed dryer, preferably hot air room dryer; (10) seed health inspection lab, where pathologists and entomologists could check the seeds for pathogens and insects; (11) seed germination test lab, where seed could be checked for its germination before storing or before sending out; and a (12) computer to facilitate data management.

Although some of these facilities required could be shared with other germplasm programs, the availability of this equipment is vital to ensure the high performance of the soybean germplasm management unit.

Complete facilities would not be of any use if qualified and responsible staff were not available. To manage the national soybean germplasm center in Indonesia, the following permanent personnel are required: (i) plant breeder, with strong interest in germplasm management, MS or PhD level, to lead the program; (ii) two plant scientists, MS level, to carry out germplasm evaluation for disease, pests and physiologic/agronomic performance; (iii) the assistance of a plant pathologist, entomologist and plant physiologist, to evaluate in more depth the characteristics of the germplasm; and (iv) three to four field assistants to assist in the operational work of soybean germplasm management.

The research and work program of the national soybean germplasm unit would include the following:

- to acquire all available varieties/strains from the soybean collections existing at various research institutes, universities, private companies, etc.
- to make a national permanent cataloging system of soybean germplasm, to avoid duplication, and to facilitate easy retrieval.
- to re-evaluate national soybean germplasm and to rejuvenate stock seed sufficient for immediate use and for long term storage. If possible, to get rid of duplication and to complete the passport data of each entry.
- in cooperation with plant pathologists, to screen soybean germplasm for major disease resistance, especially for rust, frog eye leaf spot, Xanthomonas leaf blight, bacterial pustule, anthracnose, viruses, seedling rot, and pod rot.
- in cooperation with entomologists, to screen soybean germplasm for major pest resistance, especially for: seedling fly, pod sucking insects, pod borer, and thrips.
- in cooperation with plant physiologists. to identify soybean genotypes for more efficient use of resources to produce high yield, including idio plant type, high harvest index, better plant growth rate, and high net photosynthetic rate.
- to provide as many parent materials as possible to breeders to develop improved varieties.
- to intensify the collection of local strains throughout Indonesia and to introduce more germplasm from abroad.
- to provide seed to various users at reliable institutions

Breeding program for specific environmental adaptation

With a diverse agro-ecology for soybean farming in Indonesia, more breeding program sites are required to provide desired varieties. Presently, soybean breeding is centralized at RILET Malang. This set up, while considered efficient, suffers some deficiencies, including:

- specific problems at various regions of diverse agro-ecology might not be known to breeders at Malang.
- the choice of breeding objectives becomes more subjective, not matched to specific problems in the regions.
- priority setting for breeding objectives is too difficult, due to so many important objectives.
- selection at early generations could not be conducted in the target environment, resulting in the non-adaptive selected genotype/variety.
- soybean production environments in Indonesia are so diverse that it is impossible for only one breeding centre to develop suitable varieties for all regions.

With the present research organization, it is suggested that satellite breeding stations be organized at the provincial technology assessment institutes (BPTPs) in regions where soybean is an important crop, under the supervision of RILET. For East Java province, a satellite breeding station is not needed, since the regional soybean breeding objectives could be directly tackled by RILET.

The tasks of the satellite breeding station are as follows:

- in consultation with RILET, to formulate breeding objectives in accordance with the regional priority.
- with the guidance of RILET, to set up a breeding program in accordance with the breeding objectives. Parent crossing may be done at RILET, but the selections and evaluations are to be conducted at the region.
- to select and identify soybean genotypes most suitable to the region to be submitted for official release.
- to produce breeder seed of released varieties for further multiplication in the region by seed growers.
- to function as a regional partner to the breeders at RILET.

National varietal adaptation and yield testing

In the early stages of BPTP development, promising lines for adaptation trials at the region are provided by RILET. The breeders at RILET therefore have the following tasks:
to select and identify soybean genotypes which have suitable characteristics for the targeted area in the region.

- to produce enough seed of the selected genotypes for testing at various regions.
- to organize the multilocation test, ensuring proper conduct of the experimental procedure and data collection.
- to supervise experiments and to select the most suitable genotype for the region for varietal release.

In the long run, when the satellite breeding stations at BPTP have already been established, the multilocation yield test would use genotypes selected from the regional program of similar agro-ecology, plus promising lines selected by RILET.

Varietal releases

Ideally, new varieties or cultivars are released for specific adaptation, or for regional adaptation. Classification of soybean cultivars based on maturity group as is commonly practiced in the USA, would not be applicable in Indonesia, due to the similar latitude of the locations. Environments for varietal soybean adaptation may be classified into five categories:

- dry land, low altitude, rainy season.
- dry land, medium high altitude, with some rain.
- wet land, early dry season, with some rain.
- wet land, late dry season with no rain.
- dry land, rainy season, with soil pH lower than 5.0.

For now, the soybean breeding program at RILET may be organized into five major programmes to match the five major agro-ecologic situations. Within each agro-ecology, specific requirements are defined, so that varietal releases for specific adaptation can be prepared.

Breeder seed production

Breeder seed production for soybean has been a constant problem. Generally it is assumed that breeder seed should be produced and made available yearly by the research institute where the cultivar was originally released. However, budget for breeder seed production has not been allocated by the National Planning Board, since the budget for breeder seed had been allocated to the Directorate of Food Crops Production. The amount of breeder seed required for seed source was generally quite large, over 500 kg for each cultivar commonly planted by farmers. Informal arrangements had been devised, whereby experimental farms produced the breeder seed and the Directorate of Food Crops purchased the seed.

To be able officially to plan the amount of soybean breeder seed, the Directorate should notify the Research Institute two years in advance concerning the quantity and type of breeder seed required. At the same time, the budget for breeder seed production should be allocated to the research institute. The production of soybean breeder seed should meet the following requirements:

- seed for planting should be derived from strictly controlled breeder seed, through plant to row checking, followed by seed uniformity inspection and pest and disease protection.
- the production of breeder seed should be supervised intensively by the breeder to avoid any possible mixtures.
- breeder seed production should be checked regularly to discard any off-type plants, disease infected plants (particularly viruses).

DUS testing of local varieties

DUS (distinctness, uniformity, stability) testing is applied to true varieties developed by breeder. DUS testing has been a requirement for the release of new varieties, to mark the variety for its uniqueness. From the agronomic point of view, DUS may not have a significant value; however, these three factors are important to the seed inspector and the seed trader. DUS testing is also a means of protection for a given named variety, to be distinguishable from any other variety.

Local varieties have evolved through many generations, adapting to various local stresses. Natural, as well as farmers' selections have reshaped the genotype constituents of the variety towards a more heterogeneous population, but of more or less similar individuals. The local variety should not be purified through mass or pure line selection, lest it lose adaptation and stability.

Thus, DUS testing could not, and should not, be applied to the local variety. Although the distinctness may be quite apparent, local varieties may not be uniform. The stability of local soybean varieties with regard to their characteristics would be high, since they have undergone self pollination for many generations. As a varietal marker for the local variety, DUS testing could be modified into a range, denoting the acceptable composition of the characters. The uniformity component in DUS testing should be excluded for the local variety requirement.

Use of greater number of locally adapted varieties

Local varieties are frequently considered to be low yielders, non-uniform, and non-responsive to optimum agronomic inputs. This is quite true for crops such as maize, rice, sorghum, and to a lesser degree, soybean. Local varieties of Aceh, Lampung, Pati (Central Java) Lumajang, Jember (East Java) are producing well in their respective localities.

There are some advantages to using a locally adapted variety, especially in high input farming systems:

- the local variety readily adapts to various stresses.
- the local variety produces well under low input farming systems.
- it fits into the existing cropping rotation and cropping pattern (mixed cropping).
- seed increases and seed supply can be controlled by farmers themselves.
- quality and taste are known and usually favored by the consumers.

In some cases, these advantages are offset by lower yield or longer maturity. Especially when intensive farming is practiced, the use of the local variety may not be advantageous, since most local varieties are less responsive to additional agronomic inputs.

The use of locally adapted varieties may be recommended when the following conditions are met:

- yield potential of the local variety is similar to that of the improved variety.
- the local variety is more suitable to the existing agronomic practice than are improved varieties.
- the seed of the local variety is readily available.
- seed of the improved variety is not available, or costs more than that of the local variety.

There are cases in which the local variety yields as well as, or better than, improved varieties at the adaptation area, such as Kipas putih in Aceh, Lumajang bewok in Lumajang, and Petek in Central Java. In fact, these local varieties have been officially recognized as the recommended varieties.

In remote areas, where the seed grower does not exist, the local variety available in the area is definitely the variety recommended for planting. This case is also true in any area where seed of improved varieties is not available.

Increasing the Role of Village Soybean Collectors as Small Seed Growers

A. Syarifuddin Karama and Sumanti[*]

Introduction

One of the bottlenecks to increasing national soybean production is the insufficient availability of good quality seed. To help to overcome this problem, it is proposed that local village soybean seed collectors be encouraged and assisted to become small-scale soybean seed growers.

Some village and hamlet soybean collectors in some major soybean producing areas of Indonesia sell soybean seed, either to farmers in the same village or to other villages. Even sales to other provinces are reported. Typically, such a soybean collector buys freshly harvested soybean plants at harvest time from an area of 5 to 8 ha, representing the production of 15-20 farmers. The collector subsequently arranges for these soybean plants to be dried, threshed, and the soybean graded, packed and ultimately sold as seed. The local seed supply system formed by these collectors operates efficiently, and soybean seed flows between seasons and landuse types.

However, in most of the soybean producing areas, the genetic material used and the management practices applied by these soybean seed collectors are not optimal, resulting in poor quality seed. This is confirmed by surveys carried out by Food Crop Research Institutes which have shown that the seed quality thus obtained is often low. Use of poor quality- seed negatively affects the farmers' soybean productivity.

Proposal to assist village soybean collectors as seed growers

This paper indicates conditions for obtaining good quality seed, which include the planting of quality seed and proper management practices during production, harvesting and processing of soybean, including consideration of:

- planting time;
- land preparation methods;
- water control, including water supply and drainage canals;
- weeding;
- soil fertility management;
- pest and disease control;
- harvesting at the appropriate physiological time, and cutting soybean plants rather than uprooting;
- drying of the pods;
- threshing methods;

[*] Bogor Research Institute for Food Crops, Indonesia. This paper is a summary prepared by C.E. van Santen

- grading;
- drying of the soybeans;
- packing methods;
- storage methods.

It is proposed that village and hamlet soybean collectors already dealing in seed be assisted to become small seed growers. Most of these collectors are farmers in their own right and are only collectors during harvest and planting time. It is suggested that creation of such a category of local small-scale seed growers would make a significant contribution towards increasing the availability of good quality seed while using the already efficient seed supply system presently operating in the major soybean production areas.

It is suggested that asistance to these small scale seed growers should cover training in the following farm management aspects:

- selection of suitable fields for seed production;
- establishment of proper irrigation and drainage systems;
- soil fertility management;
- provison of quality seed (certified seed);
- selection of appropriate planting times;
- promotion of the use of mulch from padi straw;
- appropriate pest, disease and weed control measures;
- removal of off-type plants and poorly developed plants (rogueing);
- harvesting at 95% physiological maturity, eg when 95% of the plants have reached hysiological maturity;
- cutting soybean plants at harvest rather than uprooting entire plants;
- proper drying methods of soybean pods, where drying floors are covered to keep the temperature below 42°C;
- proper threshing methods with threshers adjusted for soybean and operating at low speed (300 rpm);
- proper drying of beans with covered drying floors to keep the temperature below 42°C;
- appropriate packing and storage methods.

Furthermore, guidance, training and probably, production credit would have to be provided to help these soybean collectors cum seed sellers to assist them to become small seed growers. In addition, it is proposed that the following inputs will be provided in kind to participating soybean collectors, either on a loan or grant basis: i) high quality stock seed (SS); ii) funds for improving water control, particular for establishing drainage channels; iii) threshers, properly adjusted for threshing soybean; iv) moisture testers; and v) bag sealing machines.

The existing seed supply system (Jabal) should be continued so that these soybean seed collectors/cum seed sellers sell market directly to other farmers, farmer groups, and village cooperatives.

Cost benefit analysis of the proposal

An overview of the costs and returns associated with this proposal for assisting soybean seed collectors to become small-scale seed growers is presented in Table 1. Assumptions at the farm level include:

- one ha per seed grower;

- plant stand at planting 500,000 seeds = 50 kg of seed;
- 100 beanweight 10 gram (Wilis variety), 90% germination;
- average yield per ha of 1. 8 ton, of which:
- 1,200 kg is seed @ Rp 1,400 per kg and 600 kg is grain @ Rp 800 per kg.

Table I Cost benefit analysis.

Costs	per hectare	
Seed 50 kg	Rp 1,500	Rp 75,000
Chemicals		Rp 40,000
Fertilizers		Rp 10,000
Production labour		Rp 300,000
Harvest and processing labour		Rp 150,000
Packing labour		Rp 50,000
Packing material		Rp 25,000
Others		Rp 50,000
Total costs		Rp 695,000
Gross returns		
1,200 kg seed	Rp 1,400 per kg	Rp 1,680,000
600 kg grain	Rp 800 per kg	Rp 480,000
		Rp 2,160,000
Net returns to family labour, management & land rent	per hectare	Rp 1,465,000

Each small seed grower on average should aim at producing sufficient seed for an area of 24 ha (eg 1,200 kg seed at seed rate 50 kg /ha).

National implications

The 1994 area planted with soybean was 1,500,000 ha, for a total national seed requirement of 1,500,000 x 50 kg = 75,000 tons. Thus, 75,000/1.2 tons = 62,500 small seed growers would be required. Typical villages in the major soybean producing areas have an average acreage planted with soybean ranging from 100 to 500 ha. This would imply that each village participating in the scheme would need from 4 to 20 soybean collectors joining in the programme.

Conclusions

- Upgrading and stimulating village and hamlet soybean collectors to become small seed growers offers an efficient and low cost approach to improving farmer's seed quality.
- Weak points in the way local soybean collectors presently operate include poor seed, poor production, and poor harvesting and processing methods.
- To improve the situation, the following would be required:
    - use of high quality seed;
    - planting during the optimal periods;
    - improving drainage;
    - using mulch from paddy straw;
    - improved pest, disease and weed control;
    - improved harvesting methods (at 95% maturity, cut stalks, not uprooting)

- improved drying methods;
- improved threshing methods (improve power thresher, thresh as early as possible);
- improved package methods (double plastic bags or tins with ash);
- improved storage methods.

Farmers' Forum: Integrating Seed Systems

Introduction

Seed sector development in most developing countries started in the second half of this century. It was typically initiated by the national government and was characterized by a top-down approach using the extension service to educate farmers about the use of improved varieties and certified seed. This top-down approach was reinforced by the usually project-wise introduction of the new seed systems and their products. Unfortunately, in this process of technology transfer, policy makers and scientists often have paid scant attention to farmers' opinions on the new technology's socio-economic value for their enterprises. Consequently, the often low adoption rates of the new technology were usually ascribed to deficient extension/marketing efforts, rather than to lack of marketability of the products.

The present drive for privatization of the public seed sector requires a change of attitude, as commercial enterprises need to be client oriented in order to survive. In the process, farmers are to be recognized as the pivots of the seed system: farmers are not only seed users; they also produce and trade the bulk of the seed of certain crops in a majority of countries.

The organizers of the workshop have sought to use farmers' knowledge by inviting a number of experienced farmers, farmer/seed growers and local seed traders to participate in a forum discussion at the beginning of the workshop.

Forum members were selected from the respondents in a soybean seed survey organized by the Palawija Seed Production and Marketing Project in the provinces of East Java and West Nusa Tenggara. They were interviewed by the director of the Agricultural Technology Assessment Institute (BPTP) for East Java. Dr. Soemarno, and by Dr. Eko Legowo. extension specialist at the same institute, under chairmanship of the director of the Centre for Research on Food Crops (CRIFC), Bogor, Dr. M. Fagi.

In addition, the group was shown a trial planted at RILET with samples of soybean seed used or produced by farmers in different provinces. Forum members were asked to evaluate the performance of the 63 entries in the trial and to indicate from which plot they would prefer to have seed for their own farm.

Forum discussion

Availability of good soybean seed at planting time

The five farmers in the forum stated that in their areas there was no shortage of good seed with high germination rate. Certified seed was not important. There was no demand for certified seed in their areas. The farmers explained how the local seed supply system (jabal) ensures the availability of fresh seed throughout the year.

Availability of appropriate soybean varieties

The farmers expressed satisfaction with the varieties they were planting. However. they emphasized their interest in trying new varieties. They therefore suggested that the government make a strong effort to develop. and make available to farmers, a much wider range of varieties. In developing new varieties, not only production, but also grain quality characteristics preferred by the processing industry, should be considered.

Seed certification

The two seed growers in the forum produced both certified and uncertified seed. One of them was chairman of a farmers' group producing certified seed for the National Seed Corporation (NSC). For this purpose, fields of this farmers' group are inspected by the seed quality control service (SCCS) several times during the growing season. The group received from NSC a premium of 10% above the current farmgate grain price, while NBC paid for the certification costs. However, the bulk of the production of the seed growers was not certified and was sold directly to other farmers. This seed crop was not inspected by the SCCS, the seed growers performed this role and removed off-types and poorly growing plants to ensure high seed quality. This (uncertified but quality controlled) seed was sold at a 33% premium above the grain price, and thus generated more profits than the certified seed produced for NBC.

The high demand for locally quality controlled soybean seed was confirmed by other seed growers. Both seed growers stressed that they sold their own controlled seed, and that they received relatively high prices for it, on the strength of their reputation as suppliers of good quality seed.

The seed growers also explained that the certification procedures were very time consuming, and thus severely limited the timeliness of their marketing operation.

Other constraints referred to the lack of management training for seed growers and lack of suitable post harvest equipment (threshers, dryers and seed sorters) adapted to soybean seed processing.

The lack of demand for certified soybean seed was confirmed also by the traders in the forum, who emphasized that farmers are mainly concerned about seed germination, as soybean seed viability declines rapidly under ambient conditions.

Evaluation of seed sample plots

A trial was planted at RILET from 83 seed samples collected at farms in 35 villages, mainly in two provinces. Of all samples, 69% were from varieties officially released in Indonesia. About 50% of all samples was from Wilis, the most popular variety, developed in Indonesia.

Varietal purity

Varietal purity evaluation was carried out twice, the first time at the flowering stage by the breeder who planted the trial, and the second time, two months after planting, by staff of the seed quality control service. Five samples appeared to be mixtures, containing only 50-60% of the variety indicated by the farmers who supplied the samples. Another 3 samples were probably not of the variety stated.

Of the remaining 75 samples, about 75% had a genetical purity of at least 90%. Considering that very little certified (blue label) seed is sold (see results of the seed survey elsewhere in the proceedings), maintaining adequate varietal purity in the informal system does not seem to be a major problem.

Farmers' varietal preferences

Some of the farmers/seed growers in the forum were asked to evaluate the 63 plots planted at the same time. Variety and origin of the samples were unknown to them. They were asked to indicate from which plots they would like to have seed for their own farms, and for which plant/crop character the preferred plot were considered superior. Each farmer noted 3-5 plots in order of preference and indicated one or more of 8 listed plant/crop characters (maturity, yield, insect resistance, disease resistance, pod size, plant/leaf shape and uniformity) that motivated their choice.

The results can be summarized as follows:

- plots were not chosen at random. The total of 28 preferences listed included only 15 of the 63 plots.
- as a first choice, the 6 farmers listed only 2 of the 22 varieties present in the trial. Four of the 6 farmers preferred the popular variety Wilis, present on 36% of the plots. The other two farmers, however, preferred the variety Manalagi, planted only on one plot. This latter variety is not an officially released one and is of uncertain origin. It is thought by some to be a local variety introduced in East Java from one of the other provinces.
- if all preferences of each farmer are given equal weight, the variety Wilis was chosen only in proportion to its frequency in the trial. None of the three varieties preferred more often than would be expected from random choice were officially released in Indonesia. They include Manalagi, mentioned earlier. Another was Serayu, of unknown origin. The third, Nahon, was introduced by Nestle from Thailand for the processing properties of its beans. This variety is very early maturing and large seeded.
- the plant characters most often mentioned as the basis for the farmers' preferences were for:
    - first preferred: yield, plant height and pod size. Maturity scored very low.
    - second preferred: mostly as for first choice, but with increased emphasis on maturity
    - third preferred: pod size, and yield and earliness to an equal degree. This result was presumably affected by the early variety Nahon being strongly represented in this group.

The plots of the first and second choices did not represent extreme values for any one character but rather an optimum combination of high values for desirable traits. The farmers apparently preferred these varieties (plots) for immediate cultivation. The third choice, based more narrowly on earliness and pod size, may have been motivated by an interest in testing these varieties under their own agro-economic farming conditions.

- Comparing the farmers' perception of the merits of their preferences with actual measurements indicated that Nahon was correctly preferred for earliness but that the earliness of Manalagi was overestimated.
- Established plant densities varied strongly between plots and farmers' perceptions of yielding ability were clearly affected by this. Also, environmental effects would appear to have had a considerable effect on plot performance, and thus on farmers' preferences. Nevertheless, it is difficult to explain why two promising lines, developed by RILET, with superior yield and maturity also in the trial, did not figure in the farmers' choices.

Conclusion

In conclusion, it can be said that yield rather than maturity (in the range represented by the varieties in the trial) was the most critical factor in the farmers' choice. Furthermore, as to varietal preference, varieties that are not formally released or recommended by the government may nevertheless be of considerable interest for the farmers. This fact concurs with the demand, expressed by the farmers/seed growers during the forum discussion, for a wider range of varieties to be made available.

Country Experiences

The Development of Variety Testing and Breeders' Rights in the Netherlands

H. Ghijsen[*]

Early involvement

The history of systematic plant breeding in the Netherlands starts roughly around 1900. Until that time, farmers already used to select the best plants in the field for the next seed crop. Numerous landraces existed in several regions. One of the interesting experiences in those days was that seed from elsewhere performed better than the home or local seed. More specialization in trading and selection occurred. Some farmers took up breeding work by crossing desired plant types with each other. The resulting varieties were traded by these farmers themselves or through local seed traders. This led to an integration of breeding and trading. In 1902 the famous potato variety Bintje was released by Klaas de Vries who bred 125 potato varieties in total. This was necessary in those days because the destructive effect of virus diseases was only discovered in 1916.

New seedling varieties, vegetatively propagated, deteriorated quickly on account of the virus problems. The government policy was to support scientific research and not to take up breeding work. For this purpose, the Institute of Plant Breeding was founded in 1912. Another important milestone was the introduction of the first descriptive variety list for field crops in 1924, with the aim of stimulating the use of improved varieties. The breeders, however, were not rewarded for their work. Everybody could freely grow the improved varieties of cereals, pulses, potatoes and oil seeds. The varieties presented for the variety list were tested for their agricultural value by the Institute for Plant Breeding, extension services, interested farmers and certification organizations. (The latter were founded early in the century, on account of the need felt by farmers and serious traders to control the quality of the seed. This was regarded beneficial to seed producers, traders and users).

To enter the list, the variety should have an improved agricultural value and it should be new and pure. The field tests were regularly visited and commented on by farmers. The further development of the breeding work, research and plant variety protection is described for potato, as this gives a good example of the issues at stake (Table 1).

In 1924 prizes were offered for potato varieties resistant to the wart disease (*Synchytrium endobioticum*), which led to the first resistant variety released in 1931. This is one example of how plant breeding was stimulated in those days.

A next step was to have a more systematic remuneration system. In 1934 the existing small certification organizations founded one general body, the NAK (General Dutch Certification Agency). In the same year the NAK granted money for the listed varieties, based on the seed potato quantity. It also gave an encouragement premium to seven successful breeders.

[*] CPRO-DLO, Dept-for Registration and Plant Breeder’ Right, The Nederlands

Table I Breeding activities for potatoes.

Year	Number of breeders	Number of seedlings ('000)	Number of listed varieties
1900	10	7	-
1934	17	10	5
1944	75	50	27
1956	243	578	53
1982	188	1200	106

Four years later, in 1938, the breeders remuneration fund was founded. Its income was raised by a small levy per 100 kg certified seed potato of all varieties. Breeders of listed varieties not older than 25 years received money from the fund, based on the acreage of certified seed potatoes of the varieties involved. This system has been legalized in the Dutch Plant Breeders' Decree of 1941. The most important elements of this breeders' rights are:

- for the crops with a variety list (agricultural crops):
    1. The variety gets breeders' rights of 25 years if it is New, Distinct, Uniform and Stable
    2. The breeder of the protected variety has the exclusive right for the basic propagation material.
    3. The farmer has the right to produce and sell freely the material of the next generation(s). He pays a levy for certified propagation material for all varieties, including old, non-protected varieties.
    4. All propagation material of crops with a variety list must be certified.
    5. The breeder gets remuneration from the fund based on the certified acreage of his variety
- all other crops (no variety list):.
    1. all other crops (no variety list):
    2. The breeder has the exclusive right for all the propagation material of his variety.

The system for listed agricultural crops shows a strong linkage between listing, certification and plant variety protection (PVP). Nowadays, compulsory variety lists still exist in the EC countries. This means that new varieties, before they can be traded, must fulfill the rather high requirements of improved agricultural value and they must be Distinct, Uniform and Stable.

Fifty-five years ago, certification had grown to a fully accepted measure based on felt needs. Also for the collecting of the money and the data for the remuneration fund, the certification system was necessary.

There was a broad consensus among farmers and breeders about the system. Nowadays, with the ongoing battle between breeders and farmers' organizations within the EC about the royalties for farm saved seed, breeders might have nostalgic feelings about these old days. As can be seen in Table 2, the percentage of farm saved seed in some EC countries is rather high to very high.

Farmers could freely produce, which sometimes led to over-production of some varieties and low prices accordingly. On the other hand, propagation material of all varieties, new and old, had practically the same price. The remuneration fund was fueled for a large part by old non-protected varieties, such as Bintje, which gave a firm financial basis for the fund. Immediately after the introduction of the fund and the Plant Breeders' Decree, breeding activities increased remarkably (see Table 1). Companies also started or increased their breeding activities in other crops, even in wartime. Another way of stimulating plant breeding in potato was the provision of potato seeds to small private breeders, mostly farmers, by a special commission for potato breeding. Later on this work was taken over by the Institute for Plant Breeding in Wageningen. The seeds originated from some difficult, interspecific and intraspecific crossings. In 1938 18,000 seeds were provided freely to 30 breeders; these numbers were raised in 1950 to 120,000 and 197 respectively. From 1959 to 1983, 125 potato varieties were listed. Of these varieties, 68 originated from the seeds provided by the Institute for Plant Breeding.

Table 2 Percentage of farm saved (% of total seed demand). seed in the EC

Country	%
Germany	50
France	50
Italy	70
Netherlands	25
Denmark	5
Ireland	20
United Kingdom	30
Greece	90
Spain	90
Belgium	35

In 1961 the UPOV (The International Union for the Protection of New Varieties of Plants) Convention was signed in Paris. Based on this convention the new Seed and Plant Act was accepted in 1967. For the subject of PVP, the most striking difference with the former decree was the exclusive right for all propagated material to be exercised by the breeder or owner of the variety.

Farm saved seed, if not traded, was excluded from this. (In the new UPOV convention of 1991, it was decided that the breeder, within certain limits, could get a royalty, even if it was a small one, for this farm saved seed). To ease the monopoly of the owner over his varieties, it is possible to grant a compulsory license in the public interest and to use protected varieties for research and breeding purposes. A compulsory license has been requested several times but has never been granted.

PVP is an important motivator for private plant breeding. It should be realized, however, that the present UPOV system has emerged from a long historical development in Europe. In the case of open pollinated agricultural crops, in which the end product can be used as propagating material, it is very difficult and politically sensitive to exercise exclusive rights on a variety. It might be better to look for alternatives which have the support of the farmers, as most farmers will acknowledge the need for improved varieties.

The breeders remuneration fund system, as it existed in the Netherlands between 1938 and 1967, might be an example for countries which still have to decide about PVP legislation.

Privatization of the Seed Sector in India

Kuldip R. Chopra[*]

History and experience

The history of private seed trade in marketing vegetable and flower seeds in India dates back to the first decade of the century. There are many seed companies who have been serving the Indian vegetable and flower growing farmers for many decades. However, the business was primarily dominated by household mail order for kitchen and flower gardens, mostly of temperate varieties originally imported from Europe, as little emphasis was given in India on breeding superior varieties of most vegetable crops.

Until the 1960s research to evolve high yielding varieties in cereal, oilseed and pulse crops was conducted by state departments of agriculture. Limited quantities of seeds of identified, superior varieties were multiplied at state seed farms and made available as nucleus stock to progressive farmers, who in turn, multiplied, sold or exchanged them with neighbours. The spread of a new variety was thus lateral. Because of lack of coordination among scientists working in each state, there was duplication of research efforts. A system to monitor genetic and physical quality of seed under multiplication did not exist.

The cropping pattern in India is dominated by wheat and paddy. However, substantially large areas (31.7%) are also planted to sorghum, pearl millet and maize (Table 1), the crops for which the genetic system to develop hybrids was known,

Table 1 Area and production of major cereal crops in India (1994).

Crop	Area (million ha)	Yield (kg/ha)	Total Yield (million tons)
Paddy	42.60	2694	114.8
Wheat	23.98	2323	55.7
Sorghum	14.50	757	11.0
Pearl millet	10.45	656	6.9
Maize	5.95	1644	9.8
Total	97.48		

Restructuring of the crop breeding approach through the All India Crop Improvement Project system in the late fifties laid the foundation for organized seed sector development in the country. Release of the first four maize hybrids in 1961, sorghum hybrids in 1962, pearl millet in 1963 and introduction of high yielding dwarf varieties of wheat in 1964, paddy in 1965 and F1 cotton hybrids in 1968, necessitated development of scientific technology for maintenance of parental lines, production in adequate quantities of various seed classes, and an organized system for technology transfer to the seed multipliers, and parallel development of procedures, rules and standards designed to guide seed multipliers in quality seed production.

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At the same time, the Central Ministry of Agriculture in cooperation with state governments launched massive demonstration and mini-kit programs to popularize use of hybrid seeds.

To meet the nation's growing demand for quality hybrid seeds, USAID and the Rockefeller Foundation (RF), with assistance from state departments of agriculture, identified and trained good seed multipliers. The identified seed multipliers were in general:

- progressive farmers who maintained links with research stations and seed multiplication farms;
- rural based, educated and exposed to scientific farming techniques;
- willing to take risk of failure of new innovations;
- possessing above average ability, necessary resources, personal reliability and sincere interest in seed;
- aware that seed is an important input and is different from grain; that it should posses inherent attributes of high genetic purity, high germinability and capacity to produce healthy seedling;
- maintaining a business attitude towards farming with belief that application of improved production technology will increase yield and hence profitability.

Since the mid 1970s, thousands of such farmers in most seed growing estates have become skilled seed multipliers capable of producing high quality seeds of improved varieties and/or hybrids.

Strangely, the cereal seed industry in India started with double cross maize hybrids which required maintenance and multiplication of four inbred lines and two single crosses to produce hybrid seed. The sorghum hybrids, which quickly followed, required maintenance and multiplication of male sterile parents, maintainer parents and a restorer line. It was, thus, easy for the trained seed multipliers to produce high quality seed of improved wheat and paddy varieties when they were introduced. F1 hybrid cotton required emasculation of all buds of female parents and their subsequent hand pollination from the male buds. Indian seed specialists demonstrated that it is possible to train illiterate female labourers in perfect emasculation and pollination work at the field level on thousands of hectares. This technology was later extended to production of F1 hybrid seeds in many vegetable crops.

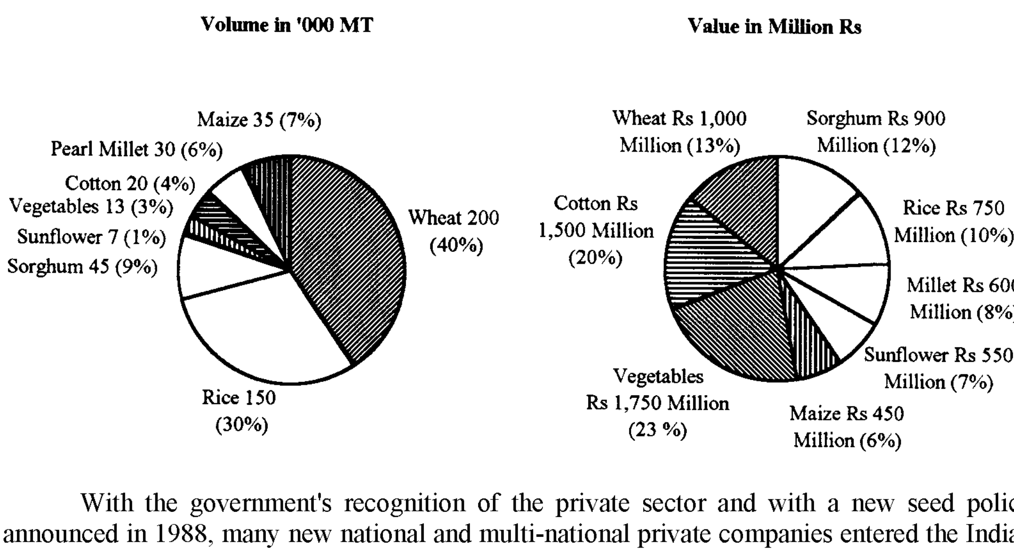
During the late sixties, state governments, particularly in the western and southern parts of the country, comprising Maharashtra, Gujrat, Andhra Pradesh and Karnataka, encouraged the nascent private sector, cooperatives and the public sector to increase seed production of hybrids to meet planned targets. At this crucial stage of seed industry development, all surplus seed was purchased by respective governments for sale through public distribution systems or for retention as buffer stock. Due to superior yield potential of the hybrids even under adverse agro-climatic conditions, area under their cultivation steadily increased, as did the business of efficient seed multipliers.

The enterprising seed multipliers were encouraged to form small seed companies individually or in cooperation with other progressive farmers. They were supported through supply of foundation seed and long-term lease of basic seed processing equipment by USAID. The farsighted entrepreneurs even commenced research to develop proprietary hybrids. They were assisted by the Rockefeller Foundation/USAID in hiring technically competent breeders and in the supply of germplasm from national and international research stations. The commercial banks were encouraged to sanction loans to create infrastructural facilities.

The central government policy envisaged a healthy and competitive seed industry development, involving both public and private sectors. The National Seeds Corporation (NSC) was formed in 1963 and was charged with the responsibility of not only producing foundation/certified seeds and quality monitoring, but also of helping in the development and training of private sector seed entrepreneurs. NSC played a remarkably successful role in disseminating scientific seed production technology and establishing the concept of quality seeds. The National Seeds Project's (NSP) Phase-I (1975), Phase-II (1981) and Phase-III (1988) were launched with the assistance of the World Bank to make the Indian seed industry viable and result-oriented. To create the necessary infrastructural facilities, the interest of private sector was also suitably taken care of in NSP-III by providing investment credit of US$ 30 million (Rs 95 crores) to the National Bank for Agricultural and Rural Development (NABARD) to refinance loans to private seed companies on favourable terms. Under NSP-I and II, the primary responsibility of producing, processing and marketing of certified seeds in public sector was assumed by the newly formed State Seed Corporations (SSCs) and NSC's role was reduced to inter-state marketing, production of foundation seed, training and assistance for the development of seed sector.

Until the early 1980s, the public sector dominated certified cereal seed production and sale, with its contribution exceeding 70%. NSC, State Farms Corporation of India (SFCI) and 13 SCCSs, by and large, were engaged in seed business of both self and cross pollinated crops. During the 1980s government policy to supply breeder seed to the upcoming private sector acted as a major catalyst for motivating the private sector with the result that their contribution in production of cereal hybrid seeds, even of public bred materials recorded a substantial increase. In 1994, total sales of the private sector were estimated to have exceeded Rs 6000 million. The private sector primarily concentrates on the production and distribution of hybrid seeds. Important private sector crops in order of value are hybrid cotton, sorghum, sunflower, pearl millet and maize (Figure 1), although sunflower area is increasing rapidly and may overtake sorghum (Turner 1994).

Figure 1 Indian seed industry market size in terms of volume and value (1994).



With the government's recognition of the private sector and with a new seed policy announced in 1988, many new national and multi-national private companies entered the Indian seed scenario. Slight deregulation of government controls, introduced under the new seed policy, spurred enormous development in the country's seed industry. To maximize yield, increase farm income and for rural prosperity, the primary thrust of the policy was to secure for

Indian farmers the best quality seeds available anywhere in the world. Besides, various incentives were also given to seed industry. As a result, many private companies, including multi-nationals, collaborated with government agencies for quality seed production and also invested in R&D to identify proprietary hybrids and varieties in various crops. Such proprietary hybrids now play a key role in increased crop production and in fulfilling the seed requirement of the nation.

Private research contribution to socio-economic changes in agriculture sector can be summarized as:

- increased investment in plant breeding and agricultural research;
- increased range of products in economically important crops to meet local and regional requirements;
- profit making opportunities for the parent organization, contract seed multipliers, seed distributors, retailers and farmers;
- increased national crop productivity; and
- increased employment opportunities in applied research, production, processing and marketing.

Private seed companies which entered seed production activities in the seventies have built up good organization and management to achieve desired operating efficiency and have acquired expert skills needed to create effective and efficient seed production operations, especially needed for production of hybrid/improved variety seeds of cereal, oilseed, fibre, vegetable and flower crops.

Constraints

Research and development

A major boost is required to revamp the agricultural research system by creating conditions and favourable policy initiatives for enhancing private sector investment in agriculture. This may be achieved through:

- removal of all restrictions, central and state, for the acquisition of land/land use for the purposes of setting up seed research centres in different agro-ecological zones across the country;
- bringing import of seed/propagating material of cereals, oilseeds, pulses, fibres, fodder and vegetables under OGL within the provisions of PFS order 1989;
- by making available germplasm/propagating material developed in the country under the national programs to both public and private sector in a fair and equitable manner;
- the current NBPGR system of asking for a declaration that germplasm/research material imported through NBPGR can be shared freely is a strong disincentive to bring in elite material for development in India. This process needs a review and immediate change to recognize the proprietary nature of the imported germplasm/ parent lines.
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Introduction of new varieties

Improving the availability and choice of superior planting material at a faster pace calls for a total review of the current system of varietal introduction. The present system of testing is unsatisfactory, time consuming and not free of bias. In fact, the current system could be held responsible for stopping, delaying, or depriving farmers of some superior hybrids/planting material.

The new system may consider to :

- establish an independent national register of varieties/hybrids;
- register varieties/hybrids on the internationally accepted DUS (Distinctness, Uniformity and Stability) system. Implementation of this system should be the responsibility of an independent autonomous body; and
- produce/market all registered varieties/hybrids under the provisions of the Seed Act of 1966.

Public research programs should support private research in hybrid crops and should shift emphasis from breeding commercial hybrids and varieties to more basic aspects of breeding, such as genetic enhancement and biotechnology.

ICAR is presently preparing a new perspective plan to upgrade farm research and manpower development systems in the country. The research system is already being reoriented to assure sustainability and globalization of agriculture and would emphasize diversification, value addition and encourage exports. It is hoped that the views expressed publicly will be taken into account while designing policies.

Seed production

The technology of seed production is moving at a rapid pace. The private seed industry has demonstrated its ability to produce high quality seeds by converting farmers around the country into quality seed multipliers. The following steps are required to increase the production and availability of high quality seeds:

- to establish a national register of seed companies under the Seeds Act 1966. This will help to weed out the menace created by unscrupulous, fly-by-night operators;
- to introduce legal provision within the Seeds Act 1966 to prevent poaching and admixture of contracted seed production by unauthorized traders;
- the minimum seed standards should be reviewed and re-established on a realistic basis in consultation with the private seed industry; and
- breeder and foundation seeds of desired quality in sufficient quantity should be made available in time to both public and private sectors on an equitable basis.

The genetic and physical quality of both breeder and foundation seeds of the parents of publicly released hybrids and varieties are often of poor quality. The system of their multiplication and quality control monitoring needs critical review.

Seed pricing

There is often criticism regarding the high prices for seeds of privately bred hybrids and state governments tend to control their selling prices. The pricing structure for private hybrids includes:

- investment in research;
- higher procurement rates paid for private bred hybrids;
- better genetic and physical purity;
- superior and attractive packing; and
- superior performance of privately bred hybrids.

The companies that breed superior privately bred hybrids certainly benefit, but the farmers and the nation receive far greater gain in terms of better economic returns and higher national productivity.

Government intervention: legislation and policy issues

The issues discussed below revolve around the relationship between government and the private sector and are perhaps based on a certain mutual suspicion of intentions. Although at the highest level, government policy is to reduce controls and to make the economic system more transparent, in practice there is potential proliferation of legislation effecting the seed sector. Given the current climate of economic development, there is an urgent need for a positive relationship between the government and the private sector. In order to fulfill farmer's needs and GOI food production targets for the year 2000, the existing misapprehensions should disappear to ensure private sector investment in infrastructural improvement and expansion to increase quality seed production.

Presently, the Indian seed industry is governed by the following acts: Seed Act 1966; Seed Rules 1968; Seed Control Order 1983; Essential Commodities Act 1955; Package Commodities Order 1975; Standards of Weights and Measures Act 1976; Consumer Protection Act 1986; export regulations and quarantine; GOI draft act on Plant Variety Protection; state acts concerning land acquisition/land use; and state acts for the control/movement of crops and seeds.

The policy framework hitherto has been regulatory with excessive legislation. The above plethora of legislation covering the seed sector is out of date and restrictive rather than progressive. The multiplicity of acts, rules and administrative orders has resulted in over regulation of the nascent industry.

Quality assurance

The fundamental principle that seed quality is the responsibility of the producer/marketer of the seed should be established. This has been enshrined in the Seeds Act 1966 and the industry firmly believes that the present legislation is comprehensive enough to regulate the quality of seed. Certification on a voluntary basis, as stipulated in Seeds Act 1966, should be continued. The provision of compulsory certification for research-based technical collaboration companies is a retrograde step causing delay and adding costs with no benefit whatsoever to the Indian farmers. This provision should be removed to fully realize the benefits of the Seed Policy.

Plant quarantine

The importance of plant quarantine is fully supported by the seed industry. There is an urgent need to overhaul the current plant quarantine organization to set up a well-defined, well-trained and well-equipped system for providing plant quarantine facilities of international standards. Well-structured transparent guidelines should be drawn and made available to everyone for efficient compliance and release of the quarantine material.

Seed exports

It is evident that in the current state of development the Indian seed industry, working closely with Indian farmers, can produce high quality seeds of international standard at costs comparable to global competition. There now exists a significant opportunity for India to export hybrid seeds and to participate in the growing international seed market valued at US$ 50 billion. The following policy initiatives need to be taken:

- remove seed/planting material from the category of restricted items. Demand increases the supply, be it for domestic or export market. Government could reserve the right to restrict the export of any seed in case of a national shortage, but including seeds in the restricted list only creates bureaucratic delays which in the past have cost very dearly in the cancellation of various firm export orders;
- establish at least four independent seed testing labs in four major seed production/ export locations (Hyderabad, Bangalore, Aurangabad and Delhi) accredited to ISTA. Many export orders have been canceled due to inability of Indian exporters to provide Orange International Certificates required for the export of seed; and
- remove the provision of certification of seeds for export. Export of seed and the quality standards required is a decision for the buyer. Notification and certification of Indian varieties/hybrids developed especially for India have no relevance for the export markets.

The GOI draft act on plant variety protection

To meet the actual needs of the country, the government of India (GOI) draft act on plant variety protection has been devised on principle of sui generis that is, being of its own kind. However, it has a strong element of farmer protection and provision for compulsory multiplication of varieties by third parties if the breeder's own supply is inadequate. The private seed sector normally seeks variety protection to obtain return on investments and hence sees the act as having little benefit if it is passed without changing this clause. Further, the act also demands that parental lines of all hybrids must be handed over to another agency for registration purposes. The private sector sees danger in likely misuse of its precious material, hence there is a strong feeling that if the act is passed with these clauses intact, the very objective of increased investments by the private sector in variety research may be defeated.

The time is right for a progressive policy initiative which removes the above hurdles that handicap the Indian seed industry today. Given the right policy, the Indian seed industry has all the makings of becoming a global player.

Policy on subsidies

Government policies play a crucial role in accelerating competitive development in the seed sub-sector. Preferential treatment, either to the public or private sector, can substantially retard the growth of the other sector. The seed procurement and selling prices of publicly bred materials for both sectors are more or less similar. However, subsidies are still paid on seed to reduce the cost to farmers and the manner of their payment discriminates against private sector suppliers. Furthermore, the mechanism for disbursing the subsidies is quite cumbersome. The subsidy element given to one sector results in heavy loss to the other sector. The policies on subsidies need to be corrected. Otherwise, the recent enthusiasm and initiative displayed after the new seed policy would be adversely affected and the seed companies would have to reconsider their massive planned capital investments.

Low profit market

The market for seed of each of the major crops may be analyzed in various ways, for example by volume, by value, by the nature of varieties available, (hybrid or non-hybrid), by the source of variety (public or private), and by supplier (public corporation or private company). There are naturally some linkages between these factors. For example, the privately companies tend to concentrate on both breeding and marketing of crops which are of relatively low volume, high value and amenable to hybrid technology. Conversely, the public corporations, by reason of their service obligations to breeders and farmers, tend to produce and supply high volume, low value cereal and pulses, although they also participate in the hybrid seed market (Table 2).

The total value of the present market is about 1000 crore Rupees or US$ 320 million. The availability of hybrids is a crucial factor in determining the private sector contribution in individual crops.

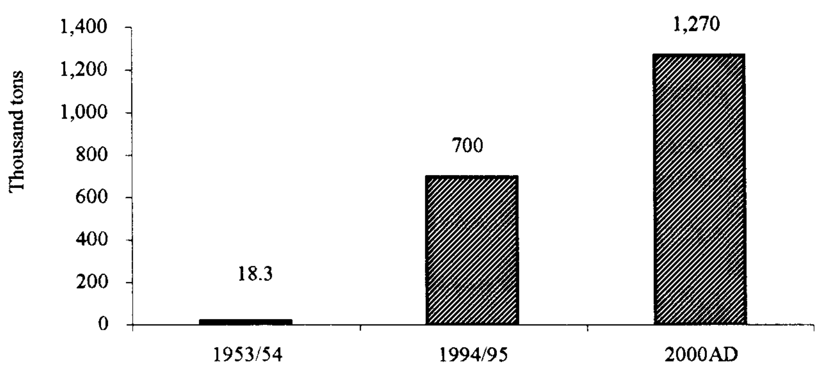
Table 2 Indian seed industry market segmentation: (low profit vs. high profit markets).

Sector	Focus	Share (%)	
		Volume	Value
Public Sector (State & Central)	High Volume Low Value Varieties	60	40
Private Sector (Family, Corporate, Multinational)	Moderate Volume High Value Hybrids	40	60

Economic prospects

Formal certified/quality seed distribution in India has considerably increased from a mere 18,300 tons in 1953/54 to 0.7 million tons in 1994/95. An expert group constituted by government of India in 1987 suggested that by 2000 AD the total requirement of certified/quality seed in the country would be 1.27 million tons (Anonymous 1993). Wheat and rice together account for over half of the market size by volume (Figure 2).

Figure 2 Quality seed supply ('000 tons).



Present value of the formal seed market is estimated at about Rs 1000 crores or US$ 322 million with private sector contributing approximately 60% (Figure 3).
The National Commission on Agriculture has estimated that India will require 225 million tons of food grain by the year 2000 AD. The requirement of certified/quality seeds would exceed 1.5 million tons, meaning that we will have to at least double our present seed production capacity.

Commercial exploitation of hybrid vigor in recent years in maize, sorghum, pearl millet, cotton, sunflower and castor has been a crucial factor in the phenomenal increase of private sector contribution to the total turnover. Efforts are beginning to exploit this potential in crops such as paddy, cajanus, rapeseed and mustard. Many private seed companies have also established bio-technology laboratories and are commercially exploiting tissue and protoplast culture technology for the indigenous market as well as for export (Figure 4).

As a guide to the current size and structure of the private sector, in 1993 there were said to be 140 private seed companies (excluding purely traders and dealers), of which 24 had collaboration agreements with an overseas partner. The existing private sector can be broadly classified (Turner 1994):
a few long-established companies (say pre-1980) which have built up significant breeding programs and now concentrate on their own proprietary varieties;
a number of established smaller companies which still depend mostly on the marketing of public sector varieties, although they may have a few products of their own; and
a significant group that has entered the market within the last few years, including new domestic companies (some having links to foreign companies), diversified into seeds and subsidiaries of multi-national corporations; many of these are in the process of developing R&D facilities.

Figure 3 Indian seed industry market segmentation.

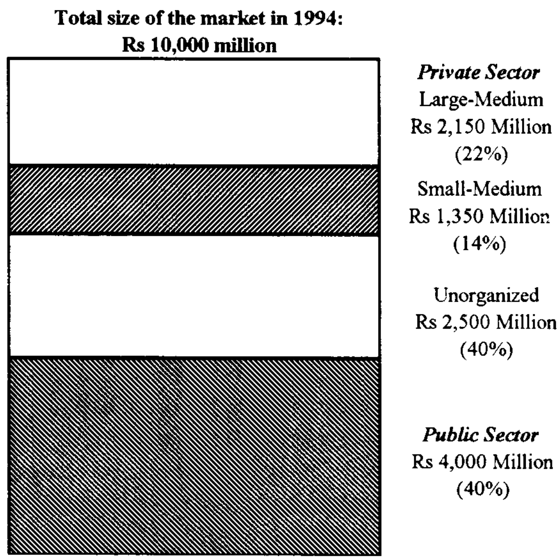
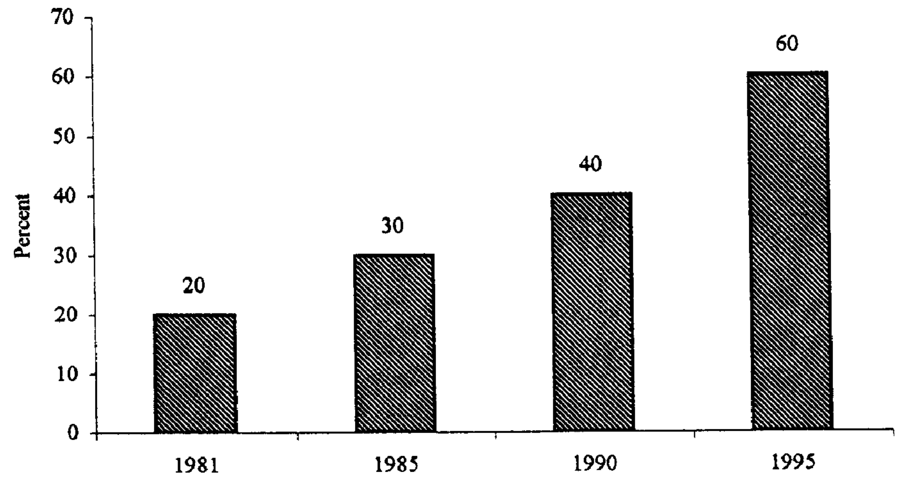


Figure 4 Share of private sector in seed industry (1981-1995).



High quality improved variety seed has already been accepted by the educated and well-to-do farmers. The challenge in the coming years will be to convince the small farmer to accept quality seed of recommended adaptable hybrids or varieties. The time has come when the seed companies, particularly in the private sector, should specialize in specific farming systems to cater to the seed needs of the farming families in their entirety. To encourage small farmers, it is necessary to develop area specific technologies considering their economic conditions and the agro-climate of the region and to act as catalysts in transferring such technologies from research laboratories to the farmers' fields.

The Indian economy is opening up the opportunities and challenges offered by the globalization of agriculture. The Indian seed industry is on the threshold of becoming a global player, while playing a crucial role in the development of Indian agriculture. There is significant potential for increased private sector involvement in an environment which, in recent years, has become increasingly favourable for private initiatives. Hence, better prospects and an expanded role for the private sector in India's future seed industry are envisaged.

Concluding remarks

The Indian farmer has now realized the benefit of high quality seed with superior genetic performance. He also has realized that seed is the cheapest input in his total cost of cultivation, hence he is willing to pay a fair price. The present coverage under high yielding varieties/hybrids, even in major cereal crops, provides great potential for increasing the formal seed market share which both the public and private sector could exploit.

The Indian seed industry has also reached a stage of maturity and is in a position to compete at national and international levels. It may, however, be recognized that the private sector will, for some time, continue to concentrate on the more lucrative sectors of the market, with a strong emphasis on hybrids and the more specialized low volume crops, such as vegetables.

The fundamental strength and potential of the Indian seed market cannot be doubted. The country has a very large population and a strong commitment to self sufficiency in food production, which can only be achieved by increasing productivity per unit area. In the commercial sense, the Indian seed industry is passing through a period of accelerated evolution. The major incentive that the policy framework could provide is the removal of excess legislation and regulations which not only cause delays but also increase unethical business practices and add costs to the detriment of farmer's interests.

If the prevailing uncertainties about possible legislative changes which may retard seed industry growth are favourably clarified, the present trend of the industry's accelerated growth in domestic market, custom production and export are likely to continue and the private sector can look forward to playing a key role in the development of Indian agriculture and take its rightful place in the global market.

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Seed Sector Development in Bangladesh with Focus on Secondary Food Crops

Marjo J. A. F. Vervoorn (editor)[*]

Introduction

General information on Bangladesh

The population of Bangladesh is around 120 million, of which about 80% is living in the rural areas. The population density of 775 persons per km2 is one of the highest in the world. Population growth has come down but there is still a continued growth of over 2.0% per year. This is a dominant factor in development issues of the country.

Agricultural sector

Agriculture continues to be a major sector in the economy contributing over 35% to the GDP. In recent years, the growth of the agricultural sector in terms of GDP increase has remained behind most other sectors with just over 2% growth in constant terms, as compared to a GDP growth of over 4% for the economy as whole. Within the agricultural sector, crops are outstanding in terms of contribution to GDP (28%), while forestry and livestock sectors each contribute between 2.5% and 3% to the GDP.

Slightly more than 60% of the total surface of 147,570 km2 is used for agricultural purposes. This area, of about 9 million hectares, consists of alluvial plains which are farmed annually with a multiple cropping pattern. Cropping intensity in 1991/92 was about 172%. The average cultivated area per farming household is about 2.0 acres. Nearly 50% of the farming households own less than one acre while 10% of the rural households own no land at all.

Cultivated area

Figure 1 shows the cultivated areas for the major crops in 1991/92. Rice is by any measure the most important crop, since it occupies 74% of the area under cultivation. It is grown successively in the summer season (Kharif-1, March to June), the rainy season (Kharif2, July to October) and the dry winter season (Rabi, November to February). Crops grown in rotation are wheat, oil seeds, pulses, vegetables and potatoes in the winter season and jute and sugarcane in the summer season.

This paper focuses on the secondary food crops, tubers, oil seeds and pulses which contribute to almost 10% of the annual cultivated area.

Seed replacement rates and seed sources

The seed replacement rate is defined as the proportion of the cropped area which each year (or season) is supplied with fresh, purchased seed from recognised sources. The remaining seed is referred to as retained seed and includes seed retained in households, locally exchanged

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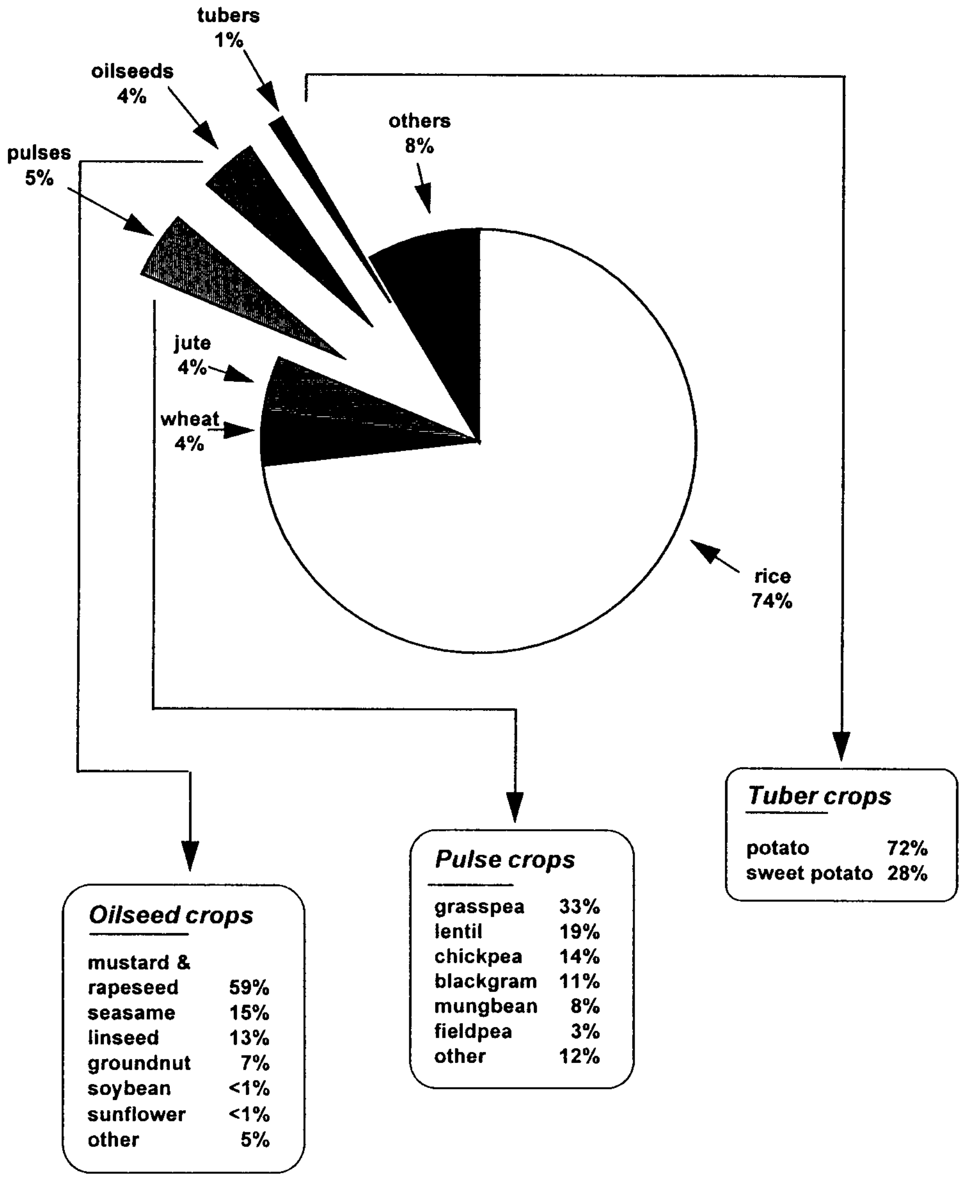
or bought on the local market, where grain is sold as seed. In Bangladesh, the average replacement rate for all crops is very low, only 5%, meaning that 95% is retained.

Figure 1 Cultivated area for major crops, Bangladesh 1991/92.



Source: Bangladesh Bureau of Statistics, 1993

In 1994/95 the total estimated seed requirements for potato are 150,000 metric tons, for oilseeds 8,000 t and 23,000 t for pulses. Estimated replacement rates based on the available market supply, show no difference with the average for Bangladesh: 6% for potato, 3% for oilseeds (with exception for soybean and hybrid sunflower) and below 1% for pulses. Tables 1 and 2 illustrate the percentage retained versus purchased seed for the three crop categories, including the market shares of the public, private and informal sectors in 1994/95.

Table 1A Seed requirements, market supply and replacement for tubers 1994/95.

Crop	Area ('000 ha)	Requirement (tons)	Market Supply (tons)	Replacement (%)
HYV	71	106,684	9,115	9
IPV	46	45,580	280	1
Total/average	117	152,264	9,395	6

Table 1B Seed requirements, market supply and replacement for oilseeds, 1994-1995.

Crop	Area ('000 ha)	Requirement (tons)	Market Supply (tons)	Replacement (%)
Groundnut	37	3,740	62	2
Rapeseed/mustard	339	2,710	133	5
Lineseed	75	1,125	2	0
Sesame	83	66	-	0
Soybean	2	120	58	48
Sunflower*	1	9	11	100
Total/average	537	8,364	267	3

Table 1C Seed requirement, market supply and replacement for pulses, 1994-1995.

Crop	Area ('000 ha)	Requirement (tons)	Market Supply (tons)	Replacement (%)
Grasspea	240	5,927		0
Lentil	213	7,442	21	0
Chickpea	101	4,036	22	1
Blackgram	79	2,361	4	0
Mungbean	60	1,785	13	1
Fieldpea	19	1,50	-	0
Total/average	710	23,053	60	<1

Sources: For area: Monthly Statistical Bulletin of Bangladesh 1 July 1993, Bangladesh Bureau ofStatistics;
for market-supply: Seed Industry Promotion Unit of the Crop diversification Programme, 1995.

Table 2A Volume of market supply of tubers for the different sectors.

Sector	1992/93		1993/94		1994/95	
HYV						
Public	6,530	100%	6,310	78%	6,415	70%
Private	-	0%	1,730	22%	1,940	21%
NGO	10	0%	-	0%	760	8%
Total	6,540	100%	8,040	100%	9,115	100%
IPV						
public	-		-	0%	-	0%
Private	-		69	35%	120	43%
NGO	-		130	65%	160	57%
Total	-		199	100%	280	100%
Total tubers						
Public	6,530	100%	6,310	77%	6,415	68%
Privat	-		1,799	22%	2,060	22%
NGO	10	0%	130	2%	920	10%
Total	6,540	100%	8,239	100%	9,395	100%

Table 2B Volume of market supply of oilseeds for the different sectors.

Sector	1992/93		1993/94		1994/95	
Groundnut						
Public	23	90%	37	97%	59	95%
Private	-	0	-	0%	-	0%
NGO	3	10%	1	3%	3	5%
Sub-total	26	100%	38	100%	62	100%
Rapeseed/mustard						
Public	50	99%	87	99%	130	98%
Private	-	0	-	0%	-	0%
NGO	1	1%	1	1%	3	2%
Sub-total	51	100%	88	100%	133	100%
Sesame						
Public	-		-	0%	2	100%
Private	-		-	0%	-	0%
NGO	-		-	0%	-	0%
Sub-total	-			0%	2	100%
Soybean						
Public	20	44%	30	27%	12	21%
Private	25	56%	80	73%	31	53%
NG	-		-	0%	15	26%
Sub-total	45	100%	110	100%	58	100%
Sunflower						
Publi	-			48%	5	44%
Private	0	7%	3	52%	3	26%
NGO	2	93	-	0%	3	30%
Sub-total	2	100%	5	100%	11	100%
Total oilseeds						
Public	93	75%	156	65%	208	78%
Private	25	20%	83	34%	34	13%
NGO	5	4%	2	1%	25	9%
	123	100%	241	100%	267	100%

Table 2C Volume market supply of pulses for the different sectors.

Sector	1992/93		1993/94		1994/95	
Blackgram						
Publi	-		4	100%	4	100%
Privat	-		-	0%	-	0%
NGO	-		-	0%	-	0%
Sub-tota	-		4	100%	4	100%
Chickpea						
Public	13	100%	24	100%	22	100%
Privat	-		-	0%	-	0%
NG	-		-	0%	-	0%
Sub-total	13	100%	24	100%	22	100%
Lentil						
Publi	-		18	100%	20	97%
Privat	-		-	0%	-	0%
NG	-		-	0%	1	3%
Sub-tota	-		18	100%	21	100%
Mungbean						
Sub-tota	-		5	100%	13	100%
Privat	-		-	0%	13	100%
NG	-		-	0%	-	0%
Sub-tota	-		5	100%	13	100%
Total pulses						
Public	13	100%	51	100%	59	99%
Private	-	0%	-	0%	-	0%
NG	-		-	0%	1	1%
Total	13	100%	51	100%	60	100%

Two main factors influence these low replacement rates. The first factor is that the production and distribution of quality seed are insufficient to meet demand. Secondly, there is a lack of suitable improved varieties, especially for pulses and oil seeds. At present, the available improved varieties do not differ from current popular land races. As a consequence the adoption rate by farm households for those varieties is low. Only recently, over the past three years, have improved or HYV varieties for most of the crops begun to be released for multiplication and distribution.

The government of Bangladesh (GoB) is aware of the above mentioned constraints. With a view to overcoming these constraints, a National Seed Policy was formulated. It gives directions to the development of the public and private sectors for production of sufficient quantity of improved seed and for making it available to Bangladeshi farm households in sufficient quantity, with acceptable quality, at appropriate times and at a reasonable price.

In this paper, the main features of the seed policy are outlined. Then, the state-of-the art is presented of the public, private and informal seed sectors, highlighting the secondary food crops: tubers, pulses and oilseeds. The last chapter gives suggestions to further improve the interaction between the three sectors.

National seed policy

The new National Seed Policy was drafted in 1989 and gazetted in April 1993. The overall purpose of the policy is to make the best quality seeds of improved varieties of crops conveniently and efficiently available to farm households with a view to increasing crop production, farm productivity, per capita farm income and export earnings. To achieve this purpose, the main strategy is to rationalise the seed sector by promoting the participation of the private seed sector in all stages of the seed industry from breeding to marketing of seed. In the past, the public sector had exclusive control. The main features of the policy, to arrive at a balanced development between the public and private sectors, are presented in Box 1.

However, the revised seed ordinance still has to pass the Parliament after which the MOA can approve the new seed rules. In the meantime, registration of seed dealers and varieties has started at the Seed Wing of the Ministry of Agriculture. This Seed Wing was created primarily to serve as a Secretariat for the National Seed Board (NSB). One of its main functions is to help update the policies and plan strategies for the development of the seed industry, with special attention to promoting private sector seed enterprises.

Status of the public seed sector

Variety research and development

The National Agricultural Research Stations (NARS) involved in the variety development of tubers, pulses and oilseeds are Bangladesh Agriculture Research Institute (BARI), Bangladesh University of Agriculture (BAU) and Bangladesh Institute of Nuclear Agriculture (BINA).

So far, the NARS have not directly collaborated with the private sector for screening of varieties which are commercialised outside Bangladesh. Therefore, the Crop Diversification Programme (CDP) of the MoA took up an adaptive research programme with the objective of testing varieties successfully commercialised in similar growing conditions to those of Bangladesh. Contacts were made with various organisations in India, Thailand, the

Philippines, Australia, USA, Pakistan and Myanmar (Burma). Screening programmes have been implemented with various collaborators in the public, private and informal sectors during the last three years. The major conclusion of the programme is that the current commercial hybrids of maize and sunflower have significantly out performed the varieties released through NARS.

Box 1 Main features of the National Seed Policy.

Development and promotion of improved seed varieties

The National Agricultural Research Institutions (NARS) will continue to pursue breeding programmes for the so called notified crops: rice, wheat, jute potato and sugarcane. However, special effort should also be made to evolve improved varieties for pulses, oilseeds, tuber crops, vegetables, fruits and other species.

Liberalisation of the release and import of varieties

This opens a window for the private seed sector to become involved in the international seed market through contracts and joint ventures with foreign seed companies. Seed entrepreneurs are encouraged to undertake plant breeding programmes and are allowed to import breeder and foundation seed for variety development and promotion purposes.

Variety registration and release

New varieties of wheat, rice, jute, potato and sugarcane developed by the private and public sectors have to be notified by the National Seed Board (NSB). Developed or imported varieties of all other crops only have to be registered with the NSB, giving prescribed cultivar descriptions, but will not be subject to any other restrictions, such as testing and other procedures.

Seed multiplication and processing

The Seed Wing of the Bangladesh Agricultural Development Corporation will be restructured. In the future, the institution will concentrate primarily on production of foundation seeds of rice, wheat, jute, potato and sugarcane on its own farms. It will gradually cease to grow certified seed.

Access to breeder and foundation seed

Breeder and foundation seed of all varieties developed by the public sector will be made available to registered seed producers both in the private and public sectors for multiplication purposes.

Availability offacilities and equipment

With the restructuring of BADC, the excess facilities and equipment such as storage space, drying floors, dryers, and cleaning equipment will be made available on a lease basis to the private sector.

Seed certification

Only public sector breeder and foundation seed will be certified as a matter of policy. All other seed will be certified on a voluntary basis.

Quality control

Seed quality will be ensured by requiring seed packaging in labelled containers or packages. The seed quality has to meet the standards specified on the label.

Seed distribution and marketing

BADC's seed sale centres at sub-district levels (Thanas) will be phased out and replaced with a network of private seed dealers.

Seed pricing

BADC's seed prices should more closely reflect costs and subsidies should be phased out gradually to give private seed companies a fair chance to compete in the market.

Source: National Seed Policy 1993.

Oilseeds

Variety research in the field of oil crops has since 1970 resulted in the release of twelve varieties of rapeseed and mustard, five varieties of groundnut, four varieties of soybean, two varieties of sesame and one variety of sunflower. Despite this development, there remains a lack of suitable high yielding, short duration varieties which would improve the crop's financial competitiveness with other crops and facilitate its incorporation into the rice dominated cropping pattern. So far, none of the existing varieties is responsive to high doses of fertilisation and irrigation. Six promising oilseed lines are expected to be released by BARI in 1996.

Pulses

Variety development of pulses has not been very successful so far. The research institutes have set priorities for varieties with high yield levels and good response to irrigation. However, due to lack of disease resistance under high input technologies and irrigation, whole crops have occasionally failed. Therefore, since 1971 only six varieties have been released, four by BARI and two by BINA. Eleven more are in the pipeline for release in 1995/96. The lack of suitable varieties is the underlying reason why pulses grown as a food crop in the dry winter season are being replaced by other crops such as rice, wheat and potatoes.

Tubers

The Tuber Crops Research Centre (TCRC) of BARI is the main public institution involved in the release of HY potato varieties. Through its initiative, an accelerated variety release system for modern potato varieties has been approved by the NSB. Between September 1980 and November 1994, fifteen varieties were released. Maintenance of indigenous potato variety (IPV) germplasm is taken care of by BAU. Considering the need for selecting and recommending more high yielding and consumer oriented sweet potato varieties, a variety screening programme was initiated at BAU during the 1994/95 dry season. Initially 30 local and exotic germplasm materials were collected from different sources.

Production of breeder seed

Pulses and oilseeds

Institutions involved in the breeder seed production are BARI, BAU and BINA. So far, breeder seed of pulses and oil seeds is supplied solely to the Bangladesh Agriculture Development Corporation (BADC). There was a shortage of breeder seed. In 1991, 1992 and 1993, when 51, 76 and 69% respectively of the breeder seed demand could be met. To achieve its area targets, BADC therefore had to upgrade its own purified foundation seed.

Tubers

HYV potato breeder seed is imported on a limited scale from the Netherlands. Imports have been reduced from almost 1500 tons in the early 80s, to 123 tons in 1995. The balance is produced under TCRC's own breeder seed programme (150 tons) and BADC's first stage seed multiplication activities (330 tons). Techniques used are clonal selection, tissue culture and rapid multiplication (stem cuttings). Of great concern is the maintenance of the quality standards of these early generations.

IPV breeder seed will be produced on a commercial basis by BAU and a few private companies and NGOs.

Hybrid true potato seed (TPS) is imported on an experimental scale through CIP India and looks promising for small scale, homestead based operations, as well as remote areas.

Multiplication of foundation seed and certified seed

Pulses and oilseeds

The Seed Wing of BADC is the sole public institution involved in the production of foundation and certified seed of the pulses and oil crops. There are three foundation seed farms of 12, 20 and 10 hectares respectively.

For certified seed production, BADC has established contract grower zones in restricted areas around its seed processing centres. In these zones, the main bulk of certified seed is produced. The different schemes in the zones are selected by BADC staff. A lead grower is appointed by the growers in each scheme to co-ordinate the cultural practices and to keep liaison with BADC. However, agreements and distribution of foundation seed take place on an individual basis. Quality control through field inspections is carried out by BADC staff at three stages: after sowing, at early flowering and prior to harvest. During the harvest period, the seed price is set based on the prevailing market price plus a premium of 20 to 25%.

In Table 2 the volume of seed supplied of certified seed is presented for the last three years. The market share of BADC is nearly 100% (59 tons) for the pulses. Blackgram, lentil and mungbean were only recently taken up into the seed portfolio. In 1994-95, the market-share for oilseeds amounted to 78% (208 tons) of which rapeseed/mustard (130 tons) and groundnut (59 tons) formed the bulk. New Life Seed, a private seed company, takes more than half the share of the soybean 53% (31 tons). The small portion of sunflower (5 tons) is composite seed while the share of the private sector (3 tons) is imported hybrid seed.

Tubers

Imported and locally produced breeder seed of HYV is multiplied into 1500 tons of foundation seed in two multiplications (F-1 and F-2). This takes place on one seed nucleus farm of BADC (F-1) and four additional seed farms (F-2).

The final multiplication into 6000 tons of certified seed takes place in 10 contract grower zones. Although the production per hectare is more than 17 tons (seed quality), BADC only purchases 10 tons per hectare. The balance (approximately 2000 tons) is sold by the growers as improved seed to neighbours or cold store owners. This lateral spread system of high quality seed contributes considerably to the improved production of table potatoes.

IPV seed is only produced by several private seed farms and NGOs. The production of TPS hybrids is done on an experimental scale by TCRC. BADC and several private companies and NGOs take care of the tuberlet production.

Seed certification and quality control

Quality control and certification are the mandate of the Seed Certification Agency (SCA). This agency is at present implementing a strengthening project with assistance of the Netherlands government, in order to enact the tasks and duties as described for the SCA in the new National Seed Policy. The FAO Quality Declared Seed System will be adopted for most crops. Certification on a voluntary basis for secondary food crops is not foreseen before 1997 (HYV potatoes) and 1998 (oilseeds and pulses).

Pulses and oil seeds

Seed certification has so far played no role in inspection and certification of pulses and oil seeds. Also, breeder seed is not certified. The internal quality control at the foundation farms is implemented by the deputy director of the farm and its staff. The main constraints are at present the lack of uniformity and distinctive characteristics of some varieties. Most crops do not have clear varietal descriptions. Only recently has BADC started to treat breeder and foundation seed with seed dressing chemicals. Certified seed will not be treated because of fear that farm households may consume the seed. First an extension campaign should be launched to make people aware that the seed is treated and thus unsuitable for human consumption.

Tubers

Internal quality control activities are carried out on a voluntary basis: fields of TCRC breeder seed production programme are visited by the future buyer, BADC and the private sector companies. BADC's Foundation and Contract Growers Certified Seed Programmes are under the supervision of a separate quality control section within the Tuber Crop Division. Final field inspection is done in collaboration with staff from TCRC and SCA.

Seed distribution and marketing

The certified seed is distributed from the processing centres to one of the 64 seed sale centres at district level. From here the seed is further distributed to the sale centres at the sub-district level. Since June 1993, in line with the National Seed Policy, BADC has been closing down these sub-centres, from the original 464 to 36 in July 1995. The idea is that these will be replaced by a network of private seed dealers. The regional centres would be developed as wholesale centres. There is reason to believe that the present distribution network of BADC and dealers is not sufficient to cover the whole country.

Seed extension and promotion

The Department of Agricultural Extension (DAE) is the main party involved in seed extension. Improved varieties are demonstrated in a crop demonstration programme. Block supervisors (extension agents) form the main contact points for the farm households to get information on variety development. However, on average one block supervisor has to serve about 900 farm households with very little means. Not surprisingly, he is reaching very few households (about 3% according estimates of the World Bank). The bigger farms which also happen to be the early adopters are mainly visited. Moreover, as discussed before, there is a lack of suitable varieties released from the research stations. Superior varieties introduced by the private sector are not yet included in the crop demonstration programme, because, as a matter of policy, DAE demonstrates only varieties developed by the public sector. This will be changed with the introduction of the Seed Policy.

Status of the private seed sector

There are two registered seed associations in Bangladesh: the Seedmen's Society of Bangladesh (SSB) and the Bangladesh Seed Merchants Association (BSMA). The latter is the oldest, and at present it has taken the lead role in the private sector organisation associated with the seed industry development. Together, both associations have about 150 genuine seed members. The majority of these derive from the vegetable seed sector. It is expected that the seed market for secondary food crops will be developed mainly through the existing network in the vegetable seed sector.

In line with the National Seed Policy, the seed associations will play an important role in communication between public and private sectors. For example, they are representing the private sector in NSB.

A joint assessment of the Seed Industry Promotion Unit (SIPU) of CDP and FAO indicated that there are possibly 1,000 to 1,500 permanent wholesale and retail seed dealers in the country. This means that only about 10% are members of one of the associations. In the future, to be able to make use of the benefits of the new Seed Policy, dealers will have to register themselves at the Seed Wing of the MoA.

There are two main constraints identified for private sector involvement in the production, storage and marketing for all crops and especially for the secondary food crops, namely marketing expectation and financing possibilities.

Marketing expectation of the secondary food crops

The present marginal rate of return as well as the uncertainty of the market imply that the seed entrepreneurs are very careful in investing in these crops. In the next section, the present involvement in the market for these crops is presented in more detail.

Financing possibilities

In principle seed companies can register themselves with the Board of Investments and as such make use of several facilities like exemption of customs duties. The seed industry. being registered as an agro-based industry, may be financed by banks with loans up to 70% of the total equity. However, at present the banks do not accept that seed production, storage and marketing are agro-based industrial activities. The seed business is considered more as a trade activity. Therefore, most banks are reluctant to make credits available to potential investors. There clearly exists a need for sound seed business plans to convince the banking sector about the viability of the seed business. At present, seed credit norms are being established to provide directives for seed production of various crops. These norms are expected to support and stimulate the banks to assess the credit and finance level for any request on seed production or seed enterprise development.

Private sector involvement in tubers, oilseeds and pulses

Table 2 shows clearly that the private sector is only involved on a very small scale in the market of the secondary food crop seeds. Exceptions are HYV potato and soybean.

Tubers

About 20% of the total production and marketing of HYV potato is taken care of by the private seed companies. This market share was achieved in only three seasons which clearly indicates that the crop is a profitable market product with a commercial demand.

Variety development of IPV started very recently at BAU, which also maintains a stock of breeder seed. In line with the National Seed Policy, BAU has linked up with a private seed company and a network of NGOs for multiplication and distribution.

Oilseeds

Private sector involvement for these crops is limited to soybean and sunflower. Actually, one single company, New Life Seed (NLS), takes the main share of the market (over 50%). NLS originated from an international NGO and is involved in all stages from variety development to seed marketing. Private interest is also mounting for hybrid maize.

Pulses

The actual marginal rates of returns, the non availability of suitable varieties and the easy storability of these crops make them less attractive for private entrepreneurs. Therefore, not much private interest is expected for these crops in the near future.

Status of the informal seed sector: traditional seed systems

The informal seed sector is defined as the seed production and trade, which is not institutionalised, of purchased (improved) varieties. This may involve groups of farm households producing seed for their own use as well as selling seed to surrounding farm households or local seed dealers. In this context, the traditional seed system stands for the seed production and trade of retained seed.

Seventy percent of farm households own less than one hectare of land out of which 50% have less than one acre (0.4 hectare). Therefore, the majority of the households belong to the category of small and marginal farmers. Leasing land or sharecropping are common systems. Estimates indicate that about 35% of all households are cultivating land that is not their own. The dominant rice cropping systems are low-input subsistence systems. Secondary food crops are planted in the winter season and have to compete with the winter rice (Boro) and the wheat crop.

As mentioned earlier, seed replacement rates are low, on average about 5% for all crops. Secondary food crops are no exception. The low replacement rates mean that the majority of seed is farmers' retained, farmer-farmer exchanged or traded on the local market where grain is sold as seed. At present, there are no actual data available about the seed flow in the traditional seed systems.

Low replacement rates may be the result of low input use and risk avoiding behaviour of the subsistence farm households. However, it is assumed that even resource-poor households would be willing to pay for good quality seed and improved varieties if this were profitable, in other words giving more yield or financial income. As mentioned before and illustrated in Tables 1 and 2, the two underlying main reasons for the dramatic low replacement rates are the lack of suitable varieties (pulses and oilseeds) and the low volumes of improved seed on the market (potato, oilseeds and pulses). A third factor is the lack of information about new varieties. Most of the resource-poor households are not reached by the existing extension network.

The National Seed Policy aims at privatisation of the seed market. However, for the secondary food crops this market is small and dominated by the public sector. The private sector still has to develop. To bridge the gap between the withdrawing public sector and the developing private sector, an important role is foreseen for the informal seed sector to become involved in the production and distribution of improved varieties and quality seed at the grassroots.

Role and experience of NGOs in the seed sector

Bangladesh has a dense network of NGOs. There are about 900 NGOs registered with the NGO bureau. However, estimates indicate that when all smaller non registered groups of local clubs, charitable societies and other voluntary organisations are taken into account, the network consists of about 6000 NGOs.

The network started to develop after independence in 1971. Initially NGOs were involved in relief and rehabilitation programmes helping the government with returning refugees who had taken shelter in India during the war of independence. During the early seventies, they became involved in integrated rural and community development activities of which agriculture formed a major component. In the late seventies, most NGOs realised that their approaches mainly benefited the local elite. Therefore, more and more NGOs shifted from community development towards a target group approach. Homogenous groups of poor people with similar economical interest were selected to participate mainly in income generating activities (Chowdhury 1989). Although NGOs may differ from each other in style and emphasis, they all follow similar trends. They carry out social awareness programmes, group formation activities, formal and informal training courses, saving and credit programmes.

Since NGOs have a network of organised rural groups and well-developed training and credit facilities, they are considered an important vehicle for developing the informal seed sector. The role NGOs are assumed to play includes distribution of quality seed and improved varieties, organisation of certified seed production, and promotion of new varieties and the use of quality seed. If seed activities are being developed, they may also, as a next step, become involved in variety screening.

Basically there are two ways for NGOs to follow: either they develop into a local seed enterprise as in the case of New Life Seed, or they assure their role as an intermediate between seed grower groups and seed companies and between seed customers and seed suppliers.

The Netherlands Technical Assistance Unit of the Crop Diversification Programme (CDP) has initiated seed activities on an experimental basis with five selected NGOs. The seed activities are focused on secondary food crops and include training and demonstration programmes on seed production. Criteria applied to select the NGOs were the following. The NGO should have:

- operational field crop activities;
- a group and programme infrastructure to reach poor households, including female members;
- prior experience in commodity production and/or marketing;
- a sound credit programme linked to agricultural activities;
- willingness to operate the seed programme on a non-subsidised basis.

Lessons learned so far are summarised below.

Organisation of a seed unit

Most NGOs do not have experience in seed production and marketing since this was the sole domain of the public sector. Prior experience with seed is often limited to seed distributior (mainly rice and wheat) in rehabilitation programmes following natural disasters. Only very recently have some of them, such as the agricultural branch of the Grameen Bank, started to organise seed procurement from commodity crops. In this case, the NGO procures grain as seed from selected farm households belonging to their target group. After procurement the NGO processes, stores and redistributes the so-called improved seed to other target group members.

The NGOs involved in the CDP have appointed seed agronomists or seed technologists to run the seed related activities. These persons were included in the CDP's training courses on seed production, storage and marketing. At present, they are capable of organising seed production programmes. Further improvement requires the development of an appropriate seed strategy and seed plan. In this context they are advised to create a separate seed unit and keep accounts of the cash flow involved. The latter is of importance because most NGOs have high overhead costs for the implementation of their programme components. To be competitive and sustainable in the seed market, they should at least recover their costs.

Seed distribution and sale

The phasing out of BADC's seed sale centres has created an enormous gap in the national seed distribution. This is considered an opportunity for NGOs to establish themselves in the seed market. However, none of the NGOs is very keen to buy seed from BADC and redistribute it on credit or cash to their target groups. There is an aversion to procurement of seed from BADC. Most of them prefer to produce their own seed. Moreover, the margin between BADC wholesale and retail prices is at present between 3% and 7% which is a very small margin and not sufficient to recover the costs for distribution. Most NGOs estimate at least 10% distribution costs.

Another factor is that most NGOs are not yet aware of the actual seed demand of their target groups. It is assumed that there exists a demand for quality seed and that the main benefit they can provide to their target groups is seed at the right time for a reasonable price. A market oriented approach should be adopted in the ongoing NGO seed activities

Seed production

The selected NGOs show a keen interest in seed production as an income generating activity for their target groups and for themselves as seed entrepreneurs. Although cost-benefit analyses for contract growing with their target groups are still in preparation, the indication is that the target group approach is most likely not the right approach for contract growing.

Target groups of NGOs are mainly landless and marginal farm households which have no land or only a small acreage of land. The scattered plots make it difficult to organise growers in adjacent blocks necessary for seed production. Therefore, most NGOs are arranging land on lease or share-crop basis. This practice is increasing the production cost and, thus, reduces the profit margin for the already resource-poor growers. Besides, seed production has to be regarded as a cash crop. Due to the rather high input, it carries considerable risks. The resource-poor target groups are not able to take such risks.

Considering the above discussion, it has been suggested that NGOs separate seed distribution from seed production. For seed production, they were advised to select groups of farm households which are known to produce a good crop and which show keen interest in producing seed. Preferably, the selected growers should be sufficiently self-reliant to be able to accept losses in meagre years. The seed produced would be procured by the NGO and distributed to its target groups. Most NGOs, however, are very target group conscious and hesitate to involve non-target group members in their programmes. Moreover, they claim that they do not have credit facilities available for outside, non-target groups. The proposed concept of separated production and distribution groups should be further explored to see if it can be adapted to make it fit into the existing organisational structure of NGOs.

Seed processing and storage facilities

The NGOs lack processing and conditioned storage facilities necessary for some crops such as potato and soybean. If they want to be involved in seed production, they either have to arrange for these facilities for example through BADC, or find financial means to build these facilities. Like the private sector, they lack capital to develop their seed related activities.

Seed production training and seed promotion

NGOs have demonstrated that they are very successful in organising groups of farm households for seed demonstration and training programmes. Actually, this is their greatest strength. Therefore, their major contribution in the informal seed sector is foreseen in organising, training and institutionalising contract grower groups and linking these groups with private seed companies for a fee. Seed grower groups may also be organised for seed exchange between farm households. In this situation, the NGO plays the intermediate role. An important task for NGOs is foreseen in organising seed promotion and awareness campaigns at the grassroots level.

Independent contract grower groups

An alternative to initiation of seed contract growing in the informal sector is to use already existing groups of organised farmers in adjacent blocks. An example is the organised land and water users' groups of the Bangladesh Water Development Board (BWDB). At present, CDP and BADC are implementing a seed production programme with BWDB. The extension officers of the BWDB organise the growers and BADC is doing the field inspection and procures 50% of the seed produced. The other half is processed by the seed growers and stored jointly in the godown of BWDB. The next season the growers are expecting to sell their seed to farmers' cooperatives and to local dealers. The concept is that these groups, after being trained and experienced in seed contract growing and trading, will turn into independent seed contract grower groups.

Integration between public, private and informal seed sectors

The formal seed sector In Bangladesh is gradually changing. The dominant role of the public sector is decreasing and the private seed sector is expected to fill the subsequent gaps as well as expand the market of purchased seed. In the process of this development, an important role is foreseen for the informal seed sector to become involved in seed production, storage and marketing of certified seed at the grassroots level. The following suggestions are made for the interaction between the three sectors during the transitional period.

Linkages with the traditional seed systems

The existing seed flows in the traditional seed systems should be outlined crop-wise, to get a clear picture of the constraints and needs of farm households. Only then can an effective strategy be developed for integration between the formal and informal seed sectors. In this respect, the CDP project will implement three surveys for the secondary food crops on household seed systems, seed dealers and seed contract growing.

Transfer of knowledge

BADC should transfer its existing technical knowledge about seed production, processing and marketing to the private and informal seed sectors. Although activities in this field are already ongoing by making use of BADC staff as resource persons in training programmes, more systematic transfer of knowledge is required. Means and ways for transferring knowledge will include developing a curriculum for training of trainers, publishing practical manuals and organising on-the-job training courses at BADC seed farms and seed processing plants.

Variety development

As stated also in the Seed Policy, the public sector should tune its breeding and variety development activities more to the needs of farm households, especially for pulse and oil seed crops. Private seed companies are expected to take up the lead role in importing commercial varieties for evaluation in Bangladesh. However, they will be interested only in seed of crops which have a high profit margin. Therefore, the NARS should play a more pro-active role in the screening of less profitable crops. Informal seed organisations like NG0s, which have established themselves as excellent seed producers, might be included in the variety screening programmes for a fee.

Seed production

It is foreseen that for the near future the public sector will remain responsible for the breeder and foundation seed production of most secondary food crops. As such, sufficient government funding should be assured. All efforts should be made to increase the efficiency of production. certified seed production could gradually be transferred to seed enterprises and contract growers' associations in the private and informal sectors.

Availability of processing and storage facilities

In line with the Seed Policy, BADC should make its excess facilities and equipment available to the private and informal seed sectors on a lease or rental basis. This is crucial for the development of the private and informal sectors because there is no seed processing equipment available in the country outside BADC. The charges for storage, handling and processing should strike the right balance between covering the cost and attracting interest from the private sector.

Seed distribution and marketing

Price setting between wholesale and retail prices of all categories of seed has to cover the production cost and leave enough margin to get the private and informal sectors involved in the seed distribution and marketing. Practically, this implies that BADC or any other public sector organisation should start charging realistic prices for their products. A market information system jointly operated by the three sectors will play an important role in marketing management decisions.

Seed extension and promotion

All three sectors should combine their efforts in seed extension and promotion campaigns. Important topics to cover in seed extension, next to production and seed care, are seed labelling, types of seed, seed sources and seed quality. Through their extensive grassroots network, the NGO sector is probably the best player to organise seed awareness activities. To streamline these activities, close collaboration with agricultural research institutions and the Department of Agriculture Extension (DEA) is a prerequisite.

Seed labelling

So far, only imported seed and seed derived from BADC have been labelled. Developments in New Life Seed show that labelling and introduction of a brand name are essential ingredients for promotion and confidence building. Therefore, a systematic labelling system for seed sources and quality should be built up in the informal seed sector, so that farm households will know where the seed is coming from and what seed quality they are buying. Such a labelling system should be supported by independent quality monitoring institutions and an extension campaign on the labelling, types and sources of seed classes. The quality control monitoring should be implemented by the Seed Certification Agency of the government. Seed extension on labelling can be implemented jointly by NGOs and the Department of Agricultural Extension. Seed and variety promotion are tasks of the seed suppliers from all the three sectors, public, private and informal.

Seed quality control

Seed, being the single most important input in agriculture, has a price. Farmers all over the world are willing to invest in high quality seed as long as an independent service oriented organisation assures its quality. In Bangladesh, seed quality assurance of secondary food crops, together with varietal development are areas which the government should consider continuing to subsidise.

Summary

The seed sector in Bangladesh is gradually developing. Exclusive control by the public sector in the past has not been conducive to market-response developments. The use of improved seed by farm households is still small. Over 95% of all seeds is farmers' retained or purchased from local markets where the grain is sold as seed. This low replacement rate is mainly caused by to the non availability of suitable varieties and, if available, the lack of quality seed. Only recently, the public sector started releasing, producing and distributing improved varieties. The new Seed Policy gazetted in April 1993, gives broad outlines and directives on the rationalisation of the seed sector, while it also emphasises full participation of the private sector. Since then, the private sector has become increasingly involved in the import and trade of improved varieties. Not surprisingly, the seed companies started to deal with seed of crops for which a commercial demand exists such as vegetable seeds, hybrid maize, hybrid sunflower and seed potatoes. In view of the actual marginal rate of returns of the pulses and most oil seeds, it is expected that seed companies will not be interested in these crops in the near future. An important role therefore is foreseen for the informal sector in seed production, storage and marketing at the grassroots level. This paper discusses the situation in secondary food crops and gives suggestions how interaction between public, private and informal seed sector can be further improved.

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Experiences with Small-Scale Local Seed Schemes, particularly in Africa

*0. Neuendorf**

Introduction

The need to improve the food basis for an ever increasing population led very early on to an intensification in plant breeding and to the building up of national seed schemes in the developing world. The aim was to supply the farmer with high yielding varieties. Unfortunately, with some exceptions, the high yielding varieties did not spread as anticipated. Obstacles to overcome were many. Inputs such as fertiliser, pesticides and water, just to name a few, and improved cultivation techniques were not available, i.e. to expensive to pay for. Factors such as home-made restrictions in the form of government rules and regulations which are not conducive to enhancing crop production, and world food prices distorted by the subsidies of rich countries, all contribute to the fact that the food basis is not secure. Civil strife, war and droughts aggravate the problem in Africa.

The project

The realisation that the formal seed sector only partially fulfils its role and that the huge informal seed sector should not be considered as a sector with great promise to market new varieties, but that its merits should be examined to discover whether there are useful interactions possible with the formal sector, led to the inception of the project Promotion of Small Scale Seed Production by Self Help Groups. The core problem is described as follows: the results of the breeding progress achieved at national and international levels are not being disseminated sufficiently; currently, the indigenous varieties (ecotypes) which have developed on the smallholdings are disappearing. As a result, the existing production potential is not being adequately utilised.

The project commenced in April 1994 and aims to find workable solutions for a self-sustaining way to produce seed at the household level, to interact with the formal seed sector to achieve seed security, and to produce site adapted varieties.

Zimbabwe

Zimbabwe was chosen as the project location because it has very interesting features which will help to understand the informal seed sector better and to monitor future developments which will occur as a result of increased competition in the formal seed sector.

In Zimbabwe, as in much of Southern and Eastern Africa, maize is the staple food crop. Maize is planted on one and a half million hectares. Maize is followed in decreasing order of importance by millets (260,000 ha), groundnut (164,000 ha), sorghum and sunflower (approximately 130,000 ha each), and soybean (72,000 ha).

* Small Scale Seed Project SADC-GTZ, Zimbabwe.

The maize seed industry is dominated by five research-based private seed companies. These are the Seed Co-operative Company (Zimbabwe), Pannar Seed Company (South Africa), Pioneer Hi-Bred International (United States), Cargill Hybrid Seeds (United States) and Pacific Seeds (Australia). These companies are continuously producing new superior-performing hybrids for farmers. Roughly 95% of the maize is planted to hybrid seed annually, and in 1995 in excess of 35,000 t was purchased on the formal market compared to 640 t of sorghum, 214 t of millet varieties, and 790 t of groundnut (Ministry of Agriculture 1995). Because most of the maize is planted to hybrids, commercial maize seed sales expanded rapidly between 1980 and 1995, from 15,000 t to 35,000 t per annum.

In contrast, most millets, groundnut, sorghum and sunflower are planted to unimproved cultivars and farmer-saved varieties because seed companies concentrate on maize, soybean and sunflower crops where they can achieve high profit margins in order to obtain competitive returns on their research and marketing investments. Although the Zimbabwean government has breeding programs for maize, sorghum, pearl millet, soybean, groundnut, sunflower, beans, cowpea, bambara nuts, and vegetables, all of which have produced improved varieties, most products have not reached farmers because of a lack of niche market companies that focus on multiplying of crops which have low margins and small sales volume. This void in the seed market for secondary and tertiary crops needs to be filled. There are signs that the informal seed sector is responding to the challenge. It seems that traders who specialize in buying grain, store part of it and sell it as seed within local villages. They might even cultivate a piece of land for the sole purpose of producing seed. Recently, several informal seed groups and formal seed producing associations have been coordinated by non governmental organizations (NGOs) and are expanding their participation in seed production and germplasm conservation (Rusike 1995).

Development of seed systems

The seed sector in Zimbabwe provides a fine example of the different stages which lead to different seed production and supply systems, as shown in Figure 1.

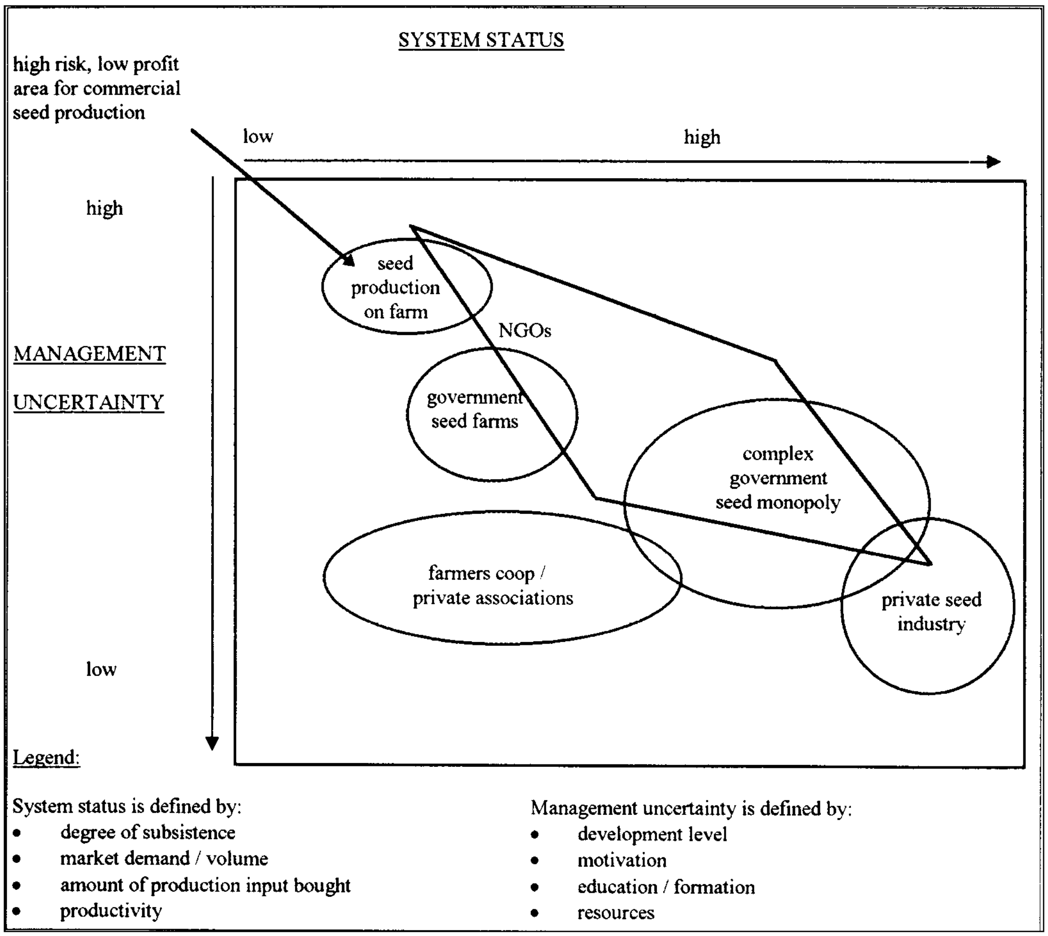
A low system status and high management uncertainty leave little room for enterprising activities in the seed sector. The farmer has no choice but to produce and save his own seed. Local seed schemes could improve this situation especially if they are linked to the formal sector.

With increase of economic progress, the situation changes to a distinctly higher level of development within the seed sector. A commercially oriented private seed industry establishes itself, and, at the same time, the government gradually discharges its activities in the production sector and takes up its original task, which is to set policies and uphold the (seed) law.

However, this development is not a self-fulfilling prophecy. In most cases, the farmer still produces his own seed, but not necessarily for all crops. The latter is the case when a strong seed industry offers a wide range of maize hybrids that are readily available in the market and when other cash crops such as cotton are planted. The seed sector shows, therefore, depending on the crop grown, a low system status with management uncertainty and the opposite of it. This is the case in Zimbabwe with its development of a strong seed industry based on hybrid maize. The top maize growing areas are in the better situated regions in terms of soil and climate and most of the maize is grown on large land holdings by commercial farmers. Smallholder farmers would most likely prefer to have open pollinated varieties

(OPVs) as their economic situation and marginal maize growing conditions make it difficult to pay for hybrid seed, fertiliser, pesticides and labour.

Figure 1 Different basic conditions produce varied seed production and supply systems.



Open pollinated varieties (OPVs), however, would lead to a lower degree of management certainty as farmers would retain some parts of the crop for seed and only occasionally buy new seed. This in turn would most likely weaken the seed industry as the forecasting of seed demand and reduced seed sales impair profits.

The seed industry in Zimbabwe has, therefore, neglected thus far to cater for crops such as sorghum and millet and the numerous bean varieties because of the difficulties involved in seed production and marketing.

This situation is deplorable but is being addressed by a multitude of projects in the informal seed sector which seek to rectify the situation. The aim is to install seed security at the household level on a sustainable basis and to generate income through the sale of surplus seed.
NGOs are in the forefront of building self-supporting seed systems. More often than not, however, they have found themselves burdened with the task of assisting with the disposal of

surplus seed. Challenged with the task of marketing seed and of establishing a long-term perspective for seed marketing, NGOs soon encountered difficulties. This resulted, and not only at NGO level but also in official donor driven projects, in failures when projects were handed over.

Experience with seed schemes

The numerous interventions at the farmer's level aiming to increase and to secure his food basis and consequently that of the nation have led to some distinct patterns derived from the different intentions of various groups (Table 1).

Table 1 Seed schemes.

<u>Environmentalists</u> • keep plant genetic resources in the wild, in situ • keeping plants in situ at farm does not exist	<u>Reformed environmentalists</u> • in situ at farm • no conservation without utilization • participatory maintenance and breeding with farmer
<u>Formal seed scheme</u> • small scale farmer-groups produce certified seed for the market • multiplication of registered varieties • Support by NGO, donor, seed industry	<u>Formal seed scheme</u> • large scale commercial farmers produce certified seed of • registered varieties on • contract with seed industry
<u>Small scale seed project</u> • informal seed sector linked to formal sector • seed security at household level • participatory maintenance of varieties • impartial to whether farmer varieties or modern varieties are multiplied • seed production is not intended toproduce surplus for marketing (formal system)	<u>Emergency seed production schemes</u> • off season production • capital intensive • multiplication of registered varieties and farmer "varieties" • mixture of formal and informal seed sector • production of standard seed (no name brand, cleaned, calibrated and germination tested seed)

Zimbabwe

Historically, seed multiplication and distribution in Zimbabwe has been dominated by a few large-scale commercial farmers' seed producers associations. Until recently the government and the large farmer owned research institute were the sole breeding sources of improved varieties and they released their materials exclusively to large scale farmers for multiplication and distribution. In addition, the Seed Services, which was designated the sole seed certifying authority under the Seeds Act 1965, exercised its control through the medium of seed associations which were responsible for supervising the production and marketing of certified seed.

The advent of the Economic Structural Adjustment Program (ESAP) has opened up opportunities to involve smallholder farmers' groups in seed production and distribution. Several seed schemes have been initiated by NGOs and private companies over the past four years, ranging from non-commercial community seed and biodiversity maintenance projects to fully commercialized operations. The major NGOs involved include the Community Technology Development Association (COMMUTECH), Intermediate Technology Development Group (ITDG), Organization of Rural Associations for Progress (ORAP), COOPIBO, a Belgian based NGO, Lutheran World Federation (LWF), and Environment & Development Activities Zimbabwe (ENDA). The seed activities of the NGOs usually form part of a number of other activities ranging from human and community development, to promotion of small scale businesses and sustainable agriculture.

COMMUTECH promotes community breeding and on-farm maintenance by farmer of varieties of sorghum, millets, cowpea, bambara nut, and also open-pollinated maize varieties. The NGO repatriates indigenous plant material to farmers which they had lost. They do actual collection and characterization of varieties on farm, covering 1,600 households and work both with groups and individuals. Plot holders get plant material from other areas, then plant and replicate the material. At the end of the season the crop is evaluated by all involved to determine whether the material is suitable or not. The farmer's task is to decide whether more work should be done with a promising variety or not.

The task of the NGO is to give the farmer technical support on how to select seed, how to handle diseases, on isolation of varieties and in general to produce a product more suitable to the community. This NGO has recently embarked upon the establishment of pilot community seed banks, using traditional practices such as seed production on a common field.

Recently, ITDG established a seed conservation scheme in response to the needs of smallholder farmers, whose main reason for increased household food insecurity in recent years was a lack of access to suitable material for the local environment. ITDG began by carrying out an inventory of farmer varieties in one district following the 1992 drought covering 800 farm households and focusing on maize, sorghum, pearl millet, finger millet, groundnut, bambara nut and cowpea. ITDG then introduced landraces that farmers had used in the past. It also facilitated seed fairs from 1992/93 onwards to encourage farmers to display seed of landraces that they grew for exchange with other farmers. When it first started, 35 farmers participated, increasing to 104 farmers three years later. Similarly, the challenge to display as many different varieties as possible also increased. In 1992/93, 17 different varieties were displayed by one farmer, three years later one farmer displayed 35 different varieties.

ENDA, with activities in establishing local gene banks, started a commercial scheme with the Seed Co-operative Company of Zimbabwe to support seed growers in the more marginal areas of the country to produce sorghum, millet, groundnut and cowpea seed that cannot be economically produced in the high potential agricultural areas. ENDA's task is to manage the seed scheme and deliver the seed to the Seed Coop. ENDA acts as the contracting agent in the field. The Seed Coop provides the seed grower training, advisory services and the crop inspection service. Due to last season's drought, from an anticipated 3,000 t of seed produced by 3,000 seed growers, less than 300 t of seed were actually produced.

To inquire into the seed situation at the farmer level, the project on Promotion of Small Scale Seed Production by Self Help Groups conducted a survey in five areas in Zimbabwe where the staple food was traditionally sorghum and millet, which have since been replaced to a considerable extend by hybrid maize.

Preliminary survey data show that a wealth of local varieties were available for different uses and different environments (Oosterhout 1995). Farmers said they had lost many of their traditional crop varieties due to the following reasons:

- War (World War I and II and liberation struggle).
- Drought.
- Deterioration of soil fertility.
- Modernisation: younger people do not want to grow traditional crops because they are labour intensive and have low yields. Young people consider growing the old varieties as backward.
- Old varieties are not in demand in the market.
- The introduction of cash crops such as cotton caused farmers to stop growing their traditional food crops.
- Seed storage became too tiresome a job. In the past seed was stored in different ways in small seed houses in earthenware containers above and below the ground. Furthermore, many of the old varieties of sorghum and millet stored better than modern varieties because of their small grain. The larger grain of modern varieties is more easily attacked by insects than the old hardier, small grain.
- In the past during times of food scarcity, coping strategies were to use whatever edible wild plants could be found in the forests before one resorted to eating the seed. Today the decision to consume that part of the harvest which was earmarked as seed is taken more easily.

In one of the surveyed districts (Muzarabani), farmers named 19 different types of sorghum, seven of pearl millet and six of finger millet. A farmer or family may grow only one or two different crop varieties, which may differ from others grown by their neighbours. Over time very specific traits develop in an area, and these are very much adapted to the environment. However, this situation is rapidly changing. With land getting scarcer due to population pressure and soil erosion, many able-bodied people have gone to the towns to find employment. Agriculture is no longer the mainstay and this has led to a decline in knowledge and effort in the rural areas.

Further reasons not specifically mentioned which led to the loss of varieties were the changes in the daily diet. Maize products (mealie meal) and the bottled home-brew beer became readily available in the shops. In cases where calamities have occurred, food aid by governments and donors further eliminated the need to keep many varieties, or any seed for that matter.

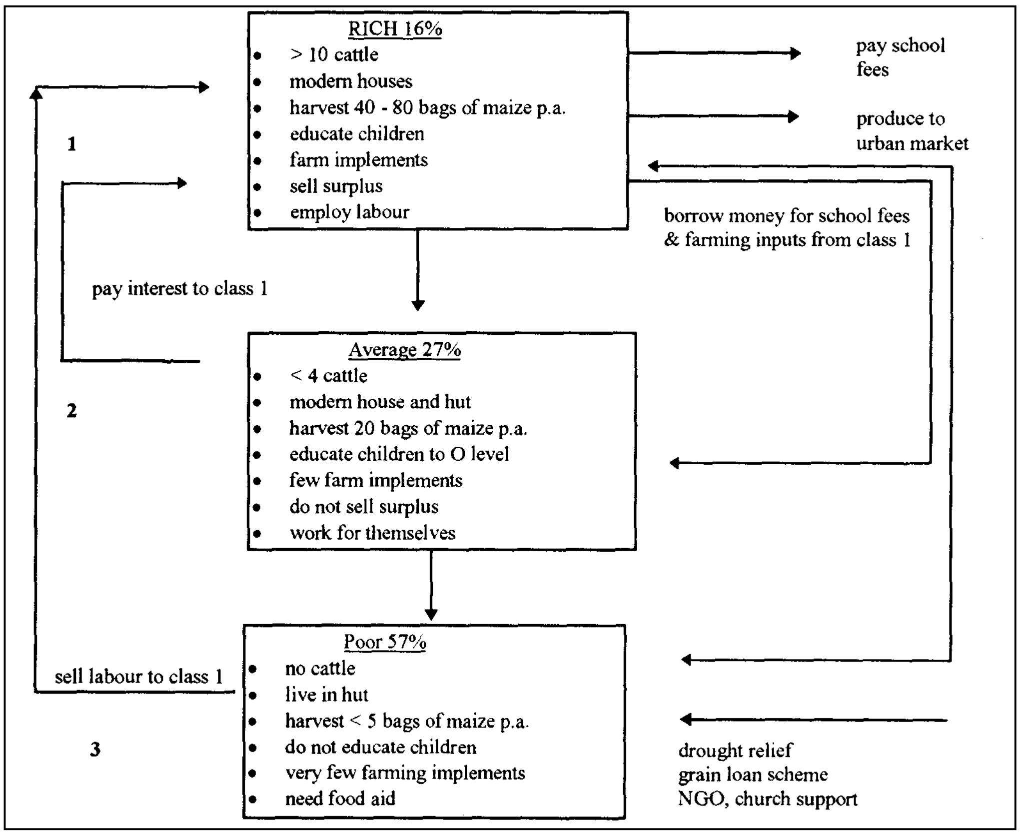
It seems that much less effort is expended nowadays to ensure that seed is well selected and carried forward for the next season. Due to drought, much livestock draught power has been lost and farmers therefore have to wait until the rains have started before preparing their fields. They are then in a rush to source seed and have to travel far to find it. More often than not, the desired seed is not available and the farmers have no choice but to buy grain for seed purposes or hybrid maize. Good quality of the latter is always available, but is not necessarily suitable for each and every climatic condition.

Two issues, namely gender and wealth, come very much to the forefront when considering the promotion of local seed schemes. Women are traditionally involved at the household level in securing seed from crops which are not considered cash crops. The promotion of local seed schemes brings opportunities, although in a limited way, to barter and sell surplus quantities, but presents the danger of women having to assume an extra workload.

Men may also consider it a status-enhancing activity with prospects for cash income and take over its management.

The second issue is the distribution of wealth in the area surveyed. According to the farmers' own perceptions, 57% of the farmers are considered poor. They live in huts, do not send their children to school, harvest less than five bags of maize per annum, are in need of food aid and sell their labour to the rich (Figure 2). Local seed schemes will therefore have to take note of these issues so as not to contribute to existing problems.

Figure 2 Transfer of wealth between different social strata in the study areas.



Source: Oosterhout 1995.

Malawi

The National Seed Company of Malawi (NSCM) was established in 1978 to produce all agricultural and horticultural crop seed for Malawi's agriculture. Because of its low margins and poor profitability, it was unable to supply smallholders with adequate quantities of certified rice, groundnut, wheat and sorghum seed at affordable prices. In response to this, the Malawian Government organized a Smallholder Seed Multiplication Program in 1985 to increase availability of certified seed of crop varieties at affordable prices in order to enhance household seed security and thereby achieve food security. Under the new program, the Ministry of Agriculture issued selected farmers with basic seed for multiplication. The Seed Technology Unit registered and inspected all seed crops grown by smallholders for certification

By 1987 the Smallholder Seed Multiplication program involved over 3,894 farmers with a total seed crop area exceeding 1,585 hectares. Utilizing smallholder farmers was found to be costly, however, because of fragmented small holdings which needed to be inspected by the Seed Technology Unit and supervised by extension staff. In 1990 the program was scaled down because of i) the high inspection costs occasioned by the fragmentation and scattering of farmers' fields; ii) the weak marketing system of buying seed from growers; iii) the lack of facilities for temporary storage; iv) weak funding of program; and v) poor economic incentives for some crops such as wheat.

In a workshop (June 1995) with six NGOs and the Department of Agricultural Research in Malawi, it was stated that seed security at the household level had not been achieved. Numerous seed schemes, by NGOs especially, have been undertaken with the aim of producing surplus seed for marketing. Due to population pressure, however, the holdings are very small and therefore it is a tedious job to produce seed and more often than not the farmer has to use the seed to feed his family.

Senegal

The On Farm Seed Project financed by USAID and carried out by the consultant Winrock International (Bragantini and Schillinger 1992) had as its long-term goal the development of a model or models of on farm seed production systems which can be replicated or adapted for use in other areas. The activities were aimed at promoting improved varieties and improving the farmers' knowledge on how to select, store and maintain the seed and improving agricultural practices in general. It was thought that farmers might produce surplus seed and enter the market. This was not the case. Farmers elected to exchange or barter seed on a scale which satisfied their immediate needs. Nevertheless, the evaluation team stated that the approach did warrant further exploration.

Namibia

Namibia's most important food crop is pearl millet, grown in the northern region of the country. Recent developments in crop breeding allowed the release of a short duration variety (Okashana 1) which is in great demand by farmers. Most of the seed used as planting material, however, is not intentionally produced for that purpose. Namibia is in the process of setting up a national seed production programme in collaboration with crop research and extension services and private seed production farmers.

At this stage, the program does not foresee going into specific activities to improve on the existing seed exchange mechanism amongst farmers. In one respect, seed security at the household level has been achieved since millet seed is traditionally stored in the dry climate for periods of up to five years.

Mozambique and Angola

After lengthy wars, these two countries are in the process of establishing a seed industry. The governments have huge development tasks but scarce financial resources with which to establish them. Numerous efforts by foreign-based NGOs are directed towards supporting government by supplying seed and forming seed grower groups. This latter activity is a commendable approach as seed is multiplied for the seasons to follow. It will be a delicate task to ensure that free seed hand-outs do not discourage farmer and rural dealers from investing in seed production.

Conclusion

Of the seed schemes mentioned, all are geared to producing surplus seed for marketing, i.e. to enter the formal seed sector. The problems faced when entering the formal OPV seed market are well known, and are further evident by the absence of the private seed industry which shies away from this market. Local seed schemes which cater for their own needs and those of their neighbours, in terms of the ongoing discussions (household seed security), which the project Promotion of Small Scale Seed Production by Self Help Groups tries to encourage, do not seem to exist.

Apparently the advantages of local seed schemes are overlooked when the marketing aspect becomes the overriding objective. Then, when harvest time comes and the seed is not readily marketed, everyone loses interest and the scheme is considered a failure.

Strengths and weaknesses of local seed schemes

Table 2, which is by no means complete, helps to discern positive and negative aspects of local seed schemes.

Economics, and integration into formal system

According to figures of the Sorghum and Millet Improvement Program (International Crops Research Institute for the Semi-Arid Tropics 1994): "Early results of an impact assessment study in Zimbabwe suggest that improved sorghum and pearl millet varieties are replacing traditional landraces more rapidly than expected. This confirms the popularity of the new cultivars with farmers and the value of past research investments, while also raising Green Revolution-type concerns regarding the diversity of germplasm available to farmers. The study confirms that the impact of new cultivars is much greater when these are accompanied by improved management practices, suggesting that the payoff to investments in agronomic research tailored to the needs of resource-poor farmers is likely to be high."

With the changing of the weather pattern in effect reducing the length of the growing season, the short duration material from ICRISAT was, and still is, in great demand. The economics of landraces replaced by modern varieties, however, is one aspect which also has to be seen in the context of whether they can be competitive with hybrid maize in marginal maize production areas. It will be interesting to see future developments in marginal maize growing areas and whether maize is going to be replaced by sorghum; the reason being that due to increased maize prices world wide, maize is becoming to expensive to use as stock feed.

No data for the project are available yet on the economics of local seed schemes. The project will, however, be looking into the matter when work starts with pilot seed grower groups. It is anticipated that the promotion of local seed schemes will be a sound investment when interlinked with the formal seed sector. Ideally, a cash strapped government would have the option of breeding and producing basic or foundation seed only and would distribute small quantities to local seed schemes for further development and multiplication.

Table 2 Strengths and weaknesses of local seed schemes.

Strengths	Weaknesses
• .plant material is site adapted i.e. can cope better with environmental characteristics	• if a farmer is not knowledgeable enough he is tempted by high prices or poverty to select undesirable plants for seed and sells the good quality for food
• seed is available when fanner needs it	• the seed maintaining cum breeding process is asking a lot of the farmer in regard to having the knowledge, the timeand land available for producing seed, especially when producing cross pollinated crops
• plant material is adapted to mixed cropping stands	• are the womenfolk burdened with extra work or is the seed activity taken from them away as a male status enhancing activity?
• seed production allows sale or bartering	• seed quality in genetic and technical terms not assured. Controlling local seed production not feasible
• Material can be selected fit for different parts of the farm land (low lying fields, andy fields, slope etc.)	
• no capital needed to produce seed as quantities produced are small	
• In situ conservation of genetic variability enhanced. Farmer as keeper of plant genetic resources	
• knowledge implanted at farmers level allows rebuilding the seed stock from small quantities quickly after calamities	
• reduces costs at NARS level to breed for many sites	
• Strengthens seed consciousness at farmer/ community level	
• helps to link the formal and informal seed sector. Infusion of new varieties, seed renewal, repatriation of lost varieties	
• Knowledgeable farmers adopt other improved agricultural practices more readily	
• spreading of site adapted plant material in the neighborhood reduces distribution costs	
• Crop stand allows neighbours to judge crop performance	
• surplus seed not needed can be used for food	

Seed quality

According to the seed law, field inspections and analytical work in the laboratory are preconditions for releasing certified seed. For many countries the adoption of a seed law in accordance with international standards has taken time and upholding the law is an expense on public funds. With local seed schemes becoming an integral part of the seed sector as a whole, however, it will become necessary to revise the law to accommodate activities in a dual seed sector. To make amendments with regard to selling seed of registered varieties without field inspections and laboratory control as in the hill seed program in Nepal, is but a first step. Matters become more difficult when local seed schemes distribute seed of farmer varieties which have not been tested and registered by the formal system.

Donors' perspectives

There is certainly not a specific donor perspective regarding local seed schemes. Recipient and donor have a common goal, however, and that is to ensure the availability of food at affordable prices for a growing world population. This demands the examination of various possibilities and donors need to explore approaches which could be helpful in securing the seed basis at the household level as one of the inputs necessary for producing food. Looking at developments in many parts of Africa, it is common knowledge that, with shorter growing seasons, much more effort has to be made to cope with this new situation. The problems nowadays are certainly aggravated by more people having to be fed than was the case in the past. Research is one of the tools which can be used to counteract this problem. Former and ongoing investments made into research and especially in the Consultative Group on International Agricultural Research (CGIAR) have yielded an impressive array of crop varieties suitable for coping with different requirements. Still desired, however, is much faster transfer of knowledge to the farmer. The existing channels for the dissemination of research findings in collaboration with the national research structures and the involvement of the farmer have considerable room for improvement. Common practice now, more so than in the past, is to closely collaborate with the farmer. This approach will hopefully allow for faster exchange of information between scientist and farmer and lead to more site-specific adapted varieties being accepted by the latter. Working closely with the farmer requires patience on both sides, however, to achieve mutual understand and trust. This is a time consuming process and recipient governments are asked to formulate a policy which recognises increasing difficulties on account of drought, coupled with a decrease in public funds and more people to feed, and which permits and enhances the utilisation of the knowledge and creativity of the people in the rural areas.
Furthermore, donors are asked to channel their contributions in such a way that they do not contribute to the fostering of a dependency syndrome, thereby undermining the self-help capabilities of the people. This in turn impairs long term investments by governments, individuals, groups and donors when a bag of seed is given as a free hand-out.

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Breeding Varieties with Farmers' Participation: Pearl Millet Improvement in Rajasthan, India

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Introduction

Participatory approaches have become widely used, applied and modified in rural development work. Much of the methodology used and being developed is action oriented. Farmers' participation in the research process may have similar merits. It is one of ICRISAT's goals to develop innovative techniques to improve the impact of its research on the nutritional and economic well-being of low-income people in these environments. Developing methods to bring farmers and scientists closer together has been one of the approaches used to achieve research results with more relevance to specific farming communities. Understanding farmers' priorities helps to target research efforts. Giving farmers opportunities to choose, improvise and adapt from a range of choices will create more useful technologies (Farrington and Martin 1988).

New varieties, breeding populations, and improved genetic materials are among the major outputs of ICRISAT's research efforts. Farmers' involvement in this process has traditionally been limited to that of a donor germplasm and of a recipient of a final product. Opportunities for farmer participation in the various stages of this process will be explored in this paper, based on research with pearl millet (Pennisetum glaucum (L) R. Br.) in the state of Rajasthan in northwestern India. This paper describes the interaction between scientists and farmers during individual stages of the breeding cycle of a cross pollinated crop and summarizes key results obtained to date.

Pearl millet in Rajasthan

Pearl millet is the major cereal crop and staple food of Rajasthan. It is grown annually on 4-6 million ha, predominantly in the drier western part of the state. The area under pearl millet varies greatly from year to year, depending on the rainfall and its distribution. There has been a slight increase in area cultivated with pearl millet over the past thirty years, probably due to increased demand for food and feed by a rapidly increasing population (Jansen 1989). The average productivity of the crop varies greatly from year to year, and rarely exceeds 500 kg/ha. In the western districts of Barmer, Jodhpur, and Bikaner, average yield levels are frequently below 100 kg/ha.

Adoption of modern varieties (MVs) of pearl millet is low in this state, in contrast to other millet growing areas in India where both improved open-pollinated varieties and single-cross hybrids are widely used (Jansen 1989). Local varieties of pearl millet from the western part of Rajasthan tend to outperform the standard MVs for grain yield under stress conditions (Weltzien and Witcombe 1989). Pearl millet is normally cropped in mixtures with short season

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legumes, and livestock are an important component of the farming system since crop residues of pearl millet and legumes are important sources of livestock feed and farm yard manure is the primary fertility amendment used by farmers.

The cycle of plant breeding activities

Breeding new cultivars of any crop involves a series of activities common to all crops. Schnell (1982) defined these major stages as generation of variability, selection and testing of experimental cultivars. This classification facilitates the analysis of the technical process of variety development, the domain of classical plant breeding research.

A successful breeding program however, needs two additional stages: the setting of goals or the definition of a target for the breeding program and an efficient system for varietal release and dissemination. These two stages need to be integrated with the technical variety development process, to allow for feedback between these stages and for a dynamic optimization of the whole breeding cycle.

Opportunities and experiences with farmers' participation: defining goals

Setting goals is usually the first step in developing an effective breeding program. Appropriateness of the goals set determines the effectiveness of a breeding program to a large extent. The goals have a large influence on the choice of breeding method, composition of the germplasm base and diversity that is required. Formulating goals is crucial to any breeding program. It is thus surprising that very little research has been reported on methodologies for identifying appropriate goals in breeding programs. Reasons for this could be historical. Seed improvement, variety development and plant breeding as an enterprise and a research discipline have evolved out of crop improvement in general (Kuckuck 1988; Gade 1993). Thus the intricate understanding of farmers' production goals, their preferences for certain traits as well as a familiarity with future trends in production conditions formed the basis for genetic crop improvement. With the rapid scientific development in genetics and its application to crop improvement, the linkage between genetic, agronomic and farming system improvements has loosened and plant breeders are frequently in a position where appropriate goals are not obviously set. This is particularly the case in marginal environments where farming is frequently subsistence rather than market oriented, and farmers' strategies for coping with large seasonal variations are not well understood (Matlon 1987).

Pearl millet cultivation in Rajasthan is such a case. We have therefore initiated research with farmers' participation on the following issues relating to the setting of goals for the breeding program:

- identification of farmers' preferences for individual traits of pearl millet;
- identification of major production constraints; and
- identification of major trends and anticipated changes in the production environment for pearl millet in Rajasthan.
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Methods

In an initial study we used formal, structured, pretested questionnaires to elicit farmers' perceptions of the relative importance of grain versus clover yield (Kelley et al. 1996). The results of this survey were mainly limited by the' fact that farmers in marginal areas of pearl millet cultivation had not been exposed to the wide range of variability available among newly released pearl millet cultivars and pre-release advanced experimental cultivars. Farmers could thus not consider the whole range of available variability while expressing their preferences and concerns.

On-farm trials

To expose farmers to a wide range of these options, we decided to encourage them to grow trials with new cultivars under their normal crop management conditions. We organized the on-farm trials with the support of local non-government and government organizations, working with farmers in the target areas (Table 1)

Table 1 Location and number of on-farm trials organized each year with the support of local organizations.

Year	District	Village	Number of trials	Supporting organization
1991	Ajmer	Kotri	12	Social Work and Research
		Singla	12	Centre (SWRC)
		Brijpura	12	SWRC
		Nallu	12	SWRC
1992/ 1993	Ajmer	Nunwa	15	Swiss Integrated Goat Development Project (IGDP)
		Udaipur Khurd	15	SWRC
	Jodhpur	Aagolale 30		Department of Soil and Conservation and Watershed Development of the Government of Rajasthan: Central Arid Zone Research Institute (DSSWSD, CAZRI)
	Bikaner	Kichiyasar	30	Urmul Trust
1994	Jodhpur	Aagolale 20		DSSWD, CAZRI
		Malunga 20		Grameen Vikas Vigyan Samiti (GVVS)
	Bikaner	Kichiyasar	20	Urmul Trust
	Chum	Krejada	20	Urmul Trust
	Banner	Bhadka	20	Society for Uplift of Rural Economy SURE
		Mangla	20	SURE

The on-farm trials were managed by farmers. Each farmer compared one experimental variety with his/her own variety. Farmers obtained assistance for the organization and layout of these trials from village investigators employed in each village. These investigators were trained to understand the trial objectives, the methods to monitor them and to administer interview schedules to collect background information on key features of the production system. Details of the process we used for selecting target regions, study villages and participating farmers are described in Weltzien et al. (1995) and Whitaker et al. (1995).

The varieties used for these trials were chosen by the researchers, and we changed some varieties from year to year in response to farmers' evaluations and interests. The varieties were chosen to meet the following criteria:

- to cover a maximum span of variability for the trait time to maturity;
- to cover a maximum span for tillering potential and panicle types;
- the varieties should have been widely tested for yield, preferably released or near release;

- the varieties should preferably be open-pollinated varieties and not single-cross hybrids, permitting farmers to produce their own seed.

Evaluation of on farm trials

Using these trials as the basis for discussions, we used several methods to understand farmers' criteria for differentiating between cultivars and farmers' preferences for individual traits and trait complexes: i) individual comparisons of experimental varieties with farmers' own variety; ii) group interviews to compare a range of cultivars; and iii) farmers' descriptions of an ideal variety.

Individual comparisons: project scientists visited the on-farm trials twice a season to hold discussions with farmers. The first visit took place before flowering to discuss field management and early growth of the experimental variety relative to the farmers own variety. Prior to harvest, plots were visited again to discuss in detail farmers' perceptions of differences between the experimental variety and their own. Individual assessments, while viewing the standing crop, indicated what characteristics farmers use to distinguish between varieties. For each distinguishing trait, farmers were asked to rank the two varieties. Farmers also ranked the varieties over all traits. After harvest, farmers were asked to measure grain and fodder yields and to evaluate grain and fodder quality of the experimental varieties compared to their own.

Group assessments: with different groups of 3-6 farmers each, representing farmers participating in the experiments, non-participating farmers, and women farmers, we conducted group interviews to compare all experimental varieties with each other and with the local variety. Groups toured a cluster of fields to see all three experimental varieties under similar growing conditions. Farmers collected 3-4 representative plants from each variety to have specimens available during the discussions.

Discussions were structured so that farmers were first encouraged to talk about differences between the local varieties and the experimental varieties. For each trait they mentioned, a picture was drawn on a card. The cards were then used to construct a matrix ranking table. Farmers ranked the three experimental varieties for each of the characteristics they had mentioned. Usually these discussions led to other topics, such as crop management, crop utilization and seed selection.

Ideal variety: during the individual and the group assessments, farmers were asked to describe the characteristics of an ideal variety, thus ranking and combining the individual traits that they had mentioned before. This was followed by discussion on the reasons for this ranking and the preferred trait combinations.

Characterization of the cropping system and its main constraints

The expression of individual traits of a crop variety depends not only on the variety's genetic composition but also on the environmental conditions where the variety is grown. Growing conditions have important direct effects on a variety's growth and performance, but more importantly the expression of many productivity related traits depends on interactions between genetic and environmental factors. These interactions are usually unpredictable. An important part of formulating goals for a breeding program is thus the identification of key environmental factors and production constraints. This allows the breeder to adapt on-station testing conditions to prevalent target growing conditions.

One complicating element is the time lag between the initial steps of variety development and its possible release and extensive adoption by farmers. This time lag normally spans five to ten years. During this period production conditions, both economic as well as environmental, can change. The description of target growing conditions thus contains an important predictive element. Discussions with farmers about their management practices, production goals, changes occurring, and factors that cause them can be important sources of information for defining target production environments for a breeding program. We focused our discussions on crop management issues and livestock-crop interactions through individual structured interviews and informal group discussions on specific topics, such as crop rotations, following practices or crop mixtures.

Results

Farmers' preferences for individual traits

Farmers used a wide variety of traits to distinguish between the experimental varieties and their own cultivars. The traits can be classified into three groups: growth and productivity, grain and fodder quality and adaptation to the environmental conditions and needs. Farmers in the three districts mentioned grain and stover yield during varietal comparisons in about half the cases. Grain yield and fodder quality were consistently mentioned more often. These two traits were the most important for varietal comparisons in all three districts (Table 2).

Table 2 Percentage of farmers using productivity related traits to distinguish the experimental variety from their own variety, 1992 and 1994 results combined, across all experimental varieties.

Trait	Ajmer 1992	Jodhpur 1992/94	Bikaner 1992/94
Number of fanners surveyed	27	44	49
Grain yield	68	59	65
Stover yield	52	36	53
Earliness	72	48	37
Large panicles	59	34	57
Large grain size	44	40	45
High tillering	20	23	65

The most important difference in farmers' preferences between the higher rainfall district (Ajmer) and the drier western part of Rajasthan was the different attention paid to tillering. Tillering is of importance to farmers of western Rajasthan as a component of both grain and fodder yield. They associate better adaptation to low water availability and poor fertility conditions with this trait (Table 3), and consider it as a component of stover quality. Nodal tillers frequently do not mature before harvest and thus contribute to the stover feed quality. Higher tillering varieties commonly have thinner stems, which result in higher intake by the animals, without the need to chop the stover. The local landraces of western Rajasthan tiller profusely from both basal and aerial nodes. They are extremely thin stemmed with small panicles and very small grain size.

The frequency with which earliness was mentioned differed markedly among all three districts. In Ajmer, the district with the highest seasonal rainfall and the longest rainy season (van Oosterom et al. 1995), earliness was mentioned most often. This is unexpected, because earliness would seem to be of most benefit in the drier areas of western Rajasthan. However, in Ajmer district the differences in earliness between the experimental varieties and farmers' own varieties were most pronounced. In Ajmer district two of the experimental varieties, FHB 67 and RCB-IC911, flowered and matured distinctly earlier than the commonly grown cultivars.

Fanners in this area had no previous experiences with this degree of earliness, and perceived it as advantageous in both years of on-farm testing. In 1992, the early maturity of these cultivars gave many farmers the opportunity to plant a post-rainy season crop with the late rains of that year. In contrast, 1993 was a dry year and this earliness was the key to a higher grain yield for many farmers in this district. In both Jodhpur and Bikaner districts, the local varieties flower early, thus the difference between local and early experimental cultivars is smaller. Confounding this is the effect of poor soil fertility and other stresses on flowering behavior. It appears that the flowering of improved cultivars under stress is delayed more than in the local varieties of western Rajasthan, thus further reducing the potential differences between the two types of breeding material.

Table 3 Adaptive traits which farmers in Jodhpur and Bikaner districts observed during three years of on-farm variety comparisons.

Trait	Reason
Plant type :	
early maturity	associated with low water requirements
high tillering*, nodal tillering, many leaves	associated with high productivity under stress conditions
tall plant height	associated with high fodder yield under stress conditions
large panicle, large grain	
Overall adaptation	
good germination, **fast germination** low seedling death	stand establishment is essential
low water requirements good growth in early drought, dark leaves, less drying, less leaf firing	
low soil fertility requirements **good seed set**	flowering, pollination and early grain development are very sensitive to stress
reduced bird damage **bristles**, glumes	in poor years bird damage causes severe losses; bristles and glumes contribute to non-preference for birds
uniformity disease resistance	

* Traits in bold type were mentioned very frequently.

Adaptive traits and adaptation where mentioned by farmers from western Rajasthan (Bikaner and Jodhpur) as criteria for which the varieties differed. Farmers' criteria for assessing adaptation of cultivars fall into two groups: i) plant type or plant architecture and ii) specific adaptations to identifiable stress situations. Farmers commonly associate early maturity with low water requirements (Table 3). The relevance of high tillering was already discussed. Tall plant height is at times associated with high fodder yield under stress conditions. Specific adaptations that farmers regularly observed were speed of germination, early growth and other responses to early season drought, the ability to set seed and fill grains and attributes that contribute to reduced bird damage, which is particularly important under drought conditions.

Farmers had specific preferences for grain and stover quality characteristics. In western Rajasthan farmers preferred the thin stemmed stover of the local varieties, possibly because choppers are generally not available in this region. Animals take in the fine straw bette- than the thick stemmed hard straw of many improved cultivars. In western Rajasthan there is a stronger preference for grain quality characteristics of the local varieties. In Ajmer district, this preference appeared to have changed perhaps through the wider availability and adoption of modern varieties (Table 4).

Table 4 Percentage of farmers preferring their own cultivar for traits contributing to grain and stover quality, as observed during 1992.

Trait	Ajmer	Bikaner	Jodhpur
Number of farmers	19	21	19
Grain size	5	0	0
Grain color	26	53	95
Cooking quality	11	5	0
Chapati taste	21	74	57
Chapati keeping quality	21	58	67
Overall grain quality	16	74	71
Stover appearance	16	16	43
Chopper quality	32	63	43
Animal preference	11	42	28
Overall stover quality	21	74	33

Table 5 Percentage of farmers using a trait to describe an ideal pearl millet variety based on surveys conducted in 1992 and 1994 in Ajmer, Jodhpur and Bikaner districts.

Trait	Ajmer 1992	Jodhpur 1992/94	Bikaner 1992/94
Number of farmers	22	32	33
High grain yield	32	56	67
High stover yield	23	28	42
Earliness	55	50	61
Large panicle size	77	75	45
Large grain size	45	34	30
High tillering	27	72	70
Low water needs	0	6	42
Good grain filling	32	9	42

Traits of an ideal variety

The most frequently mentioned traits of an ideal variety are large panicle size and tillering, with grain yield and earliness not lagging far behind (Table 5). The differences between Ajmer district and western Rajasthan are similar to those obtained from the discussions on trait preferences. High tillering is clearly of much more importance to farmers in western Rajasthan. Similarly, farmers in Bikaner district include low water requirements in their list of traits for an ideal cultivar. These same farmers placed less emphasis on large panicle size and large grain size then did farmers in Jodhpur and Ajmer district. In all districts at least 50% of the farmers mentioned earliness in their list of ideal traits. Earliness is relative to the length of the growing season in the three districts, and to the crop duration of the prevalent varieties in a district.

Evaluation of the on farm trials by farmer groups

At the end of the season, five groups of farmers in Ajmer district compared the three experimental cultivars, including two groups of non-participant men farmers, one group of participant men farmers, one group of non-participant women farmers and one group of participant women farmers.

These discussions were held 2-3 weeks prior to harvest, when HHB 67, the earliest maturing cultivar, had completed grain filling of the main panicle in most locations. Under good fertility conditions, it continued to produce tillers which were later maturing. RCB-IC 911 had completed grain filling in most cases, except under poor fertility conditions. ICMV 155 and their own cultivars had mostly not completed the grain filling stage, depending on the fertility of the land. Thus most groups used differences in earliness as one of the first criteria to differentiate between the varieties.

Differences in rankings of relative earliness reflected land quality as well as differences in genetic potential. Farmers generally felt that their own cultivars were later than all three experimental cultivars. All groups noted differences in fodder or grain yield among the three cultivars. They expected all three cultivars to yield well relative to their own cultivars in 1992. Relative yield rankings differed across groups, reflecting the quality of the land where the experimental cultivars were grown as well as the genetic potential of each cultivar.

Most groups noted strong differences in yield component structure between cultivars. The ranking of head size, grain size, plant height, and tillering ability was consistent across groups and was congruent with previous on-station comparisons. Perceptions of grain size also seemed related to land quality. Under better conditions RCB-IC 911 produced larger grains. Under poorer conditions the advantage of RCB-IC911 in grain size disappeared, as it had not yet completed grain filling at the time the discussions were held.

In addition, farmers included quality related characteristics, like fodder and grain quality or water requirements, as criteria to differentiate among the three experimental cultivars. They evaluated these qualities visually. Fodder quality for chopped fodder was related to thicker stems, whereas thinner stems were beneficial in direct feeding. Grain quality appeared to be mostly related to grain size, lighter, yellowish grain color, and sometimes the sweet taste of raw grain.

Water requirements, often considered together with fertility requirements, were judged mostly by considering earliness, tillering, and thinness of stems and leaves. Farmers appeared interested in having a cultivar that will give some amount or assured grain yield in a poor year, rather than just fodder. They seemed willing to sacrifice grain yield in a good year for a more assured grain yield in a poor year.

Production constraints

As described earlier, adaptation to the climatic and edaphic conditions is a major requirement for success of any new variety in the harsh environments of western Rajasthan. To improve our understanding of the growing conditions for pearl millet in western Rajasthan, we held group discussions with farmers in all study villages about the major factors contributing to crop failures and severe yield losses. Crop establishment is often problematic. Pearl millet seeds are small (5-14 g 1000 grain mass) so emergence under adverse conditions (deep planting, crust formation) is problematic. The seedlings are tender and fragile during the first days after emergence. Losses occur due to dry hot winds, sandblasting, and heavy rains that fill the furrows in which millet is normally sown. Thus plants are covered with soil. However, in some years emergence conditions are excellent and yields appear to be reduced by excessively high stands. Farmers are of the opinion that the available tractor drawn sowing equipment is producing a poorer seed bed than the traditional animal drawn equipment. It appears that improved sowing equipment, which would allow more precise placement of the seed, could contribute substantially to more reliable stand establishment.

Poor soil fertility is probably the main yield reducing factor in the western part of Rajasthan. The traditional farming system relied on long fallow periods to restore soil organic matter content and general soil fertility. However, farmers from all over Rajasthan report that during the past 20-30 years a decrease in the duration of fallow periods has occurred due to increased population pressure. Farmers with small landholdings fallow their land only in severe drought years. Farmers in the western part of Rajasthan do not have much experience with mineral fertilizers. With the decline in fallow periods, farmers associate a loss of organic matter and a loss of soil structure. They consider this also one of the causes for more severe crust formation.

Farmers in western Rajasthan perceive drought as the main cause for crop failures and yield losses. However, there appears to be a strong interaction with soil fertility. Comparisons of high and low fertility plots over the past four years in three districts of Rajasthan lead us to assume that water utilization could be improved greatly in many fields, if a more adequate supply of nutrients were available.

Generating variability

Choosing breeding material, developing the germplasm base for a breeding program, choosing parents, making crosses, and random mating populations are major and crucial activities of every breeding program. It is generally assumed that breeders have a major advantage over farmers in the choice of germplasm and in carrying out the processes leading to recombination and thus new combinations of traits and gene complexes for quantitative traits. However, a role for farmers in this process could be envisaged for cross pollinated crops where crossing occurs naturally.

In the villages in western Rajasthan, where none of the experimental varieties satisfied farmers needs per se, the farmers nevertheless used seed harvested from the on-farm trials for their own efforts in seed selection. This seed was most often planted in a mixture with their own variety, mainly to reduce the risk of crop failure from the new seed source. This resulted in intermating of the two groups of material, and farmers observed frequently an increase in variability in their seed stocks. We observed intense discussions among farmers about selection in these more variable seed stocks.

For the breeders it may be worthwhile to consider using population crosses and random matings made in this way by farmers, under farmers' field conditions, with a large population size and selection for the most preferred trait combinations as base material rather than making similar population crosses, often under non-representative, off-season conditions, and with severe limitations on the number of plants that can be handled per population cross. Breeders could use farmer-generated population crosses for targeted improvement of specific traits, which farmers cannot easily select for on a single-plant basis (e.g. grain yield, stover yield or disease resistance), possibly without having to spend much more effort on yield components and adaptive or quality traits.

The role of the breeder in this process would thus become more one of making useful new variability available to enable farmers to generate new population crosses with a good potential for achieving genetic gains for the key traits. For farmer-breeder interactions to be successful at this stage of the breeding cycle, farmers would need to be involved in evaluating a much larger range of material and genetic variability. It would also be beneficial if there were a better understanding of the combining ability of farmers' local cultivars with different sources of germplasm that farmers may want to use. We are presently evaluating farmer-generated seed stocks for their comparative performance and variability.

Farmers' participation in selection

In any breeding program, selection is a key activity which can occur at any of the following stages: in the composition of the base material, in the selection of parents for crossing, in the selection among progeny, in the selection among experimental varieties and in the maintenance of breeder seed stocks. Selection among segregating progeny as well as selection during the testing of experimental cultivars requires balancing between the different traits that vary within the material. Understanding of the mode of inheritance is beneficial for complex traits, such as grain yield or disease resistance. Selection in all these stages of a breeding program is normally carried out under experiment station conditions. Farmer visits to experiment stations are usually limited to the viewing of demonstration plots of a few highly selected advanced varieties. Options for them are thus limited, and feedback from farmers on these displayed options is usually not sought. Possibilities for farmers' participation in selection could be as diverse as the opportunities for selection itself.

Methods

We have experimented with farmers' participation in the selection among experimental varieties, with the aim of complementing variety evaluation with their opinions, and of confirming previous results on trait preferences and preferences for trait complexes by exposing farmers to a wider range of genotypes.

Groups of farmers, men, women, participants in the on-farm trials and non-participants from different villages were invited to the research station at Jodhpur during 1992, 1993 and 1994. At the beginning of each group visit, we discussed the crop management of our trials in detail. Groups of 5-6 farmers were then led through the portion of the trial (usually one replication with 40-60 entries), from which they would make their selections. They were asked to make selections of single rows from this trial which would be beneficial for farmers in their area. Each farmer could make up to ten selections, by tying numbered labels to the ends of selected rows. After they completed their selections we held discussions on the range of variability they saw and its usefulness as well as on their reasons for making these choices. Farmers were then given the opportunity to select one of the entries in the demonstration for their on-farm trial the following season.

The method could easily be modified to involve farmers in selection among progeny rows or for selection among single plants for mass selection in a population bulk in on-station conditions. Crucial to the success of these efforts is identifying farmers who have a keen interest in seed issues and selection for their own local area and social group. These visits are time consuming for the farmers and not necessarily of immediate benefit. Institutional issues such as formation and/or identification of representative farmers' groups become more important, not only the actual process of farmers' selection (Sperling and Scheidegger 1995).

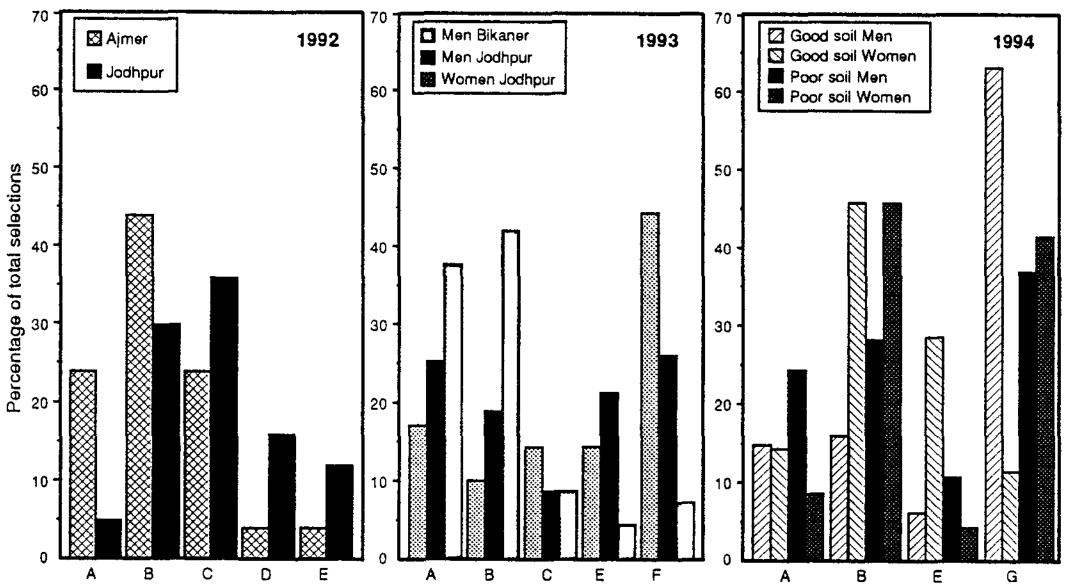
We analyzed the selections by grouping the varieties in the trial according to plant type based on time to flowering, tillering behaviour and panicle size, and recording the frequencies with which different farmers and farmer groups selected these types of material. The composition of the trial (Rajasthan Varieties and Population Trial, RVPT) changed from year to year, thus not all groups are represented each year, and the genotypes within each group are not always the same.

Results

1992 was a rather wet year with uneven rainfall distribution; short drought spells occurred in the vegetative growth stage, and towards harvest. In 1993 the trial was exposed to a severe early season drought, and received moderate rainfall for the remainder of the season. In 1994 no periods of drought occurred, and growing conditions were excellent for pearl millet. At the time of the farmers' visit to the research station in 1992, the differentiation between early and later maturing genotypes was very clear, whereas in 1993 and 1994 these differences were not so obvious, because the farmers' visits occurred later in the crop cycle.

Results from 1992 showed that farmers from different pearl millet production areas selected very different types of plants (Figure 1). Farmers from Jodhpur selected earlier maturing and higher tillering material than farmers from the higher rainfall area in Ajmer district.

Figure 1 Selections made by farmers from different districts in Rajasthan among groups of pearl millet varieties differing in plant type, as percentage of total selection made by each group of farmers, made in 1992, 1993, and 1994.



Legend:

A. medium maturity, low tillering, large panicle
B. early maturity, low tillering, large panicle
C. medium maturity, basal tillering, medium panicle
D. extra early maturity, high tillering, small panicle
E. early maturity, high tillering, small panicle
F. early maturity, high tillering, medium panicle
G. early maturity, medium tillering, medium panicle.

In 1993 fanners from Bikaner district selected mostly high tillering, tall material which were predominantly landrace accessions from another low rainfall district in Rajasthan, Bamr. From Aagolaie village in Jodhpur district, a group of men and women made separate selections in the trial. Women tended to select material with large panicles and lower tillering more frequently, whereas the men appeared to be divided, with about half of their selections made for large panicle types with high grain yield potential and the other half for higher tillering with better stover yield and quality.

In 1994, men and women from the same village in Jodhpur district (with relatively poor soil conditions) and from a new study village (with better soil conditions) visited the on-station trial. Farmers from the village with poorer soil conditions, who also had experience with some of the cultivars in their own fields, appeared to prefer a new type of material derived from combining high tillering local varieties with large panicle modern varieties. This type was equally preferred by men and women from this village. However, men from the new village with better soil conditions preferred this type of material much more than did women from the same village. These women selected mostly material with large panicles, and high grain yield potential.

The follow-up discussions indicated that grain yield, early availability of grain and the ease of harvesting by hand (lower panicle number and lower plant height) were, for women from these villages, the main considerations for making selections. For the men, stover yield and quality appeared to be a stronger concern.

Advanced variety testing, variety release and seed dissemination

It is not uncommon to have some level of farmer involvement in the final stages of variety testing, mostly through researcher managed on-farm trials, on-farm demonstrations and large-scale minikit testing. Similar types of trials are commonly organized by the extension services to expose a large number of farmers to newly available varieties and other technologies. Generally these trials are managed with the full range of recommended external inputs, which may be atypical of the predominant growing conditions in the target region. Farmers often have little input into the management of these trials. Based on our experience of the usefulness of careful evaluations of on-farm trials with farmers using their criteria, it appears that the biggest drawback of such on-farm trials is that only standard yield data are recorded. Farmers' evaluation of the test-genotypes are not sought, and farmers' evaluation criteria are not regularly used, or if so, they do not enter final reporting and play no role in the decision making process for varietal releases and recommendations (Farrington and Martin 1988). It is our experience that the type of on-farm trials we described in the first section and an attitude towards learning and understanding from the farmer reveal new information which allows a more precise assessment of the overall usefulness of a new genotype, based on the judgment of a large number of farmers. Some methods for discussions with individual farmers and farmer groups were described in the first section of this paper. Similar approaches have been used by Joshi and Witcombe (1995) to identify locally well adapted cultivars from the often wide range of already released cultivars of different crops. Such participatory evaluation and selection of existing released varieties has not only great potential for identifying locally acceptable varieties but also for exposing a large number of farmers to new varieties. Seed of already released varieties can be made available to farmers relatively easily through collaboration with existing seed multiplication and distribution agencies. This is a very effective way to utilize already existing research products.

In Ajmer district, one of the varieties (RCB-IC 911) included in the on-farm trials yielded better in two very contrasting years, 1992 and 1993. The structure of our studies resulted in a large number of farmers having had visual exposure to this variety and it was widely accepted as being better than other options. In our discussions with individuals and groups, there was a strong interest by farmers in obtaining seed for the next season. We indicated that because this variety was an open pollinated variety, farmers could maintain relatively pure seed stocks in the village. Pamphlets and posters were provided illustrating how fields might be isolated and pure seed selected. Farmers indicated a strong interest in obtaining sufficient quantities of seed to provide the community with its requirements. Farmers indicated a willingness to pay Rs 10 per kg for seed of this variety, which is slightly more than the cost for seed of local varieties in this area.

Limited availability of seed of improved genetic material is often a primary reason for lack of adoption, even if well-adapted, acceptable varieties are available, and released. Since farmers had stated a strong interest for seed of RCB-IC911, the issue of seed availability could be addressed in our study area in Ajmer district. It was agreed that ICRISAT would produce a large quantity of seed, which would be distributed by the local NGO (SWRC, see Table 1). A total of 2,500 kg of RCB-IC911 seed was supplied to SWRC in May 1994. This seed was made available to 14 villages in the area. Included were villages where earlier work had been conducted, as well as villages which had limited or no exposure to RCB-IC911. All the available seed was sold rapidly and not all the demand for it could be met.

Rainfall in 1994 was excellent and visits to the area indicated that this variety performed well and local seed production by farmers was seriously pursued. ICRISAT will be conducting an early-adoption study in 1995 to determine farmers' perceptions of their 1994 production, to assess how the seed was produced and stored, and to evaluate its spread in 1995. It will be possible to determine the impact of farmer involvement in variety evaluation and of good seed availability on early adoption.

Conclusions

We have outlined in this paper opportunities for and results from farmer involvement and participation in the main stages of a formal variety development program. Our results and observations indicate that farmer input into all these stages can be very meaningful and helpful in making such programs more cost-effective. There is no doubt that appropriate targeting will help to maximize the gains that can be expected from a breeding program. The use of farmer-generated population crosses may help to increase potential gains from a formal breeding program by relieving breeders from selecting for adaptive and quality traits, and thus allowing more focus and intensity for selection on disease resistance or productivity related traits. Planning for farmer-generated population crosses may involve more detailed analyses of the available genetic diversity, and its relationship with adaptation to and productivity under specific growing conditions.

Farmers' participation in selection was mainly discussed with respect to farmers' involvement in on-station evaluation of progeny trials, or variety trials. In the system of pearl millet cultivation as it is found in Rajasthan, it is difficult to envisage how a large number of progenies, or varieties, could be effectively tested by farmers in their own fields. There is, however, no difficulty in foreseeing farmers' involvement in the selection among single plants in a population bulk grown in farmers' fields, especially if simple methods for pollination control can be implemented.

It is well established that farmers can evaluate a small number of experimental varieties in on-farm trials under their own management (Farrington and Martin 1988). If farmers' active involvement in the evaluation and ranking of these varieties is sought, the most acceptable varieties can be rapidly identified, and the time span between variety testing, release and seed dissemination shortened dramatically, particularly if farmers have the option to multiply their own seed.

The analyses presented here are based on the assumption that a full fledged formal breeding program is desirable and its effectiveness could be supported by input and involvement from farmers in and from the target region. The different options for farmer participation described here could be combined in a breeding program in many ways, depending on needs and opportunities.

In contrast to the scenario described, there may also be situations in which it is not economical to operate full scale formal breeding programs. A thorough understanding of the traditional system of seed selection, production and storage may open avenues for specifically targeted support by breeding research of such a traditional, indigenous seed system (Hardon 1995; Lenn et al. 1995).

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Farmer-Based Variety Development, Maintenance and Multiplication in the Philippines

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Introduction

In most developing countries, variety development up to seed production and multiplication is in the hands of the government and research institutions. For high-value crops, the seed is often in the hands of private companies or corporations. These entities may be regarded as the formal seed sector. An increasing realization of the problems generated and the inefficiency inherent in the prevailing seed system has prompted non-government organizations (NGOs) and recently, also government organizations (GOs), to give a fresher look at the informal seed system. Many reviews have already been made on the potential of the informal sector, which comprises farmers, farmer organizations (FOs) or people's organizations (POs) and NGOs, to accomplish the task traditionally delegated to the formal sector (Bal and Douglas 1992; CIAT 1982; Cooper 1993; Cooper et al. 1992; Cromwell 1990; Cromwell et al. 1993; Fernandez 1992; Fernandez 1993; Friis-Hansen 1989; Henderson and Singh 1990; Hobbelink 1991; Linnemann and de Bruyn 1987; Linnemann and Siemonsma 1989; Louwaars 1994; Pimbert 1991; Seeddling 1994; Tripp 1995; Zamora 1993).

This paper is a further contribution to the discussion. It focuses mostly on the Philippine situation, although in many respects the realities are also shared by those of other developing countries. The profile of Philippine NGOs, however, is quite unique and, as such, integration with the formal system in the area of seed may pose a great challenge.

Formal seed sector profile and perspective

The formal seed system in the Philippines is not much different from those of other developing countries. Its primary objective is to make improved seed available to a majority of farmers. Despite all efforts and fund allocations to the various aspects of the seed program, usage of certified seed has remained low. In general, only approximately 10-15% (commonly less) of the national seed requirement has been provided by the formal system (Bureau of Plant Industry 1990; CIAT 1982; Cromwell et al. 1993; Fernandez et al. 1988; Linnemann and de Bruyn 1987; NSIC 1995; Turner 1991). The rest is provided by the informal seed system through fanner seed-saving and farmer-to-farmer seed exchange.

- Efforts by the formal system to improve the seed situation are often guided by the following perceived constraints:
- low usage (demand) of certified seed,
- inefficient extension,
- low level of education of farmers leading to lack of appreciation of certified seed,

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- resistance of farmers to use new varieties for various reasons,
- low quality seed produced by farmers (low genetic purity, highly heterogeneous, highly contaminated, poor seed health),
- limited coverage (in terms of varieties, crops, technology applied) of formal certification system,
- lack of storage facilities,
- high incidence of pests and diseases of crops for seed production.

In most instances, the formal system's attempt to fulfill the seed and technology needs of the farmer is through the top-down and centralized approach. It has taken up the role of "solution provider" and has advocated the use of external solutions to farmer's internal problems. This attitude is demonstrated by the formal sector's efforts to increase the availability and usage of improved varieties and certified seed through various strategies, such as:

- training of extension workers and certification personnel to improve their efficiency in the exercise of their function;
- training of farmers to make them aware of the advantages in the use of quality (certified) seed of improved varieties and to make them adopt such varieties;
- supporting the initiatives of contract seed producers and seed growers;
- subsidizing seed prices;
- providing credit linked to the use of improved seed and associated technologies;
- assisting directly or indirectly the private sector which is believed to be more efficient than the government in managing seed systems;
- advocating plant breeder's rights, which is regarded as an effective strategy to encourage plant breeders to produce more improved varieties;
- supporting the promulgation of a seed law which aims to develop the seed industry of the country.

The technology and cropping system associated with seed production have been closely linked to the Green Revolution strategy promoted in the early 1960s (Feder 1983; Fernandez 1992). It is basically a package that includes mono-cropping and high usage of chemical inputs, especially inorganic fertilizers and pesticides. Undoubtedly, the Green Revolution has realized some short-term productivity gains. However, it has already been criticized for negative long-term environmental, economic and socio-cultural impacts. These formal approaches and strategies have undermined the farmers' capability to be self-reliant and innovative. Farmers have been made dependent on institutions for the solution to their own problems.

The solutions being advocated by the formal sector are a mixture of approaches that address both legitimate problems and symptoms. The general impression has been that farmers are incapable of producing quality seed. On a macro level, farmers are made to be seed consumers rather than being allowed or encouraged to participate in the whole spectrum of activities starting from germplasm conservation up to seed distribution.

Informal seed sector: profile and perspective

Fanners and the informal sector in general vary greatly. Some express the same seed-related problems as the formal sector (Paterno 1991; Silva 1991). Others, however, have

- spelled out realities that are quite unique and sometimes unknown to, or disregarded by, the formal sector. Some of these problems include:
- seed sourcing: unavailable, insufficient or irregular seed supply;
- lack of market for farmer-produced seed;
- control of market by a few seed producers;
- inappropriateness of seed from the formal sector because i) it requires high chemical inputs, ii) is susceptible to pests and diseases, iii) is not adapted to farmer's system, iv) is "non-recyclable" or needs frequent replacement, and v) is expensive.
- inferiority of varieties in terms of germination, storability, trueness-to-type, eating quality;
- displacement of old/traditional varieties by modern (formal) varieties;
- absence of institution where farmers can get traditional varieties;
- lack of know-how/technology for seed handling/storage and production;
- linking the seed to credit, input and insurance, thus imposing further restriction on the choice of seed/variety and associated technology;
- lack of mechanism to recognize farmers' varieties in the Seed Board (now the National Seed Industry Council);
- unrealistic standard of variety registration and seed certification.
- crediting of farmers' varieties to formal plant breeders who have simply discovered or purified them;
- absence of government support for farmer initiatives in variety development, maintenance, multiplication and distribution;
- cooperation of extension workers with chemical companies;
- lack of farmer control on the means of production, especially land;
- dependency of farmers on the formal sector for their seed and solutions to other farm problems.

The organized farmers involved in seed-related activities, therefore, want to have truly improved varieties which are appropriate to their needs and farming systems. They also want to have greater control of their seed. They are quite open to new seed or varieties but do easily abandon it after a number of seasons of trials where the varieties do not prove better or are not adapted to the farmer's realities. It is a paradox that while only less than 15% of the seed used nationally is certified, approximately 87% of the rice land in the country is planted to only 5-6 modern varieties (IRRI Rice Facts 1990). Such is the result of a systematized system of seed production and promotion through various programs.

Profile of farmers, their varieties and seed

More than 50% of the population which is now estimated to be 70 million are engaged in some form of farming activity. Approximately 70% of these farmers are poor, i.e., below the poverty line of 3000 pesos (approximately 115 US$) income per month. The proportion of tribal farmers, or those who still follow traditional practices, is very small (less than 10%), while the majority of farmers are already influenced, in one way or the other, by the formal sector. However, farmers still retain or combine their indigenous practices with conventional or so-called modern techniques.

Seed saving and farmer-to-farmer seed exchange are still the predominant ways of generating or acquiring seed. It is not uncommon for farmers to select plants judged superior to the existing crop, a system that may be a demonstration of farmers' ability and interest to innovate and do some form of crop improvement. Such potential, however, remains highly unrecognized by the formal sector. To some, it is regarded too complex to merit attention and support.

The contribution of farmers in variety development has been largely unrecognized. Varieties are regarded as products of formal plant breeders while materials coming from farmers are labeled only as folk seed, landraces, or, at best, as traditional cultivars. A variety, by formal definition, would be one that is highly uniform or homogeneous, very distinct from other populations and highly stable, except for hybrids (which segregate after the first generation).

A farmer's variety, on the other hand, is a product of the interaction of the crop with the environment and farmer's cultural management practice. As such, his seed may be heterogeneous, judged impure by a formal seed analyst (Gabriel 1994). Such heterogeneity can be considered as a result of his diverse cropping strategy and of the often marginal and highly variable environments. Almost always, the farmer's priority is yield stability under suboptimal, adverse and unpredictable environments. The situation is in great contrast to that of the formal system where a variety is bred more for uniform and optimum field conditions.

Yield is an important agenda among farmers but it is not as important as stability and other traits such as maturity, aroma and taste, as in the case of food crops. On the other hand, formal plant breeding concentrates more on yield under uniform high input conditions (Linnemann and Siemonsma 1989; Pimbert 1991). It also places high priority on specific pest resistance under a mono-cropping system of production.

Several studies have shown, however, that farmers' seed is not necessarily inferior to formal or certified seed (e.g., Bale 1993; Gabriel 1994; Lanosia 1990; Malabanan 1993). Yields of modern open-pollinated varieties (OPVs) grown by farmers do not necessarily differ from those by institutions. Hybrids do not necessarily perform better than modern OPVs or traditional varieties under farmers' conditions. When grown side by side in a farmer's field, a modern variety may, in fact, perform poorer than the local farmer's variety. Under high input conditions some farmers' varieties can out-perform modern varieties. Certified seeds also do not necessarily give better performance than uncertified seeds. This has also been variously expressed by other researchers and by farmers themselves.

Recognizing that a farmer's seed is a variety, it can be said that farmers have come up with thousands of varieties long before formal plant breeding came about. These varieties have served formal plant breeders who use some so-called traditional materials in their crossbreeding work. Yet many varieties in the formal registry, especially for fruits, are farmers' varieties virtually unaltered (Fernandez 1992). Unfortunately, only very few farmers, and mostly these are the more educated and resource-rich farmers, have been recognized for their breeding efforts.

Farmers' seed systems are systematic and dynamic. Systematic selection and variety maintenance is constantly being done. Various systems of variety, maintenance, multiplication, flower induction, crop protection, seed handling, crop improvement and even seed distribution have been developed by farmers (Fernandez 1994).

Maintenance of a variety by farmers can be illustrated by looking at the staple crops, rice and maize. Most challenging is that for maize which is cross or open-pollinated (OP). A variety of maize called tiniguib, named after the kernel's chisel-like shape, has been with farmers since time immemorial. Although there are many variants of this variety, which can easily happen to an OP, they still possess characteristics that make them distinct from other varieties of maize

The farmer discourages off-types, but he is also aware of the value of such off-type. Thus, he is always on the look-out for possible new types.

Variety development strategies by farmers are often very interesting. Aside from selection based on field performance, morphological or other characteristics of the plant, fruit or seed, some farmer's practices, wittingly or unwittingly, also lead to new plant types through enhancement of cross pollination or hybridization. Some of these practices are:

- deliberate pollination of a female flower with a male flower, often rationalized to get good fruit development.
- passing a string/rope across the crop canopy (as in rice) during the flowering stage, rationalized as a means to drive away pests. It would be useful to note that there are still a number of farmers who plant different varieties in separate rows but close together in the same field. Others deliberately blend different varieties together before planting.
- planting wild relatives along with the main crop (as in maize) hoping to get new and much better crop types (Soleri and Cleveland 1993).
- allowing some sweet potato plants in the field after harvesting the roots to flower leading to cross-pollination of a crop that is self-incompatible and produced more often for the asexual parts.

After a new type is found and tested by a farmer, it is commonly shared freely with other farmers. Spread of a variety is known to be enhanced through this mechanism. Farmer to farmer seed exchange is often found to be even more effective than the formal extension system (Cromwell 1990).

Other issues: formal system

The prevailing development paradigm and the seed industry set-up

The top-down approach can conveniently systematize the implementation of a program based on a faulty framework. For many developing countries, development means high GNP (Gross National Product), being a NIC (Newly Industrialized Country), and having a lifestyle and possessions similar to those of the Western culture. While such indicators may be appropriate for some societies, food security and national welfare of a developing country like the Philippines can be easily undermined. Development from "without" as opposed to from "within" means relying on external solutions to internal problems. It also means no real positive economic growth of the local constituents.

Because of this framework, there has really been no concrete strategy that aims to make farmers self-reliant in their farm inputs including the seed (NSIC 1995). Farmers are relegated to the end of the seed chain as consumer of the output, the improved seed. In practice, farmers are seldom consulted or made to participate in the other aspects of the seed chain.

Conflicting laws, policies and programs

Using the same framework, legislation and programs have been formulated. While some government programs aim to alleviate farmers' problems and improve their well-being, they could actually run counter to farmers' interests. Such is the case of the Medium Term Agricultural Development Plan (MTADP) of the Department of Agriculture. A component of the plan is the Grains Productivity Enhancement Program (GPEP) which aims to reduce the area of production of staple crops such as rice and maize, while intensifying production in areas where these crops are decided to be grown. Aside from the fact that the program is still patterned after the Green Revolution, it has actually given away the seed control to multinational companies and to only one or two seed suppliers, one of which is a government entity itself (Vellema 1994).

The Philippine Seed Law (Seed Industry Development Act), approved only in 1992, created the National Seed Industry Council (NSIC 1994). The general aim is to enhance the development of the Philippine seed industry. However, the provisions of the Law seem to favor mostly the resource-rich farmers and the private companies. It aims to support plant breeding activities but does not recognize explicitly farmers as breeders or as researchers themselves. Protection of formal plant breeders is advocated. It recognizes the value of plant genetic resources but more for biotechnology than for other more practical uses. The existing legislation to protect the local seed industry from unfair competition, being incompatible with WTO (World Trade Organization, formerly GATT or the General Agreement on Tariffs and Trade), may soon be repealed.

Reductionism

Some of the conflicting programs and policies can be attributed to the reductionist approach also inherent in the Green Revolution (Feder 1983; McRae et al. 1989). Problems are looked at in isolation and seldom put together to get the more holistic picture. Farmers are often not represented in various fora or programs, or if at all, they are the resource-rich farmers. The result is a technology package that prescribes a uniform (optimum) technology, requiring high external inputs and applied over a highly diverse socio-cultural and ecological setting.

Reductionism is also demonstrated by the way the seed chain is commonly structured (Douglas 1981; Fernandez et al. 1988; Mabesa and Sevilla 1982; NSIC 1995; Turner 1991). The farmer's system demonstrates a more holistic approach where everything is considered from the point of crop improvement up to consumption level. Most seed programs do not at all include germplasm conservation as a major component but rather subsume it under plant breeding. This again highlights the fact that most formal genetic conservation programs are developed to serve plant breeders more than farmers who are themselves plant breeders.

Funding

With limited funds for public institution research (e.g., UPLB-Institute of Plant Breeding, IPB, receives only 50,000 pesos or US$ 2,000 annually for research on plant breeding of cereals), the government almost always predictably grabs any opportunity to increase its financial resources. This could again undermine the interest of resource-poor farmers by steering the focus on research, extension and development programs away from them in favor of the easier to access resource-rich farmers. A case in point is the recently concluded deal between UPLB and the Filipino-owned Ayala Agricultural Development Corporation where UPLB-IPB is to produce inbreeds for the hybrid seed production of the company. As expected, information on the identity of inbred lines is to be kept secret. This can be considered as a cheap deal for a private seed company wanting to develop hybrids and could greatly undermine efforts to support variety development for non-hybrids and by farmers themselves. It can be assumed that the program hopes to help farmers still, but through the trickle-down effect which has yet to be demonstrated to work in most development programs of the same nature.

Lack of confidence of the formal sector on alternative systems

The alternative systems have been downplayed systematically, partly as a result of miseducation, and perhaps partly deliberately on the part of those who wish to promote only technology packages which, in most cases, are western-based. It is only recently that alternative systems are starting to be recognized. For the formal sector to gain confidence on the merits of the informal or alternative system, initiatives from other countries need to be presented. The common misconception about farmers' abilities and attitudes may be dispelled by having more progressive well-known scientists talk about their favorable impressions and experiences with participatory research. The value of indigenous knowledge needs to be inculcated deeply into the minds of those who are generally skeptical about any farmer-developed products and practices.

Part of the mistrust of the formal sector on alternative systems is based on the reputation of some groups (NGOs). They are often labeled radical or leftist, enough to make the formal sector ignore the voice of the informal sector.

GATT/WTO, IPR and TNCs

International developments should be considered if sustainability of local programs are to be assured. The establishment of the WTO has created considerable debate in local fora, especially with the inclusion of agriculture and intellectual property rights (IPR) Article 27.3b of the TRIPs agreement under GATT mandates member states to provide for a "...patent or effective sui generis system" for protecting plant varieties. This agreement is viewed to further undermine farmers' interests. A discussion on other potential negative impacts of GATT can be found elsewhere (Moran 1994). On the other hand, advocates of GATT claim prosperity that hinges mostly on the same development paradigm mentioned earlier.

The influence that the TNCs (transnational corporations) have on GATT is quite clear. With the increasing control of the TNCs of the so-called life industry (seed, food, agrochemical, pharmaceutical and biotechnology industries), the potential control by TNCs of national economy and food security is obvious (Hobbelink 1991; Mooney 1988; Mooney 1993). The great amount of interest and investment that these TNCs are now paying to biotechnology is another area of concern. The potential negative impacts of biotechnology on health, the environment and agriculture are found in many discourses (Berg et al. 1991; Biotechnology and Development Monitor; Bosch et al. 1991; Hobbelink 1991; Moran 1994; PEER White Paper 1995; Witt 1985).

Issues: informal system

The realities of the informal system are far less than ideal. Some of the attitudes and impressions of the formal sector toward the informal sector have some basis. Some constraints faced by the informal sector are discussed below.

Funding

Most if not all NGOs are externally funded. Their agenda can be highly influenced by the framework of the funder such that compliance may require pursuit of strategies that may not necessarily be appropriate.

Funding is also an issue when it comes to supporting members who work full time in the organization. Farmers who get highly involved in training and advocacy may no longer find time to farm. This would then require some form of compensation for the opportunity cost that the fanner was willing to be subjected to.

Other concerns/agenda

Many NGOs have other agenda that may or may not be directly concerned with seed. The seed, being a basic input in production, however, has been proven to be an effective entry point for organizational building and consolidation. A major agenda among development NGOs is farmer empowerment. Sometimes, however, their seed programs failed because of lack of focus and greater commitment to other agenda. A number of well-trained farmers who would have been effective practitioners have eventually stopped farming because of heavy involvement in non-fanning activities.

Technical knowledge/expertise

NGOs in general are quite strong in socio-political and organizational matters but are admittedly short in technical training or background. This concern is particularly important because the appropriateness of information in mainstream scientific publications still needs to be validated and adopted to local conditions. Many NGOs pursue improvement in their approaches but use the formal system as the model (Zamora 1993). This is seen in the technologies used in seed multiplication, crop maintenance, seed storage, in use of descriptors and in the evaluation of genetic materials. It is also apparent that many of their efforts are geared toward making their seed and seed program conform to the formal and highly standardized system of certification.

Misuse and misinformation

Some informal initiatives are highly controlled or driven by the wishes of the formal sector, the fonder or even by a private corporation. They can be used to promote the interest of these groups to the detriment of the PO or NGO. The varieties developed by the informal sector may be adopted by the formal sector and applied with formal cultural management, in which case the varieties may not perform well. Varieties may then be judged to be poor or of substandard quality, thus validating formal sector impressions. The experience of an NGO-P0 partner organization may be cited. This group has developed and selected rice varieties without external input. The provincial governor saw that there was less damage to the variety after a typhoon. Seeds were then purchased from this group and were planted in large-scale with some agrochemicals. The crop succumbed to diseases. The conclusion then given was that the informal sector program was sabotaging the food production program of the government.

Informal initiatives in various seed endeavors

There exist various international and local examples of farmers or informal organizations who are actively engaged in variety development up to seed multiplication (Mooney 1988; Seedling 1994; Soleri and Cleveland 1993; Zamora 1993). They may be engaged in one or more components or activities of the seed industry. Their agenda can be just as diverse, ranging from simply supplying the seed demand for socio-cultural and political awareness-raising and farmer empowerment through organizational building and consolidation of institutions. In developed countries informal initiatives dwell heavily on ecological issues while in developing countries, the socio-political and economic realities may be the main concern.

The NGOs and POs involved are operating either independently or as members of network organizations. A number are now engaged in some form of seed exchange or marketing as part of their effort to generate funds for the sustainability of the programs, if and when external funding is no longer available.

Despite the number of NGOs and POs involved in the seed endeavor in the Philippines, the authors are only aware of one that has integrated all the seed activities from conservation and variety development up to distribution and marketing, the MASIPAG project (Vicente 1993; Zamora 1993). This project is a farmer-NGO-researcher partnership that aims to address farmers' problems through appropriate agriculture and empowerment. Membership is open only to organized groups and members engaged in all activities from genetic conservation to breeding, variety maintenance and seed exchange. Research on appropriate cultural management practices for selected varieties is also undertaken, while non-chemical approaches to farming are sought. As of 1993, there were 21 PO and 10 NGO members, 22 trial farms in 13 provinces, and more than 55 promising lines (from 121 crosses and 37 parent materials) have been produced. There are now more than 10,000 farmer members scattered all over the Philippines. While the initial work is on rice, other crops such as maize will be worked on in the next phase of the project.

There are also four known national seed programs in the Philippines. One of the groups is engaged in large-scale multiplication of some traditional varieties and lines tested by other programs. They make the seeds available to their farmers. Another organization is involved in active collection and establishment of community seedbanks. It has also utilized the medium-term storage facilities of the National Plant Genetic Resources Laboratory stationed at UPLB. Another group, aside from collection of traditional varieties, also conducts training of farmer curators for seed conservation. A fourth organization is involved in the collection of traditional varieties, as well as in testing them under the farmer's system of production.

Many organizations dealing with genetic conservation are still tied up with the concept that a seedbank consists of seeds kept in bottles displayed on shelves (Zamora 1993). Those that have gone past this realization may be engaged in a system that is highly akin to the formal system (e.g., in use of formal descriptors, aiming to establish genebanks or cold storage facilities, applying the same concept of seed quality and good variety as defined by the formal sector, as well as promoting the use of chemicals and monocropping production system).
Some informal initiatives in seed production even operate very much like the formal seed production system. They also concentrate on large-scale seed multiplication and marketing, only they use varieties from informal organizations doing alternative approaches in seed. On the other extreme is the case where the formal sector approached an NGO to supply them the seed since the formal varieties did not survive the drought, unlike the NGOs' seed. Unfortunately, the varieties did not fare well given the modern or conventional management system being used by the formal sector. This is expected since these varieties are mostly adapted to conditions quite different from those of the formal sector. This experience explains why some NGOs are not open to the formal sector in disseminating their seeds.

On the other hand, the informal initiatives have strengths that the formal system can learn from. These characteristics are true not only for those engaged in seed endeavors but also in other interests. They are quite strong in community organizing and awareness-raising. They are also generally highly motivated and cause-oriented. They generally are strong on grassroots work.

Considerations to enhance the informal seed system

Appropriate approaches to develop an informal seed system can be location-specific, dependent on realities of different organizations and communities involved. Some common elements, however, must be present if the system is to be effective. It must be truly pro-people and serve the majority of farmers. It must promote development, based on "growth from within", emphasizing self-reliance and food security. A new perspective is required of the formal system, one that translates its efforts into empowering the informal system. For these to be achieved, the following elements should be present:

- Revised standards: adapted criteria for a good variety and a high quality seed; varieties which are location-specific, requiring low external input, with wide genetic base, and well-liked by farmers.
- Appropriate technology and cropping system: farmer-adapted systems of germplasm or variety characterization, maintenance, storage, seed quality testing and multiplication and production; strong emphasis on building-up on indigenous or local practices, diversified and integrated cropping system; avoids use of chemical inputs.
- Seed program structure, organizational and operational changes: holistic or nonreductionist approach in a seed endeavor; activities to include genetic conservation, crop improvement up to seed multiplication, distribution and utilization; better integration of various activities; decentralization.
- Formal strategy changes: active farmer involvement in all aspects of the formal seed system; participatory seed industry; farmer-led seed programs.
- Informal sector reforms: raised level of farmer awareness to socio-political, economic and environmental issues (part of empowerment); organized and sensitized communities; developed farmer skills not only on the technical aspects but also in verbalizing other concerns and in community organizing.
- Recognition of indigenous systems: a mechanism that recognizes the validity of farmer practices and the intellectual rights of indigenous communities especially in various aspects of seed.
- Policy support to the informal sector: raised consciousness among policy makers and the more dominant actors of the seed industry of the capability and strength of the informal sector; policies and measures that counter the effect of WTO and other forces that undermine informal initiatives in genetic conservation, germplasm improvement, seed production, and distribution.
- Policy review: review of development agenda; shift in development paradigm; review of various international agreements that affect policies related to seed endeavors and the alternative seed system (e.g., WTO/TRIPs, Convention on Biological Diversity, Farmers' Rights, International Model Law on Folklore, UN-FAO International Undertaking on Plant Genetic Resources, etc.).
- Reward and accountability: appropriate award for activities or programs supporting the alternative system; a system of accountability must also be present as check mechanism.
- Change of attitude, internalization: individual transformation necessary to actualize activities or program, such as training, exposures, meetings and publications, are highly needed.

Initiatives in formal-informal collaboration

Other than the MASIPAG which exemplifies a farmer-NGO-researcher collaboration (Vicente 1993; Zamora 1993), there are other forms of collaboration that can be cited. In UPLB some training programs are offered specifically for the partners in the informal sector (Fernandez 1992). There a minimum curriculum would include not only technical topics and development issues but also human resource development and value analysis aspects to hopefully effect some degree of perspective shift.

The facilities of the formal sector, such as the genebank, may be opened to the informal sector. On the other hand, the informal sector may help increase the collection of the genebank or get involved in the characterization, maintenance, multiplication, evaluation or testing of the collection. The formal initiatives that may be cited along this line are the national genebank of Ethiopia and a plant breeding program at ICRISAT, India. Some sensitivities as to management, access and proprietary rights of collection and research output, however, need to be clearly defined when engaging in such collaboration.

At the regional level some dialogues have already been initiated in an effort to understand the realities of the formal and informal sector dealing with seed and genetic conservation. An example is the regional meeting held in Chiang Mai, Thailand in 1992, attended by IARCs (International Agricultural Research Centers), NARs (National Agriculture Research Systems), NGOs and POs (SEARICE 1992; Turner 1991).

The meeting held in Malang, Indonesia in 1987 convened both the formal and informal sectors to discuss issues related to germplasm and seed (SEARICE 1987).

The International Undertaking on Plant Genetic Resources, a voluntary agreement on the conservation and use of crop germplasm signed by most FAO member states approximately ten years ago, will convene a Fourth International Technical Conference in June 1996 in Leipzig, Germany. It will tackle policies on genetic conservation to make it more coherent with the Biodiversity Convention. It will also include a negotiation on the terms of access to agricultural genetic resources and on the concept and implementation of farmers' rights and determine guidelines to ensure that genetic diversity and germplasm conservation become important agenda of national agricultural programs.

Still other forms of collaboration between the formal and informal systems include serving on the board of these organizations or simply attending some activities that require the input from both the formal and informal sector. An NGO desk within the formal sector organization could serve for feedbacking and networking and provide the informal sector better access to the facilities and services to the formal sector. Staff exchange may also be a mechanism of collaboration. This has been demonstrated by inviting speakers in seminars or training programs.

Conclusion

Greater involvement of farmers in any seed-related activity requires major changes in policies, organizational structure and mind set of all actors of the seed industry. A shift in allocation of resources and programs in favor of resource-poor farmers, as well as decentralization of the planning and implementation of formal sector programs to involve local initiatives more, are necessary if farmer initiatives are to be supported. Appropriate laws and policies may be in place but farmer empowerment and support goes beyond such interventions. Trust in their capacity and contribution as genetic conservers, variety developers, maintainers and seed multipliers is fundamental in a country's effort toward self-reliance in its seed needs without sacrificing the environment and equity. This is a gigantic task and a challenge that can be achieved only through political will, massive reeducation and value transformation.

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Appendix 1: Recommendations of the Working Groups

Recommendations of Group I

Seed policy and seed legislation

- Existing seed legislation should be studied carefully as to its effect on satisfying local seed demand, and to clarify that it supports the government's seed policy.
- Seed legislation should allow and support the development of both formal and informal seed systems, and their adaptation to the requirements of different crops.
- Changes in regulations concerning seed supply should be introduced gradually.
- The seed trade should be allowed its own labeling system.

Formal and local seed systems

- Contract/tender to private seed enterprises the seed multiplication, from foundation seed onwards, to cut out less efficient state/parastatal entities.
- Support local breeding and genetic conservation activities; emphasize use of locally developed varieties; and address the problem of seed sourcing by ensuring greater availability of source material.
- Make an inventory and study of emerging local seed enterprises in respect of existing activities and potential to develop.
- The government should take responsibility for the seed supply not covered by the private sector.

Recommendations of Group II

Seed production

- Wherever possible, seed production should be transferred to the private sector.
- Hidden subsidies in seed production should be avoided as far as possible; if not, these should be provided to both public and private sectors. If still not possible, subsidies should be provided to the end user.
- Quality control services should be made available to all who want to make use of them.
- Seed certification as a quality control measure should be voluntary. Seed quality control should be exercised in the market through enforcements of quality standards. These standards should however be realistic.
- Seed marketing/distribution should be conducted through a dealer network system whenever possible.
- Farmer seed producers should be encouraged, eg. by making available seed quality control services and/or lease/sale of simple processing machines.
- Imbalance between investments in breeding and seed production is to be avoided.

Public plant breeding

- Consultation/participation of farmers during the process of goal setting for breeding programmes is recommended.
- Active participation of farmers in all on-farm testing and demonstration to select promising varieties is recommended.
- Whenever the situation demands, farmers should also be consulted in making crosses and in defining selection criteria.
- Germ plasm and information thereof should be made freely available at reasonable cost to any interest group that wishes to start R & D programmes.
- Governments should recognize the importance of breeding institutes and consequently should ensure that these are funded adequately.

Seed policy

- Government should formulate a seed policy clearly defining the objectives regarding seed sector development.
- Seed policy objectives should be defined such that planting material of the best quality available anywhere can be made available to farmers.
- It should be further ensured that both public and private enterprises can develop on fair and competitive terms.

Local seed systems

- Local seed systems in whatever form they exist should be supported. This requires thorough study of these systems.
- Support can then take the form of injecting improved varieties into the system and possibly also introducing simple machinery and equipment.

Recommendations of Group III

Local seed systems

- Strengthen the information flow on farmer's seed demand, availability, and utilization to improve support for local seed systems.
- Use diagnostic information to improve technology developments and other support measures to strengthen local seed systems.
- Regularly introduce new source seed into local seed systems through key farmers, extension service, grain/seed traders and on-farm researchers.
- A flexible interpretation and implementation of the seed law is required to allow functioning of local seed systems.

Variety development

- When planning variety improvement programmes, their human and financial resource requirements should be assessed carefully.
- Variety release decisions should not be based on overall national performance only: varieties can be released for specific areas and environments.

- Farmer participation in variety improvement and in decision making in variety release should be encouraged.
- Breeders should be encouraged to assist farmers in selecting within their own crops.
- There is a need for a more interdisciplinary approach in plant breeding, in particular including input from social scientists.
- Priority setting for variety development should reflect user's needs.

Seed production

- In the process of privatization of government and parastatal seed industries, the possibility of developing small scale seed industries should also be investigated.
- In order to allow private industry to enter the seed business, subsidies to parastatals should be decreased in well defined phases for particular crops, and access to early generation seed should be secured.

Recommendations of Group IV

Formal and local seed systems

- Where local seed systems function, foundation seed should be introduced into them through selected farmers and traders at a cost covering price.
- Such selected farmers could also participate in developing locally adapted varieties and act to supply feedback to the breeders on farmer response to them.
- Seed certification of the FS generation is still required to ensure high genetic purity of the seed released to the local seed system.
- Some quality control of breeder seed is necessary.
- If lacking the necessary resources to produce BS of adequate quality, breeders should be encouraged to devolve responsibility for producing this seed to others.
    - The local systems should be studied in detail to provide information on:
    - the seed flow;
    - best entry points for source seed to achieve maximum impact;
    - deterioration of genetic purity of source seed after its introduction into the local seed system, so as to determine frequency and quantity of introduction needed to maintain a predetermined average purity of seed produced in this system.

Seed legislation

- Seed legislation should not hamper the functioning of the formal and informal private seed sector. Seed trade regulation should be seen as an aid to seed sector development and not as a requirement per se.

Seed policy

- The national seed policy should aim at creating an environment favourable for the functioning of local seed systems.

Appendix 2: Workshop Programme

Sunday, 22 October 1995

Monday, 23 October 1995

- Arrival of participants from abroad
- Arrival of participants from Indonesia
- Registration of participants 17.00 - 18.00

Tuesday, 24 October 1995

08.00 - 09.00 **Registration**

09.00 - 10.00 **Opening Ceremony**

- Venue: Auditorium RILET
- Welcome by Chairman of the Organizing Committee
  Remarks by:
  Governor of East Java
  Secretary General of PERAGI
  The Representative of the Ambassador
  of the European Union, Jakarta
- **Opening Address**
  The Representative of the Minister of Agriculture, Indonesia

10.00 - 10.30
- Coffee break

10.30 - 12.00
- **Farmers' Forum**

12.00 - 13.00
- Lunch

13.00 - 13.15
- Workshop Guidelines
……….T. Bottema

13.15 - 13.45
- Policies and Strategies for Seed System Development N.
……….. P. Louwaars

13.45 - 14.15
- Problems of Privatizing the Seed Supply System in Self-Pollinating Grain Crops
…………M. Turner

14.15 - 14.45
- Secondary Crops in Indonesian Farming Systems
…………Yustika Baharsyah/Syarifuddin Karama

14.45 - 15.15	• Coffee break
15.15 - 15.45	• Economics of Secondary Crops in Indonesia T. Bottema
15.45 - 16.15	• Structure and Policy of the Formal Seed Sector in Indonesia M. Sidik
16.15 - 16.45	• The Source of Farmer's Soybean Seed in Indonesia: Systems: Findings from a Survey C. E. van Santen/Heriyanto
16.45 - 17.15	• Marketing for Palawija Seed in Indonesia P. Schroeder/Eko Legowo
19.00 - 21.00	• Reception hosted by the Directorate General of Food Crops and Horticulture

Wednesday, 25 October 1995

08.00 - 08.30	• Assessment of the Costs of Soybean Seed Production in Indonesia A. …………. Lillie/Bambang Budhiyono
08.30 - 09.00	• Seed Quality of Secondary Food Crops in Indonesia ……………Udin S. Nugraha, H. Smolders, Nasir Saleh
09.00 - 09.30	• Seed Supply of Palawija Crops: the Experience of the National Seed Corporation …………………M. Sujud
09.30 - 10.00	• Development of Variety Testing and Breeders' Rights in the Netherlands ………………….H. Ghijsen
09.30 - 10.00	• Coffee break
10.00 -10.30	• Privatization of the Seed Sector in India K. R. Chopra
10.30 - 11.00	• Seed Sector Development in Bangladesh with focus on the Secondary Food Crops …………………..D. Vervoorn
11.00 - 11.30	• Building a Foundation for a Private Seed Enterprise S. ……………………G. Chakraborty and R. Schroeder

12.00 - 13.00	Lunch
13.00 - 13.30	• Experiences with Small-Scale Local Seed Schemes, in Particular in Africa: Strength and Weaknesses ………………….. 0. Neuendorf
13.30 - 14.00	• Farmer Participation in Pearl Millet Breeding for Marginal Environments …………………….E. Weltzien
14.00 - 14.30	• Soybean Variety Development in Indonesia ……………………. Soemarno
14.30 - 15.00	Coffee break
15.00 - 15.30	• Experiences with Small Farmers Seed Business Development in India ……………………V. Hoon
15.30 - 16.00	• Small Seed Grower Schemes and Fanner-Assisted Variety Development in the Philippines …………………… P. G. Fernandez
16.30 - 17.00	• Supporting Integrated Sseed Systems: Institutions, Organizations and Regulations …………………… R. Tripp

Thursday, 26 October 1995

08.00 - 09.00	• Visit to demonstration plots of farmers' palawija seed-plots at RILET, Kendalpayak
	• Group Discussions
09.00 - 12.30	• Discussion with coffee break
12.30 - 13.30	• Lunch
13.30 - 17.00	• Discussion with coffee break

Friday, 27 October 1995

08.00 - 10.00	• Finalization of conclusion and recommendations
10.00 - 10.30	• Coffee break
10.30 - 12.30	• Opportunity for personal meetings

12.30 - 13.30	• Lunch
13.30 - 15.30	• Plenary meeting: Presentation of conclusions and recommendations by each group
15.30 - 16.00	• Coffee break
16.00 - 17.00	• Closing remarks by Director of Seed Development
19.00 - 21.00	• Cultural evening hosted by RILET

Saturday, 28 October 1995

07.00-16.00	• Excursion to the Bromo Massive
	• Observation of various cropping systems with secondary food crops.

Appendix 3: List of Participants

Name	Organization
Abad Zapatero, Ms. M.	Attache, Representation of the EC, Wisma Dharmala Sakti 16th floor, J1. Soedirman 32, Jakarta Selatan, Indonesia
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