Seed System Innovations in the Semi-Arid Tropics of Andhra Pradesh

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Abstract

An effective seed supply system is necessary to make good quality seed available to farmers at the right time and at low cost. Given the critical role played by improved varieties in increasing production of grain and quantity and quality of stover for livestock fodder in conventional cropping systems, agriculture decision-makers have the challenge of developing an integrated and cost-effective seed system that is capable of generating and delivering improved seed varieties to farmers. Such a system would be an important step toward ensuring seed security and enhancing livelihoods, particularly of dryland farmers.

Issues related to seed multiplication and delivery systems in India are discussed in this publication. The book outlines the development of the seed industry in India and highlights the changes made to seed policies over the years. It records the experience from an attempt to improve the local seed systems in four dryland agricultural districts that are typically representative of the semi-arid areas of Andhra Pradesh state. Using specific seed delivery models, it presents ways of strengthening seed systems to address the needs and vulnerabilities of smallholder farmers including those associated with livestock and fodder security in these areas.

This book is not an all-encompassing summary of the seed systems in Andhra Pradesh, nor does it try to provide magical solutions to constraints encountered by poor farmers. It does, however, attempt to illustrate alternative approaches to strengthen the seed systems by employing new approaches aswell as implementing tested approaches in new ways constituting innovation. Given the ever rapid changes taking place in the technological, socioeconomic and policy environments, understanding some of the processes and mechanisms involved in these changes as has been presented in this document will help in continuous development of an appropriate seed system and contribute to enhancing the livelihoods of poor farmers in the semi-arid areas of India.

Acknowledgment

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Seed System Innovations in the Semi-Arid Tropics of Andhra Pradesh

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Foreword

The power of a seed is unlimited. As a powerful agent of change, seeds can be a means of overcoming production constraints, thereby making a difference in the lives of the poor and hungry. This requires seed demand and supply to be balanced by way of a secure seed supply system. This would give farmers access to adequate quantities of good quality seed of the desired type at the required time and at affordable cost.

Seeds are key components in the conservation and ownership of biodiversity. Accordingly, sustainable seed supply and implementation of seed security are among the major activities outlined in the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture. Seeds therefore represent hope for the future of mankind.

Throughout our history, farmers' informal seed systems have had a great influence on the evolution of modern agriculture, by practising conservation of agrobiodiversity at the gene, farmer and ecosystem levels. Within this framework, women in particular have played a crucial role, as has been identified by a recent analysis, in sustaining the informal seed sector, and more widely, in ensuring food security. However, informal seed systems are heavily dependent on local resources and inputs, and highly vulnerable to natural disasters and sociopolitical disruptions. Therefore, investing in a range of appoaches in order to strengthen local seed systems assumes great urgency.

While the formal hybrid seed industry led by the private sector has tended to focus on profit-making species and crops, the informal sector has concentrated on crops – mainly self- or open-pollinated varieties – that are crucial to local food production systems. Given such a scenario, national seed policies concludes helping to strengthen the informal sector. International support too continues to be mainly engaged with the formal sector. Perhaps matching support is required to encourage continued development of informal seed systems.

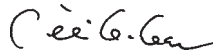
In this context, the concept of 'seed villages', which advocates self-sufficiency in production and distribution of good quality seed, is fast gaining ground. Seed villages, or village seed banks, operate under supervision and utmost transparency, inculcating mutual trust and social responsibility among farmers, thereby reducing their dependence on external inputs.

Several initiatives have been launched to revive this traditional concept, such as those initiated by the Indian Council of Agricultural Research (ICAR), the National Research Centre for Sorghum (NRCS) and state agricultural universities (SAUs). Similarly, the seed bank concept is part of ICRISAT's projects in collaboration with the Asian Development Bank (ADB), Tata-ICRISAT project in Vidisha and Guna districts of Madhya Pradesh and the Andhra Pradesh Rural Livelihoods Project (APRLP) in Kurnool district in Andhra Pradesh and other ongoing efforts in the states of Maharashtra and Karnataka.

In low-rainfall, dryland agricultural areas, cereals and legumes serve the dual purpose of providing food and income for poor farmers and fodder for their cattle. Given the critical role played by improved varieties in increasing conventional crop production, a key question arises: how do we facilitate the development of an integrated and cost-effective seed system that is capable of generating, producing and distributing improved seed varieties that meet the needs of resource-poor farmers?

This book is an attempt to review and document the existing seed multiplication and delivery systems in four dryland agricultural districts of Andhra Pradesh: Anantapur, Kurnool, Mahbubnagar and Nalgonda. While analyzing the problems associated with different seed systems in these districts, the book makes a strong case for strengthening alternative seed systems and seed delivery models that address the needs of small farmers in the context of constantly changing dynamics on the national, international, political and socioeconomic fronts.

I am sure this book will be a valuable reference source for those engaged in strengthening local seed systems as a step toward food security in the semi-arid tropics of India.



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Part IV: Innovative Approaches to Strengthening Local Seed Systems

Chapter VI

Seed Systems of Food-Feed Crops in the Semi-Arid Tropics of Andhra Pradesh, India

Farmers' own-saved seed and the community seed exchange system together constitute the civil sector in the edifice of food, feed and seed security in India. They remain vibrant and viable in spite of several bottlenecks. This chapter presents a summary of local seed systems in four districts: Anantapur, Kurnool, Mahbubnagar and Nalgonda, which are typical of the semi-arid areas of Andhra Pradesh, India.

Introduction

Seed systems in Andhra Pradesh, as in the rest of the country, consist of the public, private and civil organizations. The terms 'formal' and 'informal' have been used to classify these sectors (Figure. 8.1).The most practical usage is to consider the organized/commercial supply system as comprising the formal seed sector and all other channels as the informal. The formal component is characterized by planned seed production and named and defined varieties. These are officially tested and registered as well as processed to improve quality, and come with assurances of viability, often by certification. The informal sector generally lacks these 'seed-specific' procedures, and makes less distinction between grain and seed.

Survey

This study of the existing seed systems of food-feed and fodder crops in four dryland districts of the state was started in 2002 using informal participatory techniques and tools. Focus group discussions (FGDs) with and rapid rural appraisals (RRAs) of homogenous groups of farmers – smallholder, medium- or large-scale cultivators – were separately held in 12 representative villages across the four districts. The discussions were informal and open-ended, with the farmers given sufficient time to explain their point of view.

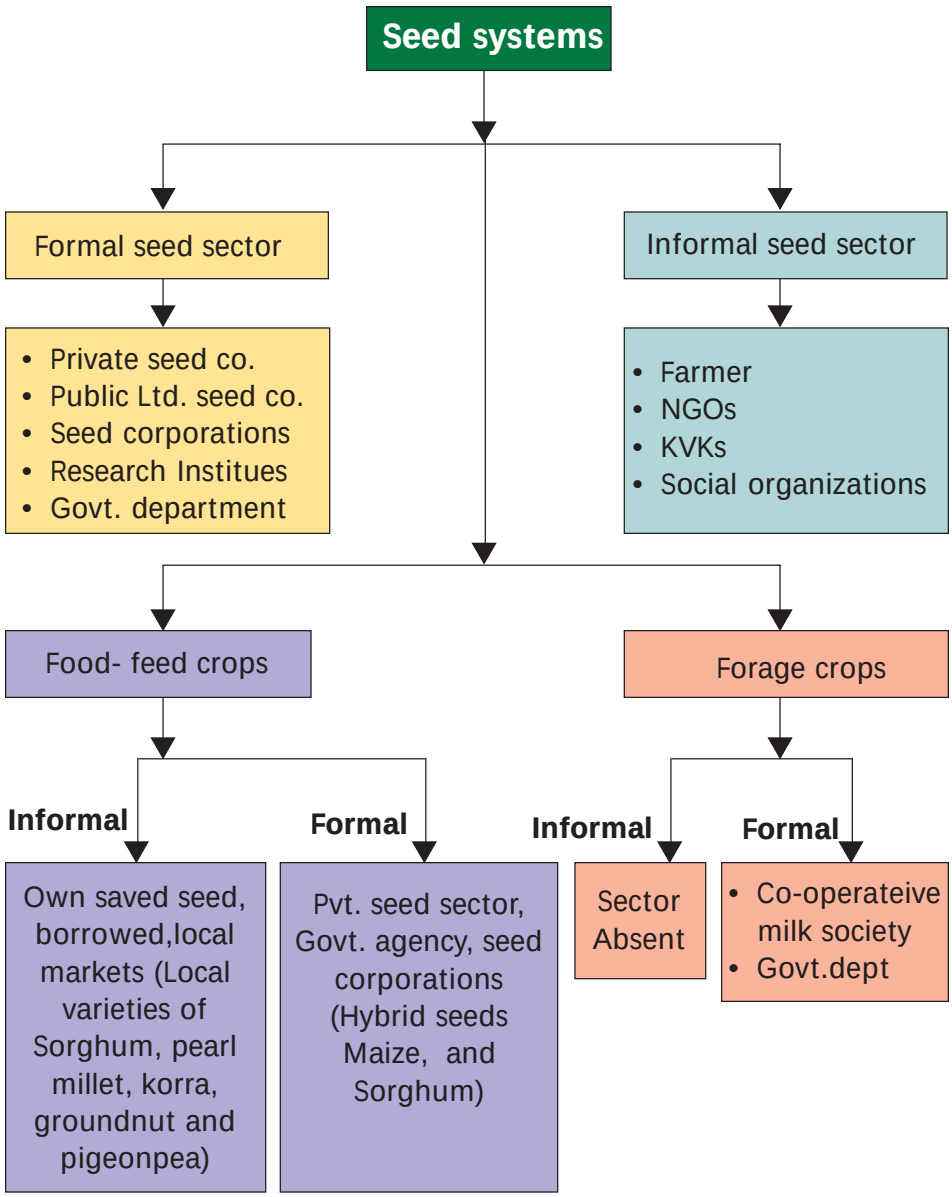


Figure 8.1. The overall schemes of seed supply in four districts of Andhra Pradesh, India.

Agroecological Profile of the Four Districts

Soils. The four districts in this study represent the semi-arid and rainfed conditions typical of the Deccan Plateau in South India. While Mahabubnagar and Nalgonda fall within the southern Telangana region of Andhra Pradesh, Anantapur and Kurnool lie in the Rayalaseema region of the state (Kesava Rao et al. 2006). Deep loamy and clayey mixed red and black soils dominate these districts (Table 8.1). Andhra Pradesh has eight subagroecological regions (National Bureau of Soil Survey and Land Use Policy (NBSS&LUP 1996–97).

Rainfall. The regions are characterized by hot summers with low rainfall and relatively moderate winters. Nalgonda with an annual precipitation range of 560–850 mm falls in zone 7.2 and Kurnool in zone 7.1 with 436–616 mm. Rainfall is the biggest ecological factor influencing yield and crop production as most of the cultivated area is rainfed. Though the southwest monsoon sets in at uniform time, its withdrawal is delayed by about 10 days in some parts of Kurnool. Among Kurnool, Mahabubnagar and Nalgonda, the former district receives the lowest annual rainfall of about 630 mm of which about 450 mm is received from the southwest monsoon. Seasonal rainfall distribution indicates that Mahabubnagar with low precipitation from the northeast monsoon is more drought-prone in the later part of crop-growing season.

Cropping systems. Rice (*Oryza sativa* L.), sorghum [*Sorghum bicolor* (L.) Moench], maize (*Zea mays* L.), pearl millet [*Pennisetum glaucum* (L.) R.Br.], foxtail millet (*Setaria italica* Beauv.), pigeonpea [*Cajanus cajan* (L.) Millsp.], cotton (*Gossypium spp.*), castor (*Ricinus communis* L.), groundnut (*Arachis hypogaea* L.) and vegetables are the important crops in these districts. Pigeonpea, pearl millet and sorghum are commonly grown as intercrops in the groundnut cropping system. In Mahabubnagar and Nalgonda, pigeonpea is widely intercropped with sorghum. Crops grown in these traditional cropping systems are primarily for subsistence. The cropping system survey undertaken as part of this study between 2002-06 indicated that sorghum, pearl millet, foxtail millet, groundnut and pigeonpea were raised using own-saved seed of traditional varieties sown year after year.

Fodder and choice of cultivars. Farmers produce a broad range of crops and varieties not only for their own subsistence but also to meet the fodder requirement for their livestock. The stover/straw from these cropping systems is an important output for the farmers supplementing the natural

grazing of their livestock. Fodder production is usually less susceptible to drought than grains as some fodders can be harvested even in years when grain production has failed. This undoubtedly influences the farmers' choice of crops and varieties. For instance, farmers in Mahabubnagar and Nalgonda districts grow yellow-seeded sorghum varieties, which yield relatively less grain but give optimum fodder yield. In Kurnool and Anantapur districts, local varieties of groundnut are grown for a similar purpose.

Table 8.1. Agroecological features of four project districts of Andhra Pradesh, India.

Feature	Districts Nalgonda North Telangana Plateau	Mahabubnagar North Telangana Plateau	Kurnool South Telangana Plateau (Rayalaseema) and Eastern Ghats	Anantapur Karnataka plateau (Rayalaseema)
Physiography				
Soils and Available Water Capacity (AWC, mm/m)	Deep loamy and clayey mixed Red and Black soils with medium to high AWC (100-200)	Deep loamy and clayey mixed Red and Black soils with medium to high AWC (100-200)	Deep loamy to clayey mixed Red and Black soils with medium AWC (100-150)	Deep loamy and clayey mixed Red and Black soils with low to medium AWC (50-150)
Agroecological subregion (AESR)	Hot, moist, semi-arid ESR	Hot, moist, Semisemi-Arid arid ESR	Hot, dry semi-arid ESR	Hot, arid ESR
Average annual temperature (°C)	26.4	26.9	28.1	27.8
Annual rainfall (mm)	745	710	660	560
Onset of monsoon	6 June	5 June	4 June	4 June
Withdrawal of monsoon	1 Nov	5 Nov	10 Nov	10 Nov
SW monsoon rainfall (mm)	540	540	450	315
Post-monsoon rainfall (mm)	150	115	145	160
Annual PET (mm)	1615	1665	1725	1845
LGP	120-150 days	120-150 days	90-120 days	60-90 days

Seed Delivery Systems of Food-Feed Crops

Traditional seed systems are location-specific and vary greatly within farmer communities (Figure 8.2). Approximately 80–90% of all planting material used except groundnut seed is by and large sourced from farmers' own-saved seed or the informal seed sector. The formal seed sector has made some progress in certain crops – notably with hybrids of maize in some villages of Nalgonda district but very little in others where the traditional (informal) system remains dominant. The study clearly showed that local seed systems continue to provide an effective means of seed procurement in the semi-arid districts of Andhra Pradesh

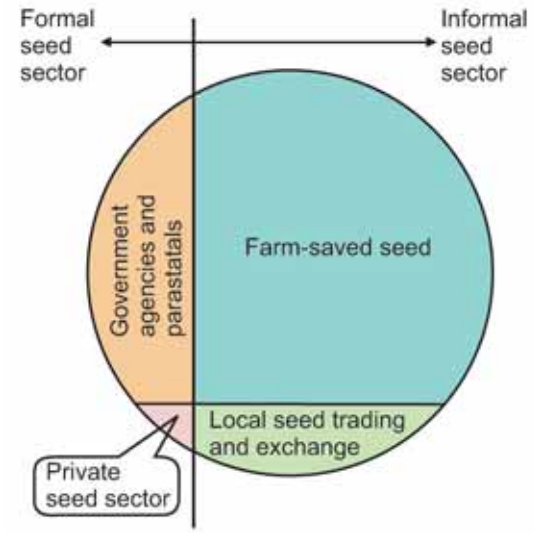


Figure 8.2. Components of formal and informal seed systems in four semi-arid districts of Andhra Pradesh, India.

A majority of farmers in the four districts grow food-feed crops such as sorghum, pearl millet, foxtail millet and pigeonpea and save a part of their produce as seed. Thus, farmer-saved seed of these crops meets 80–90% of the seed needs in these districts. The varieties used are invariably local landraces, and awareness about improved varieties, seed availability and seed access is poor. Seed is procured off-farm only when necessary as when own seed is not available due to drought, poverty or seed pests/diseases. The main sources of off-farm seed are local markets, relatives, other farmers and government relief agencies.

However, these statements about the predominance of the informal sector mask significant differences between crops, villages, farmer groups and their socioeconomic conditions. In the project districts, traditional seed systems are location-specific and vary greatly within farmer communities. On the one hand, food-feed crops and staples such as sorghum, pearl millet, foxtail millet and pigeonpea are generally sown with home-saved seed (Figure 8.3) for various reasons. On the other hand, in crops such as maize and sorghum where hybrid cultivars are used, usually by farmers in the large and medium landholding groups, the seed is obtained from private companies (Figure 8.4) In some cases, farmers discovered that hybrid seed, even with lower yield levels, could meet their needs for one or two further multiplications before they needed replacement with fresh seed.

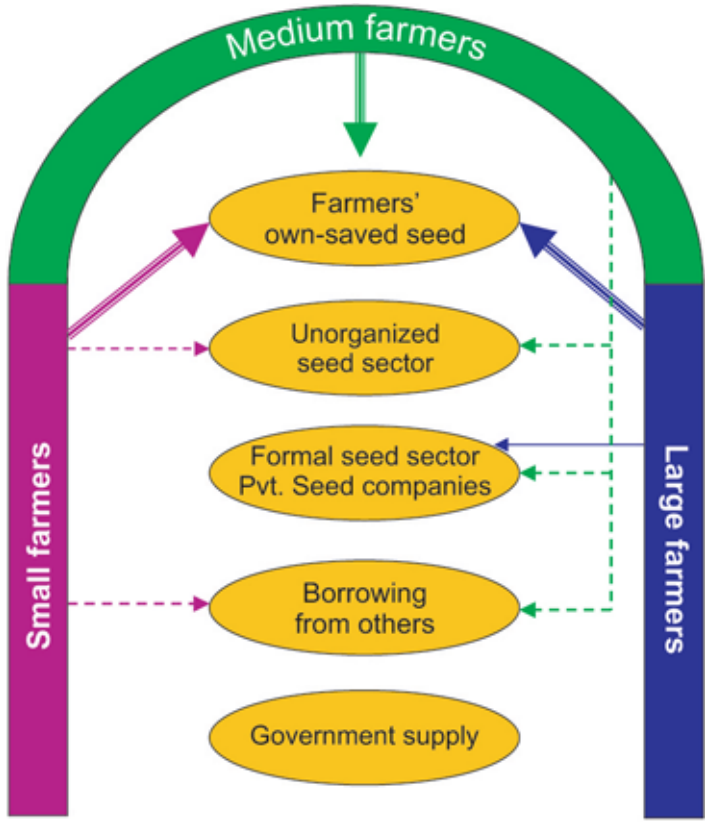


Figure 8.3. Seed delivery systems of local cultivars of sorghum, pearl millet and pigeonpea.

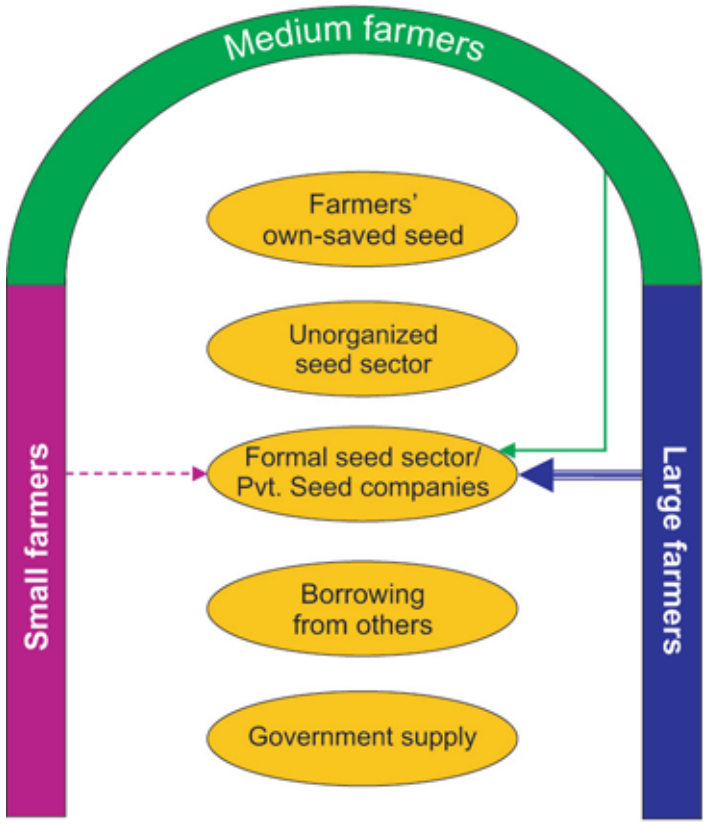


Figure 8.4. Seed delivery systems of hybrid cultivars of maize and sorghum.

Seed Sourcing Behavior and Awareness of New Varieties

Understanding farmers' seed sources and community seed distribution channels can be a complex task. Farmers tend to obtain seeds of different crops and varieties from different sources at different times. However, with regard to their seed-sourcing behavior, it is possible to discern three main groups of farmers.

- Seed-secure farmers who can meet their own seed needs
- Farmers who source seed off-farm from time to time, out of choice
- Farmers who source seed off-farm from time to time, out of necessity

Seed-secure farmers tend to maintain their own varieties. Influx of new varieties is limited. For instance, most of the sorghum farmers in Mahabubnagar did not express any particular preference for improved varieties with a white seed coat because of their nonreliability of yield, lesser preference as food and high susceptibility to climatic vagaries, and biotic and abiotic stresses. On the other hand, the farmers of Nalgonda were positive about adopting improved cultivars of sorghum and maize. Motivating factor is higher income per unit area for large and medium-scale farmers in this district to cultivate hybrid maize, cotton, sorghum and sunflower. The awareness that large-scale farmers have regarding hybrids is quite satisfactory because of active participation of the private seed sector in Nalgonda. On the whole, however, awareness of improved cultivars is not always very well-developed in traditional farming communities (Table 8.2). This may also reflect the fact that in self-contained seed systems, the same genetic material is easily available from neighbors, which serves as an easy alternative to the risk and cost of seed procurement from informal channels.

Table 8.2. Farmers' knowledge of seed of improved cultivars in four districts of Andhra Pradesh, India.

Farmer group	Mahabubnagar[1]	Kurnool[2]	Nalgonda[3]	Anantapur[4]
Smallholder farmers (<5 acres)	*	*	**	*
Medium-scale farmers(5–10 acres)	*	*	**	*
Large-scale farmers(>10 acres)	*	**	***	*

* Poor: Less than 25% of farmers aware of improved seeds; ** Average: 50-75% of farmers aware of improved seeds; *** Good: More than 75% of farmers aware of improved seeds.

1. Sorghum, maize, groundnut, pigeonpea.
2. Groundnut, pearl millet, sorghum, foxtail millet, pigeonpea.
3. Maize, sorghum, pearl millet, pigeonpea.
4. Groundnut, pigeonpea.

Farmers sourcing seed off-farm usually do so from other farmers, who often are individual cultivators known in the community as reliable sources of seed. The proportion of such seed producers or distributors within a community is very small, and this type of activity is more evident in the distribution of groundnut seed in Anantapur. However, it is often not certain whether these local seed suppliers follow any special practices to produce quality seed or if they are simply well-endowed farmers who have surplus grain to sell as seed.

Groundnut Seed System

The groundnut seed system presents a very different picture, particularly in Kurnool and Anantapur districts where the informal sector has shrunk due to agroclimatic factors and the state government has had to step in with its subsidized seed supply program through the AP State Seed Development Corporation (APSSDC). Seed sources have been related to wealth status, with big and rich farmers maintaining their own seed stocks and small farmers needing to buy or borrow seed every year. A generalized representation of the groundnut seed delivery system is given in Figure 8.5. In Kurnool, for instance, the informal sector in the form of farmers' saved seed, borrowings and local seed transactions accounts for about 50-60% (Figure 8.6) of the seed trade (Ravinder Reddy 2004a). About 40-45% of the farming community in this district depends on the subsidized seed supplied by the government agencies like APSSDC and agriculture departments. The majority of large- and a few medium-scale farmers save their seed and lend the surplus to smallholder farmers with an understanding that they repay one and a half times the quantity seed borrowed.

The situation is also different in Anantapur, where storage and borrowing of farm-saved seed has declined due to recurrent drought, poverty and prevalence of storage pests such as groundnut bruchid (*Carydon serratus*). There is a sense of insecurity among seed lenders because of frequent droughts, Hence, the majority of farmers in Anantapur, irrespective of the size of their landholding, have become dependent on the government's subsidized seed supply (Figure 8.7) (Ravinder Reddy 2004b). Sixty to seventy percent of the farmers depend on this source, but, meets only 50-60% of the total seed requirement. Therefore, farmers look to other sources of seed supply including oil mills and local groundnut traders, or buy seed within the village from better-off farmers.

The government's seed distribution program, carried out through APSSDC, has played an important role during drought years in Anantapur district. The process adopted by the corporation for seed distribution is to call for tenders from seed traders to supply groundnut seed in particular areas with the lowest bidder getting the contract. However, as there is no specification by the government as to the variety to be supplied in a particular agroclimatic zone, the contracted supplier usually procures seed as is available from the nonorganized market, oil mills, groundnut traders or even farmers. The seed is cleaned, graded, packed and supplied to farmers without specifying

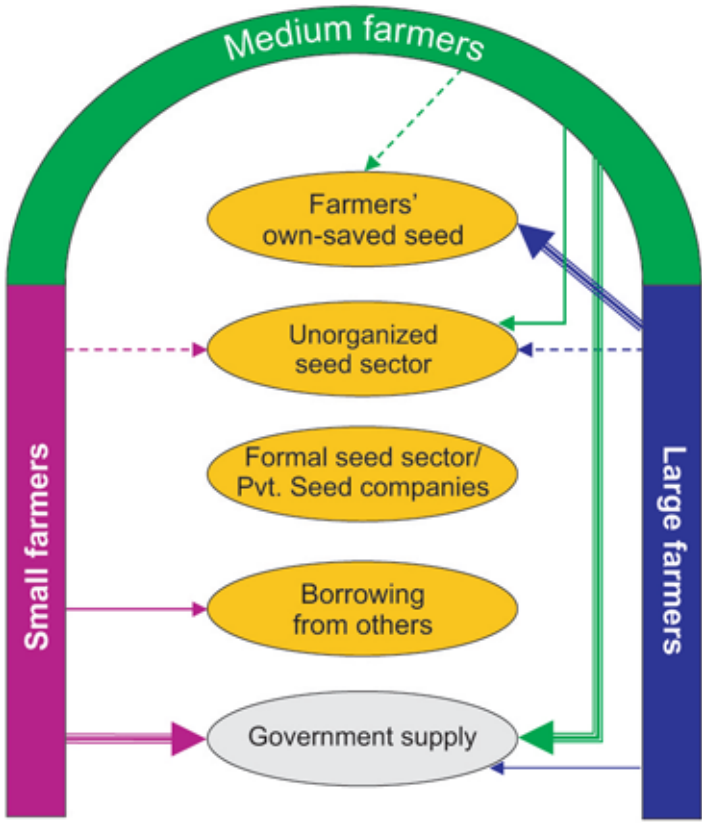


Figure 8.5. Groundnut seed delivery systems.

characteristics including the name of the variety. This often results in farmers receiving and sowing a mixture of several varieties and the cycle continues every year. With availability of groundnut seed becoming a serious issue in the last 10 years due to frequent droughts, farmers have been able to raise a good crop only about once in three years.

Constraints to farmer-saved seed system. A number of constraints act in concert to shrink the traditional system of farmer-saved seed in the dryland districts (Fodder Innovation Project, 2006).

- Groundnut seed is not stored for next years use due to the perceived threat of pod borer thus forcing the smallholder farmers to sell their produce and depend on external seed sources for the next crop.
- Distress disposal of produce by Farmer's due to financial and debt-servicing pressures.

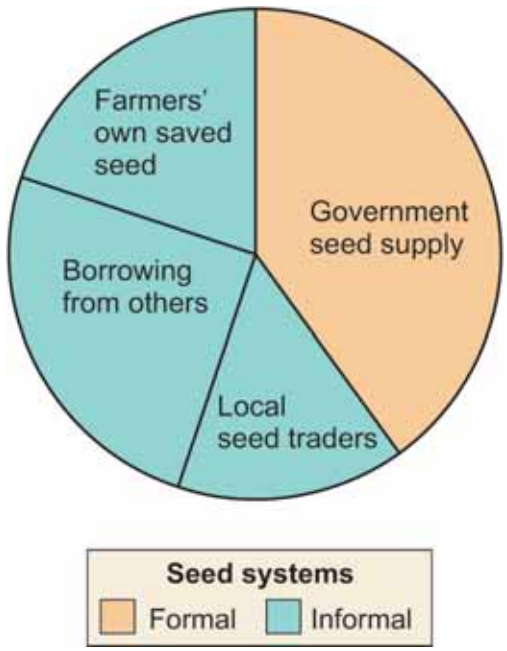


Figure 8.6. Groundnut seed supply in Kurnool district.

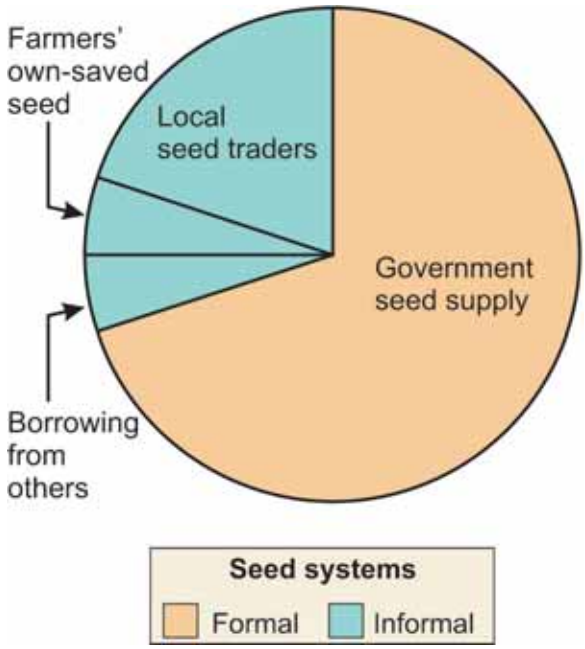


Figure 8.7. Groundnut seed supply in Anantapur district.

- Recurrent use of own saved seed for sowing resulting in lower returns to farmers
- Lack of storage facilities and the non-awareness regarding opportunity cost to increase their incomes.
- Dependence of smallholder farmers for seed on large-scale farmers, and their vulnerability to their unfair trade practices.
- Recurrent drought influencing the inflated demand for seed in the subsequent year, since drought year produces pods with shriveled kernels leading to inferior quality seeds.

Constraints to government seed supply. While the government supplies subsidized seed to farmers through APSSDC, it is constrained by several factors.

- Inadequate seed supply: Government seed supply is restricted to 120 kg seed per farmer irrespective of the extent of his/her landholding. Seed supply by APSSDC could only meet 40% of the total seed requirement. Therefore, the quantities supplied to different parts of the district do not always match the local demand.
- The denomination of the seed supplied is not known: It is likely that the seed supplied is a mix of different varieties and not pure types.
- The logistics are expensive and difficult to organize the seed supply by the government agencies due to high costs and other overheads.
- Government seed supply with high subsidies has been a deterent for entery of private sector.

Other issues. The groundnut seed supply system, particularly in Anantapur district, has been beset by several other problems which have limited the impact of the formal seed system (Prasad et al.,2006).

- Farmers are vulnerable to unfair practices such as faulty weighing by market intermediaries. The government has constituted vigilance teams to check market malpractices but they have not been effective.
- Not all watershed/village associations are able to check unfair practices by market broking agents. In some cases, the agents have linkages with big farmers to the detriment of smallholders.
- The functioning of market yards in Anantapur district has not been efficient.
- There are conflicting references on seed characteristics across actors. Oil millers prefer longer seed with higher oil contents on other side farmers prefer smaller seeds.

Forage Crop Seed Delivery Systems

Cultivation of forage crops in the four districts is very limited, perhaps amounting to less than 1% of the cultivated area. In addition, farmers' awareness and knowledge of forage crops and seed availability is very poor (Table 8.3).

Table 8.3. Farmers' knowledge of seeds of forage crops.

Farmer group	Mahabubnagar	Kurnool	Nalgonda	Anantapur
Smallholder farmers(<5 acres)	*	*	*	*
Medium-scale farmers (5–10 acres)	*	*	*	*
Large-scale farmers(>10 acres)	*	*	**	*

* Poor: Less than 25% of farmers aware of forage seeds; ** Average: 50-75% of farmers aware of forage seeds; *** Good: More than 75% of farmers aware of forage seeds.

Recently, the state government's animal husbandry department and milk cooperative societies initiated drives to popularize forage crops such as *Stylosanthus hemata*, hybrid fodder sorghum and Napier *bajra* hybrid grass. They supplied free seed of *stylo* and subsidized seed of fodder sorghum and cuttings/slips of Napier grass. Most of these subsidies are availed by well-to-do farmers who can afford to cultivate fodder crops, which require irrigation.

A general representation of forage crop seed delivery systems operating in the four districts is given in Figure 8.8. In the villages of Nalgonda, dairy farmers cultivate fodder sorghum varieties, using subsidized seed supplied by the government. The role of the formal seed sector in forage seed production and distribution is negligible.

Seed Selection and Storage

Seed selection and storage practices vary from region to region and from crop to crop. For sorghum and pearl millet, seed is selected, harvested and stored along with the stalk ear heads in earthen pots, plastic (fertilizer) bags and tin containers. Some farmers treat seed with chemicals and natural products (neem leaves, ash, etc.), while others do not treat their seed but periodically dry them in the sun after manually removing insect pests.

The majority of farmers set aside a portion of the harvest as seed. Our survey revealed that only 20–30% of farmers select seed on the basis of plant and

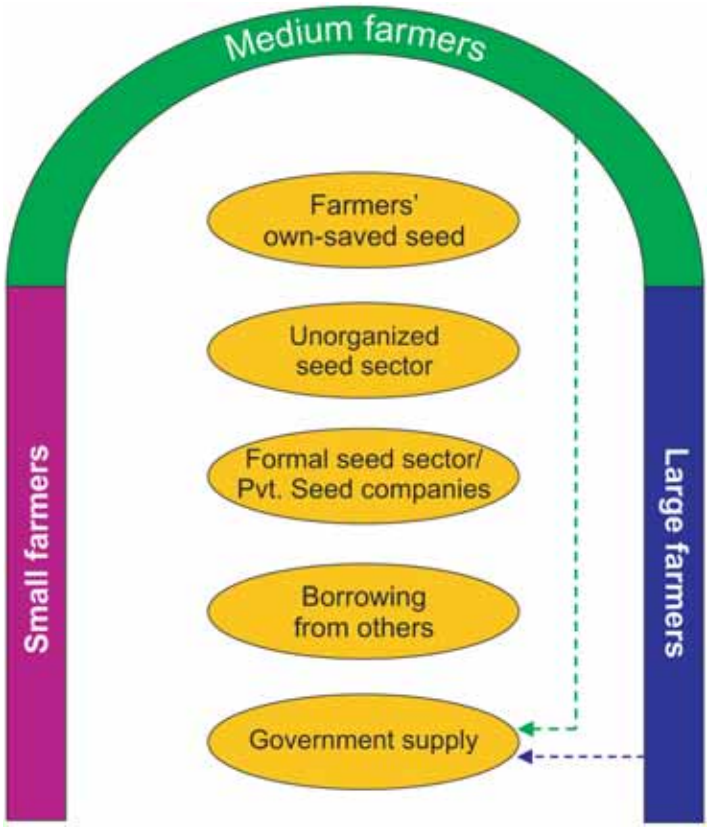


Figure 8.8. Seed delivery systems for forage crops.

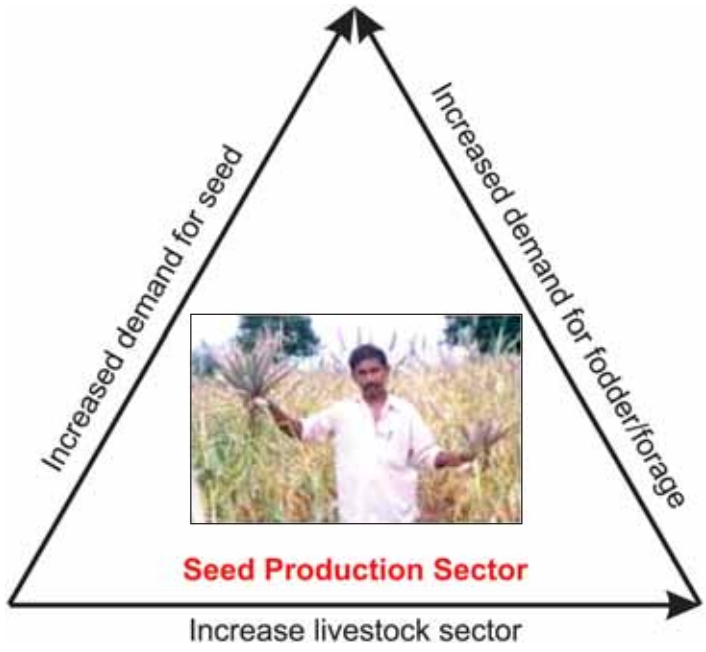
yield characters. They add wood ash and neem leaves to protect seed from storage pests. In general, such techniques appear to be adequate for cereal seed. Legume seed is more difficult to preserve. Farmers in Anantapur district face problems with groundnut bruchid, a serious storage pest, and are often left without viable seed at sowing time. Pigeonpea seed too is highly susceptible to bruchid infestation during storage, leading to poor germination.

Livestock-Seed Interrelationship

For farmers who are engaged in crop and livestock husbandry, cash receipts from livestock products (milk, butter, *ghee*) also supplement the income. Resource-poor farmers on the other hand have limited livestock assets and are at a serious disadvantage. In rainfed areas farmers who grow cereals such

as sorghum, pearl millet and finger millet have suffered from low grain yields and poor market prices. Additionally, distant markets burden the farmer with transport charges, and cultivation areas of such cereals are shrinking, in turn affecting fodder shortage. The sale of livestock during the off-season is a common practice, and dependence on farm machinery for agricultural and transport operations is on the rise. On the whole, livestock populations are decreasing and this has a pronounced effect on small farmers.

The commercial demand for and cultivation of fodder/forage crops in the project area is weak, because animals are kept mainly on subsistence. The demand for fodder/forage seed will depend upon the development of the livestock sector in that particular village and value-added industry to livestock products. However, if the livestock sector develops, particularly in terms of value-added industry, it is expected that demand for intensive fodder/forage cultivation will increase. This will translate into "derived demand" for seed, in order to meet the fodder crop requirements. The concept of derived demand is useful, as it helps to explain (1) the interrelationships between livestock development, fodder promotion and seed production; and (2) how these factors could be used as integral components of policies that support livestock (Figure 8.9).



Figures 8.9 Interrelationship between livestock, feed and seed sectors.

The availability of fodder in a particular region/village is influenced by the local cropping systems. In all 12 villages surveyed in Nalgonda, Mahabubnagar, Anantapur and Kurnool districts, sorghum, maize, pearl millet and groundnut are the main food-feed crops. There is very little awareness about improved varieties of crops suitable for different seasons and soils.

In contrast, large- and medium-scale farmers are cultivating hybrid cultivars and other cash crops for higher returns per unit area, and buying fodder from other villages to feed their livestock. Fodder crops such as sweet Sudan sorghum grass are cultivated in areas where the milk cooperatives are involved in the collection of milk and supply of subsidized fodder seed. The milk cooperative is playing an important role in distributing fodder/sweet sorghum hybrid seed to farmers at subsidized rates with credit for 15–30 days. Other fodder grasses such as Napier grass and Co1 hybrid *bajra* grass have been recently introduced in most watershed villages. Within the medium- and large-scale landholding groups, 3–4 farmers per village are cultivating fodder sorghum under irrigated conditions and catering to the green fodder needs of other farmers in the village.

An Overview of Seed Systems

In general, the study revealed that 80–90% of farmers' seed needs in the project area are met by farm-saved seed in food-feed crops such as sorghum, pearl millet and finger millet. On the other hand, in some areas, large- and medium-scale farmers growing hybrid maize and sorghum have been sourcing seed from the formal sector. As against this, cultivation of forage crops is absent and private seed companies are not particularly interested in developing or promoting them.

There is poor awareness about improved varieties, seed availability and access to seed in all villages in the project area. Seed is procured off-farm only when necessary as in times of drought or pest/disease prevalence. The main sources of off-farm seed are local markets, relatives, other farmers and government relief agencies, The formal private sector is patronized mainly by large-scale and some medium-scale farmers.

In the informal seed system, activities tend to be integrated and locally organized. The informal system embraces most of the ways in which farmers themselves produce, disseminate and access seed: directly from their own

harvest; through barter among friends, neighbors and relatives and through local grain markets or traders. The same general steps take place in the informal system as in the formal but they take place as integral parts of farmers' routine grain production rather than as separate activities. Also, rather than be monitored or controlled by government regulations, informal seed sector production is guided by local technical knowledge and standards and by local social structures and norms, including market forces. The varieties may be landraces or mixed races, or even improved varieties which have made their way into the local system. Perhaps because of their ability to meet local needs and preferences, informal channels provide most of the seed that smallholder farmers use: somewhere between 80% and 90% of the total seed sown, although this varies by region or crop (for example, the figure is much lower where hybrid maize is grown).

The schematic diagram showing the dimensions of seed systems and the various components of seed system is given in Figure 8.10. It should be noted that there is a good deal of seed flow among the different channels: formal research or commercial varieties may enter the local systems and vice versa; aid organizations may put seed from local or formal sources to the disposal of farmers. The distinction between problems of "seed availability" and "seed access" has to be assessed. The problems of seed access are much harder to answer and will depend on more detailed poverty-related information.

Recommendations for Sustainable Seed Systems in Semi-Arid Tropics

a. Farmer-to-farmer seed exchange and local seed markets are popular throughout the project area but these are not adequately linked with systems for improved seed. It is important that public sector research organizations, which are strong on varietal production, are linked with informal seed supplies. Locally operating institutions, such as NGOs, extension services, Krishi Vignan Kendras (KVKs), farmers' associations and other community-based organizations (CBOs) could play an important role in effecting this link.
b. Farmer seed producers can be efficient and some of them will have the potential to expand as specialized, small- or medium-sized local seed enterprises (Ravinder Reddy 2005). For these interventions to be sustainable, they must be based on training and market development and not on direct government subsidies.

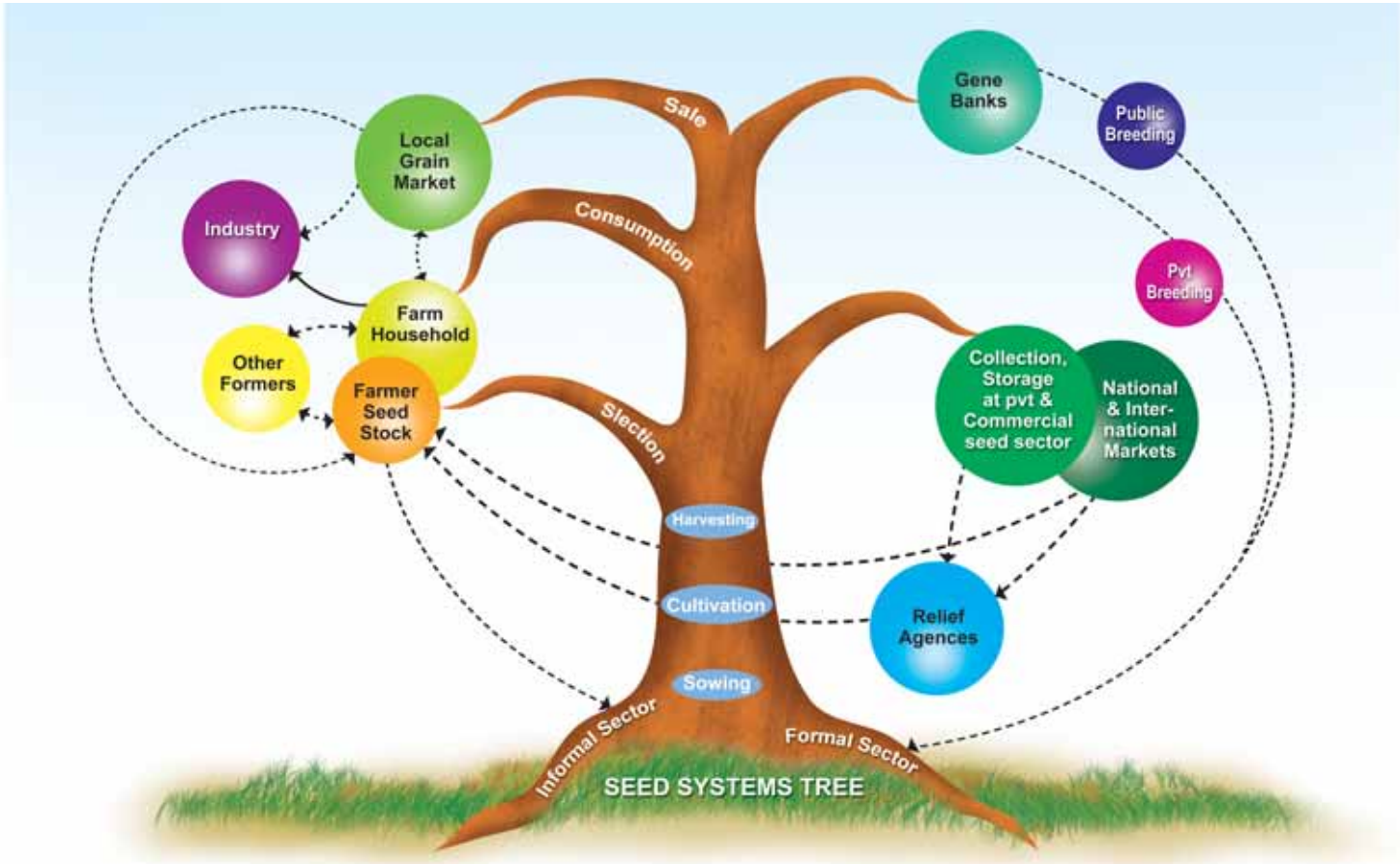


Figure 8.10. Formal and informal dimensions of seed systems

c. Sustainable and competitive groundnut seed systems will require substantial reorientation of government philosophies and programs involving groundnut seed distribution. Rather than attempting to directly supply seed to farmers, government programs will need to provide support services that allow developing formal and informal seed enterprises to respond to market (farmer) demand for seed. This essentially seeks to offer farmers a great range of choice in terms of varieties and seed sources. Indirect subsidies may still be important for competitiveness among enterprises.
d. Programs will need to be vigilant in eliminating subsidized seed distribution that restricts development of a sustainable local seed sector. The key to success in strengthening informal seed systems will be improving farmer and seed producer access to information on product and seed prices and market options.
e. Development of alternative seed systems for groundnut seed production and distribution in Anantapur and Kurnool districts is an urgent need. The formal seed sector has shown little or no interest in seed multiplication of crops like groundnut with high seeding and low multiplication rates. Transportation, processing, bagging and certification costs make the seed expensive for farmers.

Chapter VII

Designing Alternative Seed Delivery Models: Applying Innovations

The main purpose of designing an alternative seed delivery system is to address the issues of seed supply to smallholder farmers. In this chapter we shall discuss, using specific seed delivery models, ways of strengthening seed systems to address the needs and vulnerabilities of small farmers.

Introduction

Most community-based seed production models/schemes are initiated to address the farmers' problem of access to quality seed. The seed produced by community-based or farmer-saved seed systems is not processed and certified, and its quality is guaranteed only by its seller or the village seed committee. However, the seed so produced is low-priced, available at the farmer's doorstep at the right time and accessible to all farmers in the village. So an alternative seed supply model must impact farmers' access to quality seed of improved varieties at affordable cost.

The Case for Strengthening Informal Seed Systems

The regulatory and legal framework governing seed in many countries hampers the development of informal seed systems. National seed regulations are mostly based on international standards, which often are incompatible with or irrelevant to the realities of farmers' seed systems. The restrictions imposed by many national seed authorities on free exchange and marketing of seed, especially compulsory variety registration and seed certification, constrain the efficient functioning of the formal seed sector and the development of alternative seed systems (von Lossau 2000). Nevertheless, regulatory frameworks are crucial for the development of national seed systems (Tripp 2003).

The major sources of seed for small-scale farmers are their own on-farm savings, seed exchange, borrowings and local traders. However, community systems of seed supply are under pressure due to recurring natural calamities, crop failure, storage problems and poverty. In drought situations, farmers depend on subsidized seed supply by government agencies, which meet only 30–40% of the seed needs of smallholder farmers (Ravinder Reddy 2005).

Interventions required for Improving Local Seed Systems

Existing seed systems can be improved and supported by various interventions.

1. Facilitating farmers' access to seed through

a. Awareness
b. Training
c. Capacity building

2. Introduction of appropriate agricultural technologies

a. Crop diversification possibilities
b. Crop production aspects
c. Improved cropping systems
d. Integrated pest and disease management
e. Introduction of improved varieties of fodder and food-feed crops
f. Seed health and storage management

Appropriate technologies addressing crop production constraints, adequate follow-up and monitoring are essential to ensure that the technology options introduced are appropriate to local situations.

Interventions, therefore, are needed to strengthen informal seed supply systems, such as establishing village-based seed banks as an alternative seed system. Several such alternative seed delivery models that may enable sustainability of community seed systems in the semi-arid tropics of Andhra Pradesh are given in Table 9.1 and each of them are discussed hereunder.

Village-Based Seed Delivery Models

A study was conducted to examine the local seed systems operating in project villages in Andhra Pradesh and the farmers' response to the concept of village-based seed banks. A pilot village was selected with special emphasis on farmers operating in areas of comparatively low agricultural potential, with less fertile soils and lower and more variable rainfall, commonly known as complex, diverse and risky (CDR) areas. These farming households are likely to have limited land (of reasonable potential) and limited capital resources. The concept has been promoted by ICRISAT in its projects.

Table 9.1. Comparison of different seed system models.

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

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

Successful community initiatives were first documented by an in-depth study of seed villages in Asian Development Bank (ADB) and Tata-ICRISAT project sites in Vidisha and Guna districts of Madhya Pradesh (Dixit et al. 2005). The study provided the project with an insight into the concept and helped identify gaps so that it could be refined and implemented in the Andhra Pradesh Rural Livelihoods Project (APRLP) sites in Karivemula and Devanakonda villages in Kurnool district of Andhra Pradesh.

The main aim of establishing village based seed delivery models is to improve availability and access to seed of improved varieties for small and resource-poor farmers through capacity building of stakeholders at the community level to enhance sustainable supply of good quality seed at the right time and at an affordable price. As presented in Table 9.1 we discuss here five seed delivery models and their advantages and disadvantages.

In most developing countries, the formal seed sector is far smaller than the informal. The latter is the major source of planting material for smallholder farmers. Local seed systems contribute 80–90% of the seed requirement of smallholders (Monyo et al. 2003). Strategies to improve seed quality, access to and availability of improved varieties, multiplication and dissemination, availability of seed on time at affordable prices to resource-poor smallholder farmers can bring about changes in the food security of developing countries. Support from state/national governments and international organizations or any other funding agencies should be targeted at improving the efficiency of these investments by helping SHGs, NGOs, farmer cooperatives, community-based organizations (CBOs), Krishi Vignan Kendras (KVKs) and other schemes to improve or develop village-based seed programs relating to multiplication, quality control and marketing.

Model 1: Individual farmer as seed bank

In this model individual farmer acts as the foundation of seed bank and facilitator to ensure seed supply. This model could be developed as an efficient local seed system for different crops (Figure 9.1). This seed system would be most effective for crops that require a high seed rate, which are bulky in nature, or crops that involve high transport and package costs, for example, groundnut pod. This model involves training a couple of farmers in each village in seed production technology and supporting them by supplying breeder seed and technology backstopping. The individual farmer will have the guidance and support of regional, national and

international agricultural research systems to guide him through seed production, storage and distribution of seed. The advantages and constraints to this model are given below.

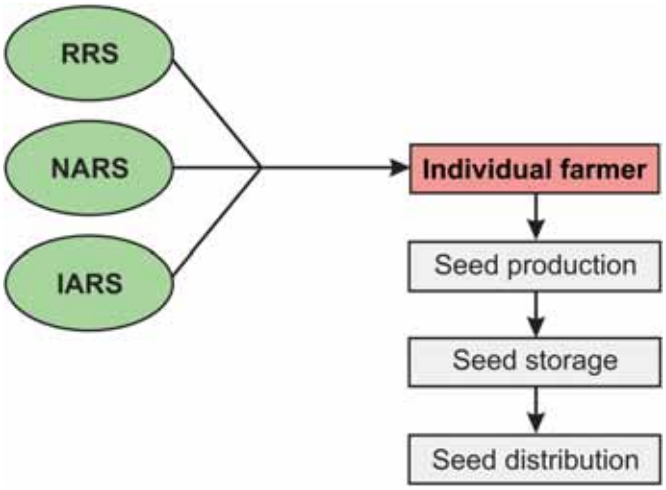


Figure 9.1 Model 1: Individual farmer as seed bank

Advantages

- This model can be tried even in remote areas where NGOs are unwilling to take up operations.
- External finance is not required as all the costs are usually met by the farmer/seed producer.
- It provides wider scope for dissemination and adoption of improved varieties through informal seed channels.

Constraints

- Using technical institutional services for individual farmers may be difficult to justify.
- Farmers are still unwilling to save seed because of storage pests and financial debts.
- Procurement of breeder seed would be difficult at the farmer level once the project is completed.
- There is no control on the selling price of seed.
- There is no control on seed distribution to different communities in the village.
- Seed distribution is limited to select groups.

Model 2: Village-based seed banks

The village based seed bank model (Figure 9.2), which advocates village self-sufficiency in production and distribution of quality seed, is fast gaining ground. Seed villages or village seed banks operate with utmost transparency, mutual trust and social responsibility. Though this is not an entirely a new concept, it is being promoted to reduce farmers' dependence on external inputs. In this model there is higher degree of farmer's participation and they make decisions through their participation in seed bank committee that makes decisions on selection of varieties suited to the region, seed production, storage and distribution of seed. The stake holders are farmers, who gets seed at lower prices than outside and they get the credit facilities also. The profit earned will be ploughed back to the community and seed system development activities. The village seed bank committee, self help groups and the farmers will have the guidance and support of regional, national and international agricultural research systems, including non-governmental organizations. The advantages and constraints encountered by this model are given below.

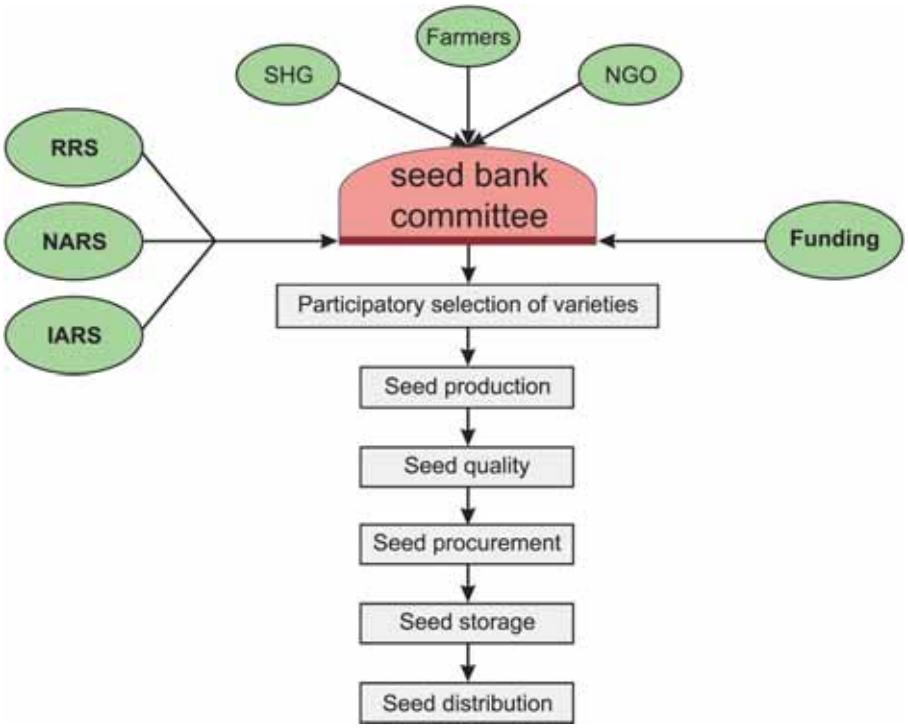


Figure 9.2 Model 2: Village based seed bank

Advantages

- Availability of improved varieties in sufficient quantity within the village
- Assured and timely supply of seed
- Decentralized seed production
- Availability of improved-variety seed at a low price
- Improved seed delivery to resource-poor farmers
- Reduced dependence on external seed sources and hence an effective measure to curb spurious seed trade
- Encourages village-level trade and improves village economy
- Social responsibility of the seed production and delivery system
- A step ahead toward sustainable crop production
- Avoidance of diseases carried through seed (seedborne pathogens) that have been produced and imported from different agroecoregions
- Scope for farmers' participatory varietal selection
- Availability of true-to-type varieties and healthy seed

Constraints

- Reluctance of farmers to adopt quality seed production practices
- Additional investment needed on inputs in seed production
- Lack of buy-back assurance to farmers from self-help groups (SHGs) and/or NGOs
- Paucity of proper seed storage facilities and management in villages
- Lack of funds with SHGs/NGOs for seed procurement, seed packing, storage and transportation
- Absence of a minimum support price for seed procurement
- Lack of technical support for seed production and its monitoring
- Responsibility not fixed for quality control aspects and monitoring of seed production
- Lack of availability, access and procurement of breeder seed for seed production at regular intervals

Small-Scale Seed Enterprise Models

Model 3: SHG-mediated system

In this model (Figure 9.3), the *rythu mithra* (farmer friends group) or SHG in each village is empowered to take up the task of seed production. Its members, however, need to adopt planning and seed production techniques

as well as secure support in terms of storage. Alternatively, arrangements may be worked out with market yards or state warehouses to have the seed properly stored.

The most critical aspects of this model are technical support and supply of breeder seed. Given such support, this model could provide significant benefits to farmers as it presents an opportunity to all members and groups to share the profits of seed production. This model performs two tasks: meeting the seed requirements of farmers as well as conserving crop genetic diversity.

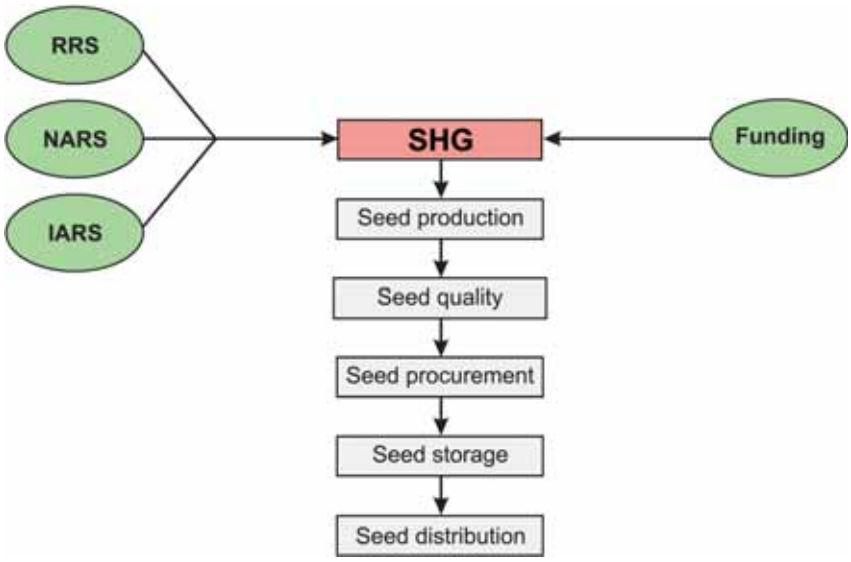


Figure 9.3 Model 3: SHG Mediated system

Advantages

- Improved access to and availability of improved varieties for all groups of farmers
- Minimum overheads
- Seed is stored in the village
- Seed available at a reasonable price and at the right time
- Control on fixing procurement and selling price of seed
- Priority for farmers' preferred varieties
- Need for institutional support for technical backstopping and supply of breeder seed

Constraints

- Reluctance of farmers to adopt quality seed production practices
- Paucity of proper seed storage facilities and management in villages
- Lack of funds with SHGs/NGOs for seed procurement, seed packing, storage and transportation
- Absence of a minimum support price for seed procurement
- Lack of technical support for seed production and its monitoring
- Lack of availability, access and procurement of breeder seed for seed production at regular intervals

Model 4: NGO-mediated system

In this model (Figure 9.4), an NGO is given the responsibility for a cluster of villages. It selects and engages farmers in seed production on a contract basis, giving preference to crops and varieties that are in demand in that particular area. Basically, NGOs are involved in mobilizing and training farmers/seed producers, planning seed multiplication, procuring, processing and marketing seed. As in other models, the NGO has to depend on other institutions for procuring foundation/basic seed stocks for multiplication.

Advantages

- Seed production operations in cluster of villages (3-5)
- Storage of seed within the village
- Seed distribution within the operational area
- Selling price can be fixed through discussions with farmers
- Improved seed availability and access for all groups of farmers
- Minimum overhead costs

Constraints

- Needs institutional support for technical backstopping and supply of breeder seed
- NGO has to depend on other institutions for procuring foundation/basic seed stocks for multiplication
- Involves more than one crop and variety in production
- Less scope for farmers' participation in selecting their choice of varieties
- More inclined toward commercial seed trade
- No scope for involving farmers in fixing procurement and selling prices
- Model needs infrastructure

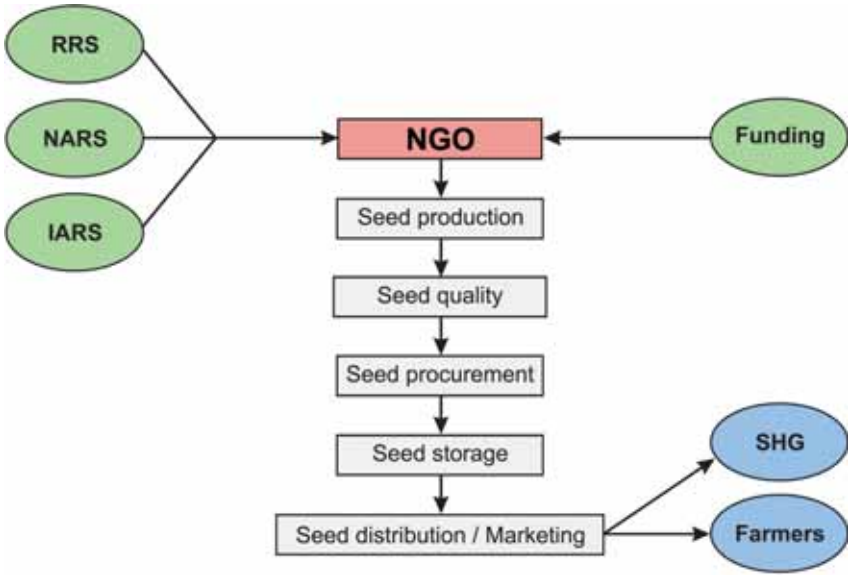


Fig 9.4 NGO Mediated system

Model 5: KVK-mediated system

The related pros and cons of the KVK mediated system (Figure 9.5), which involves KVK as central hub in the execution of this model. In this system a KVK is given the responsibility for a cluster of villages. It selects and engages farmers in seed production on a contract basis, giving preference to crops and varieties that are in demand in that particular area. Basically, KVKs are involved in mobilizing and training farmers/seed producers, planning seed multiplication, procuring, processing and marketing seed. As in other models, the KVK has to depend on other institutions for procuring foundation/basic seed stocks for multiplication.

Advantages

- Seed production operations in cluster of villages (3-5)
- Storage of seed within the village
- Seed distribution within the operational area
- Selling price can be fixed through discussions with farmers
- Improved seed availability and access for all groups of farmers
- Minimum overhead costs

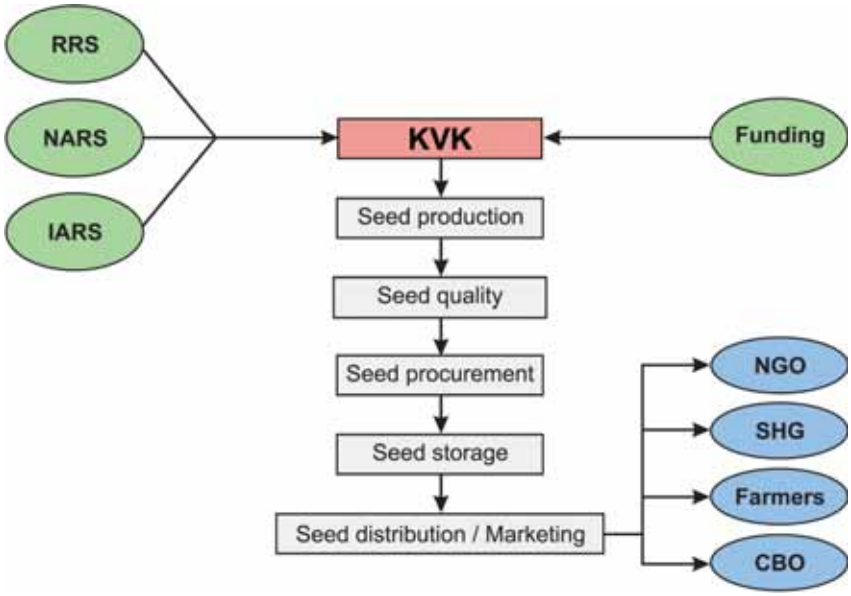


Figure 9.5 Model 5: KVK-mediated system

Constraints

- Needs institutional support for technical backstopping and supply of breeder seed
- KVK has to depend on other institutions for procuring foundation/basic seed stocks for multiplication
- This system involves large operational area, centralized production and needs large storage place (such as a warehouse)
- Comparatively higher overhead costs
- Involves more than one crop and variety in production
- Less scope for farmers' participation in selecting their choice of varieties
- More inclined toward commercial seed trade
- No scope for involving farmers in fixing procurement and selling prices
- Model needs infrastructure

BOX 1

Seed System Models in Southern Africa

Many community and commercial seed supply models have been developed in southern Africa with the objective of improving seed availability (and thus adoption of new varieties) and building capacity at the community level to ensure sustainable supply of quality seed at an affordable price. This involved partnerships with national research and extension services, governmental line departments, NGOs, private seed companies and communities (Monyo et al. 2003).

Model 1

Contract seed production by smallholder farmers for sale to commercial seed companies. Smallholder farmers produce certified seed of new varieties identified by international research centers and sell it to private seed companies, which provide logistical support and credit for inputs. ICRISAT, for instance, provides technical support for the production of good quality seed; a private seed company offers small-scale farmers contracts to produce seed, and buys it from them subject to quality.

Model 2

Promotion of improved seed through sale of small packets. In this model, seed is sold in small packs (500 g to 5 kg) instead of the usual 25 kg bags. ICRISAT has demonstrated that farmers who cannot afford the larger packs eagerly buy the smaller quantities, even at nonsubsidized rates. In the past two seasons, over 80% of the seed distributed in remote areas under the small pack program was purchased, thereby helping the spread of new varieties in drought-prone areas.

Model 3

Seed production and distribution through primary schools. Primary schools in rural areas multiply seed of improved varieties, with technical and logistical support from ICRISAT, government agencies and other partners. The schools distribute the seed to nearby communities, ensuring that smallholder farmers have access to affordable, high quality seed at a convenient distance from their homesteads.

BOX 2

Community Seed Banks in Southern Africa

Community seed banks usually store seed sourced from a wide range of individuals, informal groups and NGOs. The seed is primarily that which is retained from the participants' own production with no formal quality control.

A typology of community seed banks

All community seed banks store seed destined for crop production. Yet seed banks vary as to their storage methods and the institutional arrangements made to set up and maintain them. Based on the storage criteria, seed banks are classified into two broad categories (Lewis and Mulvany 1997).

- ***Individual seed storage**:* Farmers store their own seed; this is by far the most prevalent method of storing seed in the developing world.
- ***Collective seed storage**:* This type of seed storage occurs when farmers, either self-organized or assisted by outside organizations, coordinate storage arrangements. Although this type of seed storage does not have roots in indigenous cultures or yeoman traditions, there has been an increase in NGO-led, farmer-participatory collective seed storage projects (Berg 1996).

The other criteria employed to further subdivide seed banks are (1) type of seed, (2) seed exchange mechanisms, and (3) seed multiplication mechanisms. Based on these criteria, five types of seed banks have been identified (Lewis and Mulvany 1997).

- ***De facto seed banks:*** The sum of all seed storage in a community. These have been in existence for a long time, operate informally and are made up of separately stored, locally multiplied and modern varieties of seed, kept in individual households.
- ***Community seed exchange:*** Organized exchange of some stored seed from *de facto* community seed banks. They operate semi-formally and are made up of individually stored, locally multiplied and modern varieties.
- ***Organized seed banks:*** New institutions of organized seed collection, storage and exchange. They operate formally, and are made up of individually and collectively stored, locally multiplied, modern and farmer varieties of seed.
- ***Seed savers networks:*** New networks that organize storage and distribution of seed, mainly farmers' and noncommercial varieties, between individuals and groups across widespread geographical locations.
- ***Ceremonial seed banks:*** Sacred groves and reserves. The seed (usually vegetative) is a common property resource, collectively managed and exchanged according to local (often religious) customs and traditions. Seed conservation is not the primary function of these systems but does occur as a consequence of their existence.

The boundaries between these types of seed banks are indistinct. Moreover, the factors that define these categories are not necessarily static over time. In addition, it would be possible to subsume some seed banks mentioned above into a more generalized category.

BOX 3

Comparison of different types of community seed banks.

Type of seed bank	Rationale	Antecedents and institutional actors	Dominant type of seed	Physical quality of seed	Seed security	Equity of access	Economic sustainability
De facto community seed bank	Seed security/ production	Traditional: indigenous institution	Farmer varieties	Variable	Good but under threat	Somewhat limited access for poorer, women and ethnic groups	Good
Community seed exchange	Seed security/ production;	Traditional: indigenous institution;	Farmer varieties	Variable	Good	Majority have access	Good
• Tradition-al seed fairs	Improve seed exchange mechanisms	New: NGO/ community	Farmer varieties	Variable	Good	Majority have access	Good if it can be self-financed
• Seed shows/ competitions							
Organized seed banks	Seed multipli-	New: NGO/ grass roots	Farmer varieties	Potentially improved	Improved	Access for all	Good if it can be
• Multiplying farmer varieties	cation /conser-	group/ community	Farmer varieties	Potentially improved	Improved	Access for all	self-financed
• Multiplying ex situ seed	Seed con- servation	New: scientist/	Modern varieties	Potentially improved	Improved	Mainly benefits	
• Multiplying modern varieties	Seed multipli- cation	NGO/ community partnership	Modern varieties	Potentially improved	Improved	partici- pating farmers	Good
• Relief seed	Survival	New: Scientist/ farmers group partnership New: NGO				Poorest benefit most	Poor
Seed savers' network	Conser vation	NGO	Farmer varieties	Good	Good	Good	Good
Ceremonial seed banks	Religious	Traditional; Indigenous institution	Farmer varieties	Good	Good but under threat	Controlled by community leaders	Good

Where Informal Seed Systems Are Most Suitable? Informal seed systems may be the most appropriate in remote areas, where the formal sector finds distribution difficult and farmers can't reach seed markets easily. They may also be appropriate in smaller, limited agroecological zones, where the formal seed sector is disinterested or unable to cater because of a limited market for specific varieties or because widely marketed varieties do not suit that region. They are also suitable where the crops involved have a high seed rate and are bulky in nature, eg, groundnut pod, which translates into high transport costs.

Strengthening the stakeholders. Specifically, community seed programs should be provided with technical backstopping by international, national and/or state research institutes to strengthen the stakeholders and render them self-sufficient. The measures could include

- Farmers' participatory evaluation of genotypes suitable for their agroecological region;
- Maintenance of farmer-preferred varieties (landraces) currently being grown, as well as modern selected genotypes;
- Capacity building of stakeholders in seed production technologies, seed health and storage management and, in general, integrated pest and disease management strategies (Ravinder Reddy et al., 2006).
- Creating awareness of improved agricultural practices and disseminating information on improved seed material suitable for their agroecological region;
- Training farmers in better selection, treatment and storage practices of seed produced on their own farms. Training would help increase production through better use of the farmers' own genetic resources, indirectly conserving crop biodiversity in the region (Ravinder Reddy et al., 2007).
- Training farmers in seed health management and seed storage methods is important to preserve the viability of seed until the next season. Seedborne microorganisms and storage insects can make seed nonproductive during storage – a major problem for smallholder farmers. This is even more pronounced in leguminous seed, and control is particularly difficult;
- Training in selection and timely harvesting of a crop as well as postharvest precautions;
- Making varieties developed by national, international and state research centers available to smallholder farmers. These modern varieties must be

multiplied and disseminated through formal and informal seed delivery channels at affordable prices. Several such strategies have been implemented by ICRISAT and its partners in Tanzania (Rohrbach et al. 2002) and Zimbabwe (Monyo et al. 2003);

- Ensuring that village seed committee members undertake the responsibility of producing quality seed. Seed costs can be kept low only if locally produced seed stays nonprocessed and noncertified. The statutory standards of commercial seed are too expensive for the informal sector. Evolving a policy to certify village/community-based seed production without taxing smallholder farmers would offer greater scope for production of quality seed.

Interventions Required for Developing Informal Seed Systems

- Farmer-to-farmer seed exchange systems and local seed markets function throughout the project area of this study but are not adequately linked to systems for improved seed. Local NGOs, extension services, KVKs, social organizations and farmers' associations could play an important role in improving farmers' access to quality seed. If given an enabling legal framework, such organizations could help link farmers to other seed producers, research institutions and, importantly, small commercial seed companies working in similar agroecosystems locally and regionally.
- Traditional seed systems do not fully cater to current farmer needs. Even traditional crops and varieties benefit from maintenance of source quality seed (with varietal purity and seed health). For improved or national varieties, links between farmer seed producers and sources of foundation seed are important. Even more critical are linkages that allow seed producers access to new varieties, which is not available in the informal sector.
- Farmer seed producers can be efficient; at least some of them would have the potential to expand as specialized, small- or medium-sized local seed enterprises. Farmer associations, NGOs, KVKs and social organizations have a potential role in promoting improvement in production, marketing and distribution systems for traditional farmer seed producers. This may involve linkages with research organizations for technical backstopping and the formal seed sector for improved varieties. For these interventions to be sustainable, they must be based on training and market development and not on direct government subsidies.

- Sustainable and competitive groundnut seed systems require substantial reorientation of government policies and programs involving groundnut seed distribution. Rather than attempt to directly supply seed to farmers, they will need to provide support services that allow formal and informal seed enterprises to respond to market demand. This essentially seeks to offer farmers greater choice in terms of varieties and source of seed. Indirect subsidies, however, may still be important for competitiveness among enterprises.
- Government programs may focus on the development of the informal seed sector, linking NGOs, KVKs and farmer seed producers to sources of improved foundation seed and helping to expand marketing systems for farmer-produced seed. Programs will need to be vigilant in eliminating subsidized seed distribution which restricts development of a sustainable local seed sector. The key to success in strengthening informal seed systems will be improving farmer and seed producer access to information on product and seed prices and market options.
- Development of alternative seed systems for groundnut seed production and distribution in Anantapur and Kurnool districts is eminent. The formal seed sector has shown little or no interest in seed multiplication of crops like groundnut with high seeding and low multiplication rates. Transportation, processing, bagging and certification costs make the seed expensive for farmers. Community- or village-based seed production and distribution schemes have gained popularity in recent times. The concept of village seed banks involves improved seed and technical assistance focused on 'pilot' villages in order to train farmers in seed production, storage and distribution.

Identification of Components of Village-Based or Community Seed Production Systems

- Some of the major factors to be taken into consideration when developing village-based seed banks include need assessment, policy issues, market issues, appropriate technology, seed system studies, inputs, capacity building and funding.
- Plant breeding stands at the head of a long series of steps in seed provision. In order for the products of breeding to be delivered to farmers, there must be: (i) adequate, direct interaction between breeders and farmers, and (ii) careful coordination of all of the intermediate steps of seed provision.

- The nature of seed demanded by farmers differs. Large- and medium-scale farmers use markets to purchase uniform genetic materials that are highly responsive to chemical inputs and embody specific characteristics (eg, color and uniform grain size) rewarded by the market. In contrast, more subsistence-oriented smallholders may value characteristics such as drought tolerance, early maturity and good storage. Because of the small size of their landholdings, mixed cropping practices and strategy of minimizing production risks by diversifying the variety base, smallholders also demand smaller quantities of seed, but of a number of varieties of the same crop, and recycle seed over more seasons than larger commercial farmers.
- Strategies to improve seed quality must begin with strengthening public sector R&D on a long-term, sustainable basis. It will be especially important to build the capacity to move from homogenous seed recommendations to development and dissemination of varieties targeted to specific agroecological zones and the needs of different groups of farmers. To facilitate this process, target groups of farmers should be defined more precisely, zoning of breeding plots and field trials can be improved, and management incentive systems developed to reward researchers and extension agents when new technology is adopted by target groups.
- Strengthening public and private extension programs to increase farmer knowledge of the benefits of using new seed and transmitting information about farmer preferences to researchers will help increase the demand for new seed. Initiatives that lower production risks and improve postharvest product utilization which expands output markets are also important: seed users will be willing to pay more for new seed if their returns are increased by either lowering risks or increasing their revenues. Thus, measures to strengthen the downstream sectors of the economy are as important as strengthening the seed system itself.

Farmers need to be better integrated in every aspect of the seed system:

- as active participants in the seed research and release processes;
- as vital links in seed production and distribution through farmer-to-farmer seed exchange networks;
- as independent seed entrepreneurs producing seed for the local market; and
- as contract seed producers and informed agents/seed traders linked with private and public seed companies.

The government has a critical but different role to play in:

- providing public goods that promote efficient seed sector performance;
- developing and enforcing regulations for a heterogeneous seed sector;
- in the short- and medium-term, facilitating linkages between formal and informal sector seed suppliers as the seed system matures; and
- direct distribution of seed or seed vouchers following disasters.

Public research and extension agencies need to consider the needs of farmers who may be unable to purchase seed in the market but could benefit significantly from access to varieties with improved drought tolerance and disease resistance. For crops/regions where there is currently no commercial seed market, disseminating seed directly to farmers so that they are absorbed into the traditional system of seed supply may be a more effective strategy than trying to supply it through the higher-cost market channels, if the potential users are unlikely to be able to afford them.

- More recently, NGOs have played a role in strengthening the informal seed system, providing technical liaison with national and international research systems, educating farmers on seed selection, storage and processing, and providing technical and financial assistance to rural seed enterprises. This support has increased farmer access to improved varieties following the contraction of government-sponsored research and seed supply services. Two cautions are necessary, however: first, because NGO programs are temporary, instead of relying on them to link smallholders and research organizations, it would be better to create incentives and funding for research and extension systems to directly link with smallholder organizations. Second, a more careful analysis of the economics and sustainability of the smallholder seed firms being promoted by NGOs are needed.
- Farmers, irrespective of landholding, have draught and milch animals. Awareness about breeds and fodder is quite satisfactory due to the presence of milk cooperative societies. Small- and medium-scale farmers prefer local sorghum varieties for food and feed. There is a need for creating awareness and capacity building with regard to improved varieties of food-feed crops such as sorghum, pigeonpea and other forage crops (stylo, para grass and Napier grass). Large- and medium-scale farmers are aware of maize hybrids and their cultivation practices. Farmers are tending toward cultivation of maize hybrids because of higher returns per unit area.

Sorghum and pigeonpea crops are sown with own-saved seed by a majority of farmers across all groups. Some farmers are using F_2 generation (own-saved seed) maize hybrids with 20–30% less yield.

- The commercial demand for and cultivation of fodder/forage crops in many watershed villages is weak because of a poorly developed livestock sector in which animals are kept mainly on subsistence. The demand for fodder/forage seed depends on the development of the local livestock sector and a value-added industry to livestock products. If the livestock sector develops, particularly value-added industry, demand for intensive fodder cultivation is likely to increase. This will translate into demand for fodder seed.

Conclusion

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

Chapter VIII

Experience of Testing Innovative Informal Seed System Models: Case Study of Village-Based Seed Banks

The concept of village-based seed banks, which advocates self-sufficiency in production and distribution of quality seed, is fast gaining currency in the effort to strengthen community seed systems. This chapter describes our experience in testing innovative seed system models and presents the case study of a village seed bank in relation to its management, capacity building, farmer-participatory selection of varieties and management of seed production, processing, storage and community-level seed trade.

Introduction

Many attempts are on to revive the age-old concept of seed self-sufficiency. Village seed banks bring together seed-producing farmers and organize them to work in conditions of utmost transparency, mutual trust and social responsibility under peer supervision. An attempt was made at Karivemula village in Kurnool district of Andhra Pradesh, in the year 2002 to promote the concept of village seed banks with technical backstopping provided by the ICRISAT-led Watershed Consortium. Its objective was to ensure timely supply of quality seed of improved/high-yielding varieties to all groups of farmers as an approach toward increasing productivity and creating income-generating opportunities for better livelihoods to villagers. Much prior to this intervention, a reconnaissance survey of existing village seed systems was conducted to assess the needs of the stakeholders and to plan and develop appropriate seed bank model. This involved an in-depth study of the seed banks in the pilot villages in projects being conducted by the Asian Development Bank (ADB) and Tata-ICRISAT in Vidisha and Guna districts of Madhya Pradesh, India. This helped identify gaps so that the concept could be refined and implemented in the Andhra Pradesh Rural Livelihoods Program (APRLP) sites in Andhra Pradesh, India.

The Village Seed Bank Concept

The case studies from Madhya Pradesh provided a good deal of information. Though the communities were motivated enough to carry the process through, it was found that the lack of a scientific backup was a limitation. Such lessons learnt were put to practice in the APRLP-ICRISAT program basic objective is production enhancement to improve rural livelihoods. The main objectives of the village seed bank (VSB) concept is to make easy availability of seeds of improved cultivar to increase productivity and improve livelihoods of small-scale farmers were:

- Introduction of improved varieties and farmers' participatory selection of varieties
- Support the concept with scientific tools and community participation
- Build capacity of farmers and project staff in seed production techniques
- Incorporate lessons learnt from previous experience
- Develop a site-specific seed bank model
- Identify suitable seed production sites
- Address seed health and storage management aspects

In this process we tested two models: (1) Individual farmer as seed bank (Figure 10.1) in Devanakonda village in Kurnool district of Andhra Pradesh and (2) Village based seed bank (Figure 10.2) in four nucleus watershed villages, at Mallepally village in Nalgonda, Malleboinpalla in Mahabobnagar, Lingareddy pally in Anantapur and Karivemula village in Kurnool districts of Andhra Pradesh. Our experiences in testing these models and the results obtained are detailed below.

The scenario

The project addressed the most common issue that is common to most villages in the project area: lack of reliable seed supply systems for food-feed and legume crops. This problem is mainly due to the fact that the parastatal seed enterprises have not been able to meet the targets involved in this task. The reality is: there is some commercial seed supply, but without hybrid technology the incentives for the private sector remain limited. Use of hybrid seed by small- and medium-scale farmers remains a dream due to lack of access, availability, timely supply and affordability. The most important aspect of hybrid technology is that the farmer has to buy seed every year. He cannot save his own seed and use it in the next season. Nongovernmental and

other local organizations have begun to experiment with a wide range of seed provision innovations, but these are limited in scope. The most effective strategy will involve a combination of public, commercial and local participation, but much work remains to be done to identify the most effective and equitable formulation.

In the meantime, farmers have inadequate access to improved seed and are unable to take advantage of new varieties developed by national and international agricultural research. Uncertain production environments, particularly the threat of drought, add to the instability of the current seed provision. Policies that seek to diversify local agriculture systems are difficult to implement because of this inadequacy. Therefore, there is an urgent need to identify appropriate policies and strategies to expand and diversify national seed systems.

Model 1: Individual farmer as seed bank

The objective of this study was to develop a model with the "individual farmer as seed bank" supported by scientific tools to produce improved varieties that enhance crop productivity' create access to improved varieties; and make available seed at the right time and at affordable prices to resource-poor farmers. Such a model was developed on the basis of an analysis of the reconnaissance survey and tested in Devanakonda village in Kurnool district of Andhra Pradesh

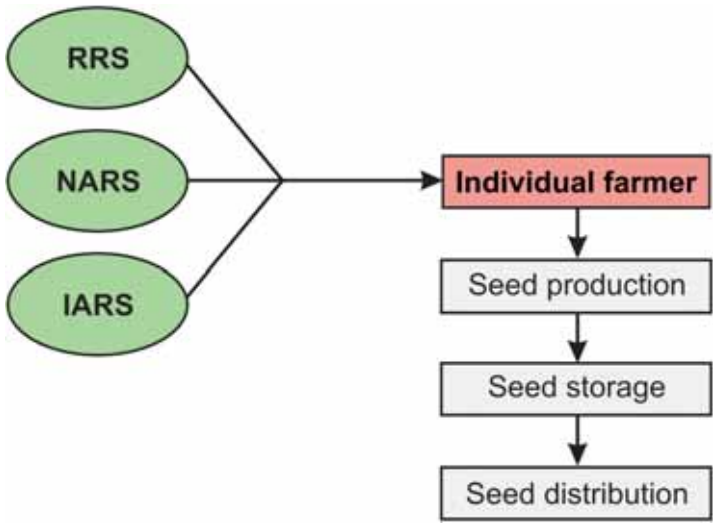


Figure 10.1 Model 1: Individual farmer as seed bank

The Process

Our reconnaissance survey studied a village seed system that has perhaps been in operation for centuries. The big farmers here play a key role in it by storing large quantities of grain in their storehouses for two purposes: first, to sell the grain during the off-season at higher rates; and second, to sell the grain as seed to village farmers in drought years or when there is a shortage of seed. Small and resource-poor farmers source their seed from these large-scale farmers. The general practice is to repay in cash or kind 1½ times the grain borrowed. In some villages, the big farmers have started small, informal seed businesses. They grow open-pollinated varieties (OPVs) under irrigated conditions specifically for the purpose of seed in the case of groundnut, but without using breeder/certified seed and not applying any other quality parameters for seed production/certification.

In recent years, farmers in Anantapur district have come to believe that sowing groundnut seed produced in the *rabi* (postrainy) season gave higher yields than *kharif* (rainy) season seed. They also believe that sowing seed produced in fields other than their own field will yield higher. This is one of the reasons why groundnut farmers do not save their own seed in that district and depend on external sources every year.

To begin with, groundnut breeder seed was distributed (Table 10.1) to select farmers in Denanakonda in the rainy season of 2003. Exercises were conducted to make farmers participate in selection of varieties and the selected variety was

Table 10.1. Quantity of groundnut seed distributed during rainy season 2003

Improved Variety	Quantity (Kg)
ICGS 11	50
ICGS 76	50
ICGV 86590	50
TAG 24TMV 2	10

taken up for seed production by interested farmers in the postrainy season under irrigated conditions. On-station and on-farm capacity building of selected farmers was undertaken, and NGO personnel, watershed development teams (WDTs) and village para workers were trained in seed production techniques as well as crop protection aspects like Integrated Pest and Disease Management (IPDM), seed storage and seed health

management. Almost 75% of the land in Devanakonda is normally used for groundnut cultivation during rainy season, and there was considerable interest among farmers in growing improved varieties.

Table 10.2. Groundnut seed produced and sold by individual farmers in Devanakonda village of Kurnool district , Andhra Pradesh.

Year	No. of farmers	Varieties	Seed sold (quintal)		Seed retained for own use (quintal)
			Cash	Kind*	
2003	2	Improved***	18	2	25 (45) **
		Local	20	-	6 (26)
2004	5	Improved	23.5	2	21.5 (47)
		Local	39	6	22 (62.5)
2005	6	Improved	35	3	18.5 (56.5)
		Local	25	-	12 (37)

* Seed sold on the basis of repayment in kind.
** Figures in parentheses are total quantity of seed produced.
*** Improved varieties mentioned in table 10.1

It is evident from the results of the intervention that there was an increase in the number of individual farmers who took up seed production of improved varieties and sold the seed to other farmers in the village besides using for his own farm. The sales were predominantly on a cash basis rather than kind (Table 10.2). Here we see a shift in the local seed system among smallholder and resource poor farmers, where farmers are willing to invest on inputs like improved variety and good quality seed because of access to them, timely availability and affordable costs.

Several studies done in Africa have observed that modes of seed exchange are changing as most farmers are at least partially integrated into the market economy (Lewis and Mulvany 1997). The exchange of small grain-seed used to be generally free of charge, or bartered for labour, an axe, or any other material of common interest but it is now on a cash basis. Mugedeza (1996) notes that selling seed to other farmers has become the most prevalent form of exchange in Zimbabwe.

In Karivemula, there was an increase in the production of seed of improved and local varieties as well as in the number of farmers engaged in this activity. We also noticed a shift in the local seed system in which smallholder and resource-poor farmers were willing to invest in inputs like improved varieties and good quality seed because they now had access to them at the right time

and the right price. This change in attitude is a positive indication that farmers are willing to adopt technology suitable to their eco-region provided there is access and availability of materials in their vicinity. The concept of 'individual farmer as seed bank' has the potential to be a successful innovation in local seed systems. By giving the support of scientific tools to a traditional system of seed exchange, this innovation can be sustainable in disseminating improved varieties and improved production technologies at the village level.

Pros and cons of the model

- This model can be tried even in remote areas where NGOs are reluctant to take up operations.
- External finance not required as all costs are met by farmer/ seed producer.
- It is effective and provides wider scope for dissemination and adoption of improved varieties through informal seed channels.
- Using technical institutional services may not be justifiable for individual farmers.
- Farmers are still unwilling to save seed because of storage pests and other financial debts.
- Procurement of breeder seed would be difficult at the farmer level once the project is completed.
- There is no control on the selling price of seed.
- There is no control on seed distribution to different communities in the village.
- Seed distribution is limited to select groups.

Model 2: Village based seed banks

The village based seed bank is graphically represented below in Figure 10.2, and the process involved is discussed hereunder.

Process

Project implementing agency (PIA) jointly with SHG implemented the project in liaison with research institutes group [Regional Research Stations (RRS); (International Agricultural Research Centers (IARC); National Agricultural Research Centers (NARC)} for technical backstopping and with donor agency for financial support. The PIA will identifed the potential

farmers and project staff for training course. The course constituted of technical details about the seed production, varietal characteristics, isolation distance, purity standards, rouging of off-types, pest and disease management. post-harvest practices like seed cleaning, health and storage management were taught during training at appropriate time. Farmers with the help of PIA were encouraged to question the seed production process and formulate their own bylaws to enforce quality seed production among fellow farmers. This model was tested in four nucleus watershed villages, at Mallepally village in Nalgonda, Malleboinpalla in Mahabobnagar, Lingareddy pally in Anantapur and Karivemula village in Kurnool districts, PIA and Seed bank committee has passed informal resolution for quality seed production in their respective villages. Karivemula, a nucleus watershed village in Kurnool district, was chosen as the pilot village and the results of our intervention are presented as a case study.

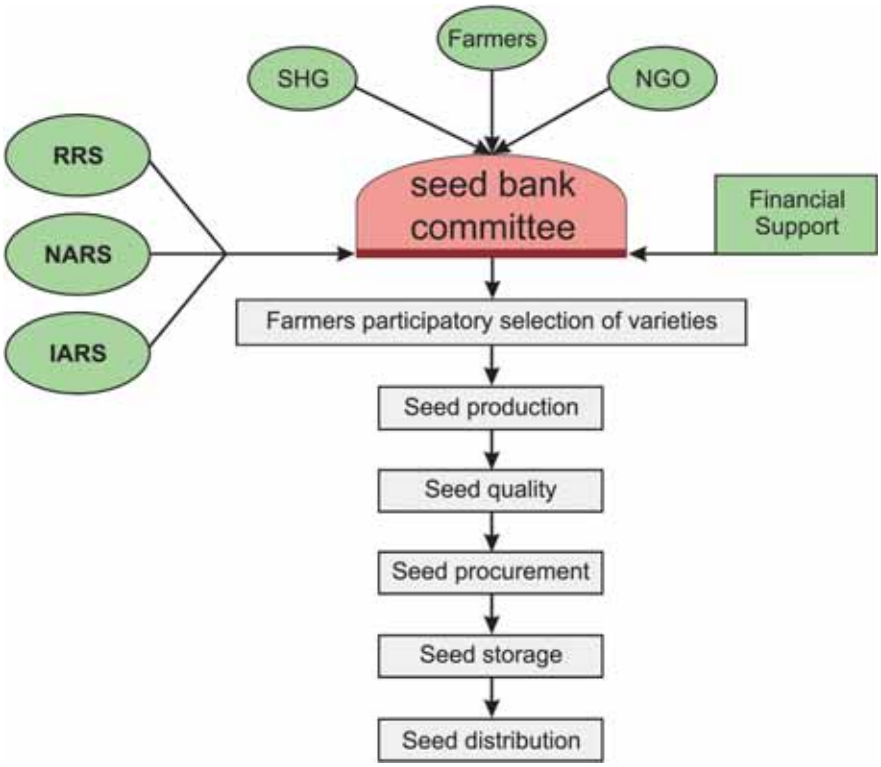


Fig. 10.2 Model 2: Village based seed bank

1. Reconnaissance

Before upscaling the seed village concept in APRLP project villages, a rapid rural appraisal (RRA) was undertaken to get an overall picture of the existing seed systems in the project area. This was done by interviewing a total of 36 informal farmer groups in three watershed villages each in Mahabubnagar, Nalgonda, Anantapur and Kurnool districts. Informal group discussions were held with different groups of farmers – invited on the basis of their landholdings: small (<1ha), medium (2-5ha) and large (>5ha) – and also individual interviews with village leaders, NGOs and progressive farmers. A cross-sectional representation of small-, medium-, and large-scale farmers with agriculture as their main occupation was selected for the informal group discussions. Observations and data collected during the informal interviews in different watershed villages were documented (Ravinder Reddy et al. 2006).

Findings of village survey

a. Farmers' sources of seed

The survey revealed that traditional seed systems are location-specific and vary greatly within farmer communities. Farmers' sources of seed and seed delivery systems are discussed more fully in the chapter VI: Seed Systems of Food-Feed Crops in the Semi-Arid Tropics of Andhra Pradesh, India.

- Karivemula has a vibrant agricultural economy. The most important crop is groundnut, which is grown in over 400 ha. The other significant crops are tomato (320 ha), cotton (192 ha), sunflower (160 ha), pearl millet (120 ha) and chillies (40 ha).
- Over 70% of smallholder farmers depend on other sources for groundnut seed.
- Awareness of improved groundnut varieties is poor.
- The average groundnut pod yield from local varieties is 750–1250 kg ha^{-1}.
- Over 95% of the cultivators own small/medium-sized landholdings (Table 10.3) and are not aware of improved cultivars (Table 10.4).

Table 10.3. Farmers' landholdings in Karivemula.

Farmer category	Proportion (%)
Smallholder farmers (<1 ha)	39.9
Medium-scale farmers (1–5 ha)	55.9
Big farmers (>5 ha)	4.1

Table 10.4. Farmers' knowledge of seed of improved varieties in Karivemula.

Farmer group	Awareness about improved varieties[1]
Smallholder farmers (<1 ha)	*
Medium-scale farmers (2–5 ha)	*
Large-scale farmers (>5 ha)	**

1. Groundnut, pearl millet, finger millet, pigeonpea.

* Poor; less than 25% farmers are aware of improved varieties; ** Average (50-75% farmers are aware of improved varieties; *** Good above 75% farmers are aware of improved varieties.

- The majority of medium-scale landholders and almost all large-scale farmers use their own seed for sowing while smallholders depend largely on external sources for seed (Table 10.5).

Table 10.5. Sources of groundnut seed in Karivemula.

	Seed source		
Farmer category	Own-saved seed	Nonorganized markets and government supply	Borrowed from other farmers[1]
Smallholder farmers (<1 ha)	30%	20%	50%
Medium-scale farmers (2–5 ha)	40%	30%	30%
Large-scale farmers (>5 ha)	100%	-	-

1. Groundnut seed is borrowed and repaid in kind in the ratio of 1:1.5.

Most small- and some medium-scale farmers source groundnut seed from other farmers, nonorganized markets, moneylenders, fertilizer/pesticide dealers and government agencies which supply subsidized seed. Government agency distribution of seed for each household is not fulfilling the complete seed requirement of the farmer and hence he has to depend on other sources to fulfill his seed requirement.

b. Productivity constraints

- Frequent droughts
- Low soil fertility
- Poor soil water conservation practices
- Low-yielding crop varieties
- Poor extension services on crop production
- Uncertainties of prices and markets
- In groundnut, seed accounts for a major input cost

- Poor credit facility and high interest rates charged by private moneylenders
- Poor awareness, nonavailability availability and inaccessibility of improved varieties
- Poor seed quality

Based on the findings of the survey, it was decided to organize the farmers of Karivemula to start a village seed bank on a pilot basis. The findings gave an insight into the areas that needed emphasis during mobilization. It was decided to approach the problem holistically by taking into consideration the cultivators' constraints. Quality seed needs to be facilitated with scientific practices to yield the best results; therefore, special emphasis was placed on developing an alternative seed system through a consortium approach (see APRLP-ICRISAT consortium diagram (Fig. 10.3) by involving agricultural universities, regional research stations, the state agriculture department, national agricultural research centers (NARCs), international research centers (IRCs), nongovernmental organizations (NGOs), community-based organizations (CBOs) and farmers. The following activities were undertaken to develop the village seed bank (VSB) with technical backstopping by several agencies mentioned above :

- Farmer-participatory selection of varieties
- Improved crop production practices
- Seed treatment with appropriate protectant chemicals
- Nutrient management based on soil analysis
- Appropriate soil and moisture conservation measures
- Pest and disease surveillance and integrated management
- Right harvesting time, method and seed storage techniques
- Seed health management

2. Formation and management of VSBs

The concept of village seed banks (VSBs) was received with great enthusiasm by self-help groups (SHGs), village organizations (VOs) and project implementing agencies (PIAs) in the watershed villages. The proposal for constituting a village committee to manage the seed bank was successfully implemented. The secretaries of the village organizations and SHGs became members of the VSB committee and were given the responsibility of seed production, procurement, storage and fixing the procurement and selling prices of seed. The PIA, usually an NGO, and the VSB committee passed resolutions to ensure the quality of seed and redistribution of procured seed

in the village. Their responsibilities also included decisions regarding allocation of seed quantities to each farmer in the nucleus watershed (Karivemula village)and satellite villages (five villages around the nucleus watershed).

3. Capacity building strategy

In order to harness synergy between technology and community participation, special emphasis was placed on building farmers' capacity to produce quality seed. Systematic and timely training programs on seed production were developed, and logistics planning was used to attain the objectives.

A peripatetic training strategy was adopted for attaining maximum coverage in the given time. In each nucleus watershed village, two persons each from the PIA/NGO and watershed development team (WDT) apart from 2–3 interested farmers and ICRISAT field staff were targeted for training. The method followed in the Karivemula nucleus watershed village was replicated in all the other watershed villages of the APRLP–ICRISAT project. About 15–20 farmers were trained at each site. The consortium mode of execution is given in Figure 10.3.

The PIAs were asked to identify potential trainees from among the farmers and project staff.

They were assigned the responsibility and liberty to make arrangements best suited to their conditions. The course consisted of technical details relating to the VSB concept and seed production. The trainees were taught the principles of seed production, varietal characteristics, isolation distance, purity of seed, pest and disease management in seed production plots, and seed health and storage management. On-farm training in identifying and controlling pests and diseases and seed health management strategies was imparted. Posters and illustrations were used as teaching aids. Posters reiterating key points were displayed in the PIA's offices for ready reference after the conclusion of the training program. Farmers were encouraged to come up with queries about the seed production process and formulate their own bylaws to enforce quality seed production among fellow farmers. The PIAs, VSBCs and farmers together passed a resolution to make production of quality seed morally binding on the community.

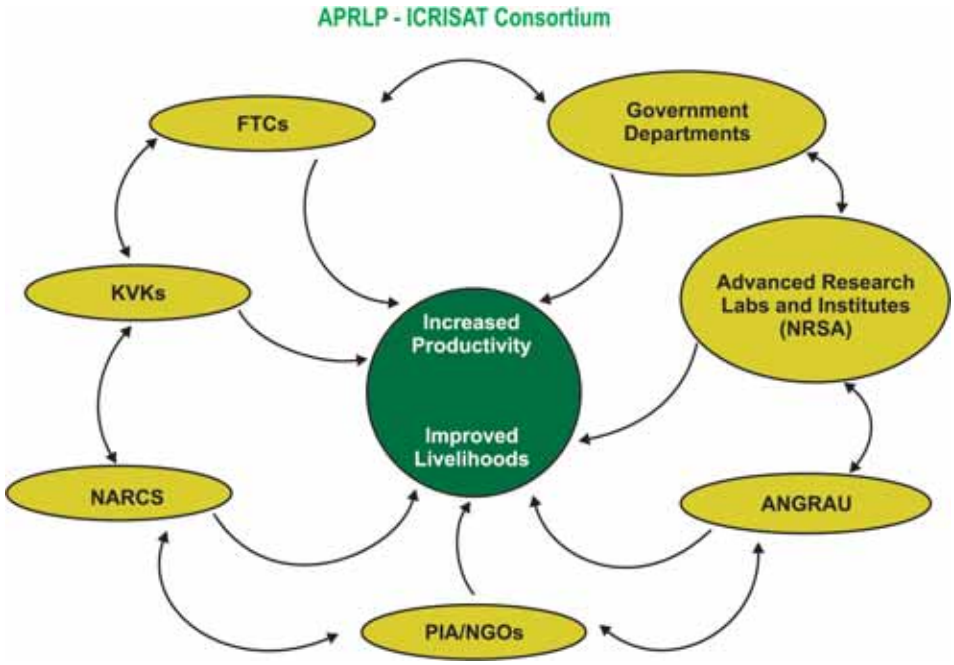


Figure 10.3 APRLP-ICRISAT consortium approach

4. Farmers' participatory selection of varieties

In the rainy season of 2002, breeder seed of selected varieties of different crops were procured from various research stations (consortium partner institutions) and provided at a subsidized price (Table 10.6) to farmers who volunteered to take up on-farm trials of the seed with their local varieties as control. At the end of the season, PIAs, VOs and the farmers were involved in evaluating these varieties on the basis of pod yield, fodder value and other varietal characters. The farmers of Karivemula selected three varieties of groundnut, ICGS 11, ICGS 76 and ICGV 86590, saved the seed and multiplied it during the postrainy season. In the rainy season of 2003, seed production of different crops and selected varieties was taken up. The seed was procured by the VSBC (Table 10.7) and distributed on demand to other farmers in the village.

Table 10.6. Distribution of breeder seed (kg) in watershed villages during rainy season, 2002.

WatershedVillage	Castor	Castor	Pigeonpea	Greengram	Sorghum	Pearl millet	Groundnut
	Jyothi	Kranthi	Asha	MGG 295			
Nalgonda	900	850	1400	1450	550	400	-
Mahabubnagar	1000	1750	1850	285	850	0	-
Kurnool	220	310	1100	330	425	900	300
Total	2120	2910	4350	2065	1825	1300	300

5. Monitoring seed production

During the seed production process, PIAs, VOs, seed growers and ICRISAT scientists jointly inspected the production plots. The farmers were trained and given technical guidance on the different steps of seed production: selection of the field, identification of varietal characters, removal of off-type plants (rouging), disease and pest control measures, precautions to be taken during harvesting and threshing and information on seed health, grading and storage management.

6. Seed health management

The following guidelines were developed to help farmers understand and adopt seed health management in select crops.

a. Groundnut seed and pod diseases

- Treat the seed with Benlate® + captan (1:1) at the rate of 3 g kg-1.
- Select healthy plants for the purpose of seed and harvest pods separately.
- Maintain optimum plant water relation to harvest fully mature kernels.
- Grade the seed, and select bold seed for sowing; and discard small, shriveled, discolored ones.
- Avoid nonmature, semi mature, moisture-stressed or over mature kernels.
- Do not harvest seed crop on cloudy and wet days.
- Dry pods properly and store them in a well-ventilated place.
- Sow seeds at a depth of 3.75–8.75 cm depending on soil moisture – this facilitates good seedling emergence.
- Rotate the crop every 2–3 seasons with cereals such as sorghum, maize and millet to reduce the inoculum of soil- borne diseases.
- Uproot dead and wilting plants every week and destroy them.

b. Castor wilt

- Treat the seed with 2 g kg^{-1} carbendazim followed by 10 g kg^{-1} *Trichoderma viridi*.
- Apply farmyard manure (FYM) (190 kg ha^{-1}) mixed with Trichoderma viridi 2.5 kg ha^{-1}.
- Pull out disease-affected plants at regular intervals from flowering to maturity and burn them.
- Avoid using fields prone to water logging for seed production.
- Avoid collection of seed from wilted plants.

c. Pigeonpea wilt

- Harvest seed from disease-free plants.
- Treat seeds with Benlate® + thiram (1:1) 3 g kg-1 seed.
- Intercrop with cereals sorghum, pearl millet and maize.
- Uproot wilted plants at regular intervals from flowering to pod maturity and use them as fuel.
- Avoid collecting seed from wilted plants.

7. Seed procurement

The farmers and members of the seed committee inspect the quality of seed not only at the time of procurement but during seed production too. A sample of the seed is kept aside from each seed lot and subjected to germination tests before seed distribution in the next season. The seed committee and the farmers fix the procurement price, which usually is 5–10% above the market price. The seed procurement prices of different crops in Karivemula during the season, November, 2004 are given in (Table10.7) and the quantity of seed procured in Table10.8. The committee decides the selling price after taking into consideration the market prices of seed and grain.

Table 10.7. Seed procurement prices fixed by the village seed bank committee of Karivemula.

Crop	Seed procurement price (Rs kg^{-1})	Grain price range in market (Rs kg^{-1})
Groundnut	17.50	15–17
Castor	15.00	13–14
Pigeonpea	17.50	14–16

Table 10.8. Quantity of seed procured by village seed bank in Karivemula

2004				
Watershed village seed procured	PIA (NGO)	Crop	Variety	Quantity (tons) of
Karivemula-Kurnool district	Awakening people action for rural development (APARD)	Groundnut	ICGS 11	16.08
			ICGS 76	64.34
			ICGV 86590	12.10
		Pigeonpea	Asha	9.00
		Castor	Kranthi	5.50
2005				
Karivemula-Kurnool district	Awakening people action for rural development (APARD)	groundnut	ICGS 11	3.00
			ICGS 76	10.00
			ICGV 86590	5.60
			TAG 24	21.70
			TMV 2	10.300
2006				
Karivemula-Kurnool district	Awakening people action for rural development (APARD)	Groundnut	ICGS 11	3.00
			ICGS 76	4.00
			ICGS 91114	13.00
			TAG 24	20.00
			TMV 2	162.00
		Pegionpea	LRG 41	5.36
		Chickpea (Bengalgram)	KAK 2	7.6
			JB 11	4.50

Village seed bank concept extended to satellite watershed villages in year 2005, Karadikonda and Jillelabudka produced 6000 kg of groundnut seed (TAG 24-4000kg and TMV 2-2000kg) and 1000 kg each of TMV2 and TAG 24 respectively in Devanakonda Mandal of Kurnool district.

Thus, the committee ensures that the farmers have an incentive to sell and buy seed within the village. However, it was seen that large-scale farmers saved their own seed and distributed it to relatives and friends in the village and elsewhere.

8. Funding

The money required for the procurement of seed from farmers (seed producers) was secured from the District Water Management Agency (DWMA), a government of Andhra Pradesh organization funded by the Department for International Development (DFID), UK.. The amount was

extended to the VOs mediated by NGOs as a revolving fund (Figure 10.4). The VO in turn funded the HGs involved in seed production at a minimum interest rate.

9. Seed storage management

The PIA and SHG are given the responsibility of selecting a proper place for seed storage, normally a house with a reinforced cement concrete (RCC) roof, stone flooring and cement walls. The house is cleaned and whitewashed, and the walls and floor sprayed with Malathion at the rate of 2 mL L^{-1}. The seed bags are sun-dried for a couple of days and sprayed with malathion before being filled. All legume seeds are sun-dried and stored in clean gunny bags and fumigated with aluminium phosphide at the rate of 3 g cu mt^{-1}. for 5–7 days.

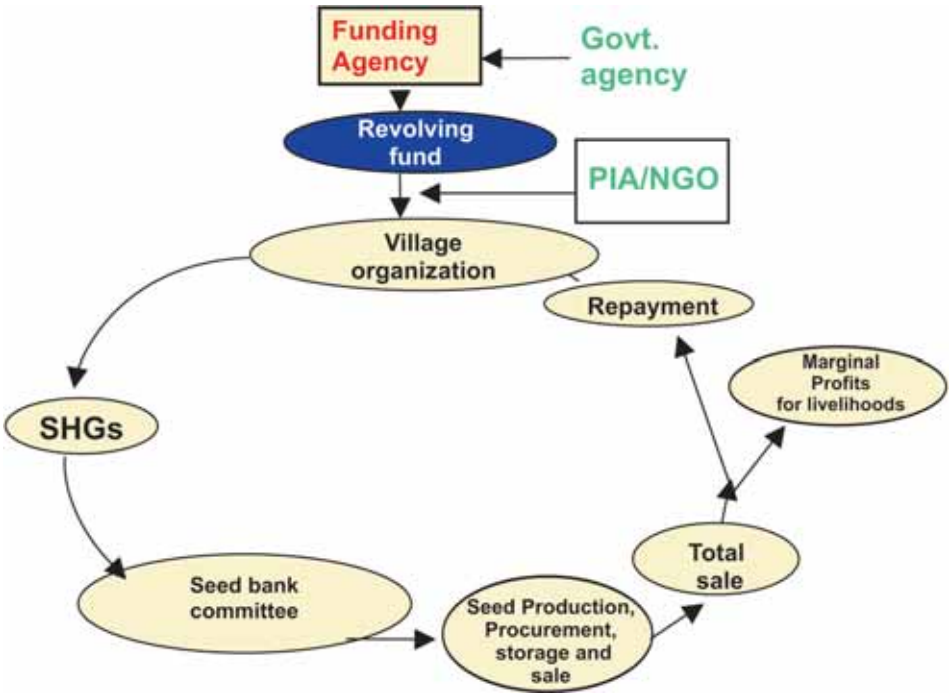


Figure10.4 Fund flow diagram of village seed bank.

Guidelines for seed storage

The following guidelines are followed for proper storage of the seed.

a. Preventive measures

- Use new bags to avoid insect infestation and mechanical mixture.
- Thoroughly clean and whitewash the storage structure.
- Disinfect seed storehouse with a residual spray of insecticide such as malathion 50EC (one part per 100 parts of water) at the rate of 5 L 100 sq m^{-1}.
- Make sure that stacking and labelling is done properly while arranging seed bags.
- Ascertain that seed is properly dried before storage.
- Store seeds of different types such as cereals and pulses separately to avoid the spread of insect attack.

b. Maintenance of seed store

- Make sure that the processing units and storage structures are always clean.
- Keep all sweeps away from the seed godowns so that insects do not breed and reinfest seed.
- Carry out inspections of seed lots in storage structures at least once a fortnight. Fumigate seeds thoroughly if insect infestation is detected.
- Fumigate with aluminium phosphide (2–3 tablets of 3 g each per ton of material with an exposure period of 5–7 days or 1 tablet per cu m space). Fumigation may be done at intervals of 40–50 days.
- Carry out periodic sampling (30–40 days) to check for insect infestation.

Seed treatment

Regardless of their circumstances or location, farmers are invariably concerned about the quality of the seed they use. The time from sowing to plant establishment is of critical importance in nearly all cropping systems. Based on their own experience and the good results obtained from farmers' participatory on-farm trials on seed treatment (Ravinder Reddy et al 2006), the VSBC resolved to treat seed prior to distribution. They concluded that

treatment plays an important role in protecting seed from seed and soilborne pathogens; also, it works out to be more effective and more economical. The VSBC's treatment of seed is detailed in Table 10.9.

Table 10.9. Seed treatment schedule adopted by village seed bank.

Crop	Seed treatment	Dosage (g kg^{-1} seed)
Pearl millet	Thiram	2.5
Groundnut	Benlate® + captan (1:1)	3.0
Pigeonpea	Benlate® + thiram (1:1)	3.0
Castor	Carbendazim	2.0

Benefits of seed treatment

- Inexpensive and effective method of disease control
- Easy to apply and saves time
- Uniform protection all over field
- Inexpensive crop establishment insurance up to seedling stage
- Protects seed and seedlings from seed and soilborne diseases
- Increases germination percentage.
- Reduces number of chemical sprays and environmental pollution
- Increase in yield.

10. Seed distribution /Marketing

The VSBC resolved to sell seed only to farmers of the village and release small quantities to satellite villages. In case of there being a surplus, it would be sold to individual growers of other villages through their SHGs at the same price as to local farmers. The seed marketing was never been a constraint because VSBC constituted of members from CBO supported the seed bank activities.The selling price was fixed at less than the commercial market price and more than the procurement price. The difference in price was to cover expenses such as the premium paid to seed producers, processing costs, salaries, wages, electricity, bags, chemicals, rent, cost of seed treatment, transport and cleaning losses and interest on the capital. The quantity of seed distributed in the village is given in Table 10.10.

Table 10.10. Seed distributed in Karivemula

Year/crop	Quantity seed distributed (quintals)	No. of Farmers benefited	Area (ha) under improved varieties
2004			
Groundnut	92.0	46	36
Pigeonpea	8.65	83	173
Castor	5.00	110	-
2005			
Groundnut	145.3	68	142
2006			
Groundnut	202	87	202
Pegionpea	5.36	76	137
Chickpea	12.1	96	26

Farmers of the neighboring villages approached the VSBC of Karivemula for seed in May-June, and priority was given to those who had registered in advance by paying Rs 100. In satellite villages, the responsibility of seed distribution was given to the respective SHG. While distributing seed (groundnut pods) to farmers, a pack of seed treatment fungicide was also given with appropriate instructions and advice on improved crop management practices.

11. Adoption of improved varieties

The area under improved groundnut varieties in Karivemula increased from 1.2 ha in 2002 to 8 ha in 2003, 36 ha in 2004 and 142 ha in 2005, and 202 ha in 2006 and the number of farmers adopting new varieties from 3 in 2002 to 87 in 2006 (Table 10.10).

Table 10.11. Adoption of improved varieties of groundnut by farmers in Karivemula.

	Number of farmers				
Variety	2002 rainy season*f*	2002 postrainy season	2003 rainy season	2004 rainy*f* season	2005 rainy season
ICGS 11	1	1	4	17	4
ICGS 76	1	2	6	21	7
ICGV 86590	1	1	3	12	11
TAG 24	-	-	-	5	24
TMV 2	-	-	-	-	22
Total	3 (1 ha)	4 (2 ha)	13 (8 ha)	50 (36 ha)	68 (142 ha)

About 400 ha was expected to come under improved varieties in the rainy season of 2008 in the nucleus watershed village. Information and awarness about improved varieties and VSB activity spread to the satellite watersheds through farmer interactions, relatives, farmers' day celebrations and local newspapers.

Table 10.12. Effect of improved varieties of groundnut on pod and haulm (fodder) yield.

Variety	Pod yield (kg)	Increase in pod yield over local variety (%)	Haulm yield (kg ha^{-1})	Increase in haulm yield over local variety (%)
ICGS 76	2380	73	2670	34
ICGS 11	2128	54	2200	11
ICGV 86590	1916	39	1968	1
Local cultivar	1374	-	1989	-

Livelihood options

Since improved varieties were now available within the village at reasonable prices, farmers were able to take up sowing on time. This led to a 55% increase on an average in pod production, 15% increase in fodder production (Table 10.12), and Rs 12,500 ha^{-1} increase in income over the local variety in 2003–04. In many parts of the semi-arid tropics, crop residues are the main source of feed for livestock. In India, crop-residues from dual-purpose crops including rice, wheat, sorghum, pearl millet, pulses and oil seeds account for up to 60% of total feed (Parthasarathy Rao and Bhowmick, 2001). In the northern part of Nigeria, the major sources of feed are crop residues of sorghum, maize, millet, cowpea and groundnut. Despite the massive amounts of crop residues saved and fed to livestock, feed shortage and low quality feed remains a major constraint to smallholder livestock production. (Roothaert et.al.2006a) . These models or technologies developed consist of dual-purpose legume and cereal varieties that have higher food and crop residue yields, better feeding value of crop residues, and management practices that improve either yields or feeding value, or both, (Roothaert et.al. 2006b). In India an improved dual-purpose groundnut variety, ICGV 91114, produces higher pod and fodder yields than the local variety, and has the potential to raise milk production by 10% due to high feeding value of its haulms (ICRISAT, 2006).

The adoption of dual-purpose improved groundnut varieties led to an improvement in livelihoods in terms of increased production and higher returns per unit area.. The VSB concept also set in motion an alternative seed system, guided farmers toward much-needed seed security and increased awareness about new/improved crop varieties and production technologies. It also contributed significantly to revenue generation (Table 13.)

Table 10.13. Revenue generated by self-help groups through village seed bank in Karivemula, 2004.

Crop	Quantity of seed seed procured (quintal)	Seed purchase price (Rs kg^{-1})	Seed selling price (Rs kg^{-1})	Gross profit (Rs)
Groundnut	92.42	17.50	20.00	23105.00
Castor	5.00	15.00	20.00	2500.00
Pigeonpea	8.65	17.00	22.00	4325.00
Total income				29830.00
Expenditure[1]				8500.00
Net income				21330.00

1. Includes seed store rent and expenses on seed cleaning, grading, packing and pest control.

Positive Results and Lessons Learnt

The implementation of the seed bank concept in the APRLP-ICRISAT project sites provided a good learning opportunity for the project staff. Encouraged by the results in Karivemula, the government of Andhra Pradesh has adopted the seed bank model developed by ICRISAT for upscaling in 322 mandals in the state to strengthen alternative seed systems. The results of this intervention will encourage SHGs, NGOs, KVKs and farmers to invest in small-scale rural seed enterprises, which will duly enhance adoption and dissemination of new improved varieties and production technologies.

- The seed production capacity of smallholder farmers can be developed by providing linkages to institutions and NGOs for technology backstopping.
- The program disseminated improved open pollinated varieties (OPVs) to smallholder farmers in dryland areas. This can greatly accelerate the diffusion of improved varieties.
- Small seed producers are motivated by the incentive of higher procurement prices for seed produced by them.
- The new varieties are of longer duration than the local varieties.

- There is low preference/acceptability in the market for the new varieties.
- The selling price of improved varieties is lower by 10–15% in the local markets.
- The new varieties yield 55–60% more than the local cultivar.

Frequently Asked Questions by Farmers

- "Who will buy our seed? At what price?"
- "Where do we store seeds until the next season, protected from biotic and abiotic factors?"
- "Can we store seed safely in village conditions?"
- "Can we sell seed without any legal problems?"
- "Where can we source breeder seed?"

Farmers' Concerns

- Maintaining minimum isolation distance is a practical problem during the rainy season. Pigeonpea and castor, which need such a practice, are grown in almost all villages in Nalgonda and Mahabubnagar districts, particularly by smallholder farmers.
- Seed production in the postrainy season is acceptable but the lack of assured irrigation is a constraint. Low yield and high cost of cultivation are concerns for pigeonpea during the postrainy season.

Advantages of VSBs as farmers see them

- Availability of improved seed varieties in sufficient quantity within the village
- Assured and timely supply of seed
- Decentralized seed production
- Availability of improved variety seed at low prices
- Improved seed delivery systems to resource-poor farmers
- Reduced dependence on external seed sources and hence an effective measure to curb the spurious seed trade
- Encourages village-level trade and improves village economy
- Invokes social responsibility of farmers in seed production and delivery
- A step ahead toward sustainable crop production
- Avoids introduction of diseases through seed (seedborne pathogens) produced and imported from different agroecoregions
- Scope for farmers' participatory varietal selection
- True-to-type varieties and healthy seed within farmers' reach.

Constraints

- Farmers' reluctance to adopt quality seed production practices
- Additional investment for inputs in seed production
- Lack of buy-back assurances from SHGs/NGOs/VSBCs
- Lack of proper seed storage facilities in villages
- Lack of funds with SHGs/NGOs for seed procurement, seed packing, storage and transportation
- Difficulties in fixing a minimum support price for seed procurement
- Lack of technical support for seed production and monitoring
- Assigning responsibility for quality control aspects and monitoring of seed production
- Availability, access and procurement of breeder seed at regular intervals

Impact

Planning to scaling-up of the VSB concept, the model developed by ICRISAT to other villages in Andhra Pradesh by the Department for Agriculture.

Basic guiding principles for developing sustainable alternative seed systems

- A seed bank should be built upon a solid understanding of all the seed systems farmers use and the role they have in supporting livelihoods. The local system is usually more important for farmers' seed security and has been shown to be quite resilient. Depending on the context, the focus of a seed bank should normally be on keeping the local seed system operational. However, such systems are often not sufficiently understood because of their complexity. There is a need for more emphasis on understanding local seed systems; their role in supporting livelihoods, and on needs assessment.
- Alternative seed systems must be effective with the immediate objective of facilitating access to seed of appropriate and improved varieties.
- Seed bank interventions should facilitate farmers' choices of crops and varieties.
- Seed bank interventions should aim at improving, or at least maintaining, seed quality. They should facilitate access to improved varieties that are adapted to the local environment and the needs of farmers, including their fodder requirements and nutritional needs.

- Monitoring and evaluation should be built into all seed bank interventions to facilitate learning by doing and thereby to improve interventions.
- An information system should be put in place to improve from pilot village learning, as a repository of information gained from cumulative experience. Such information systems should be institutionalized at the national level.
- The intervention must have a strategy to move from the pilot village level to the district and state levels; capacity building or a development phase should be included in the design of the intervention.

Conclusion

Smallholder and marginal farmers are often at a disadvantage in absorbing agricultural technology related to genetic enhancement of the productive potential of crops. This is because of the system of centralized production and distribution of improved seeds. Though the organized sector is able to produce a large quantity of seeds, the supply chain is unable to cope with the demand across the length and breadth of the country. Thus, the farming community depends to a large extent on own-saved seed and external sources such as nonorganized markets, borrowings from other farmers and government departments.

The formal seed sector has made a small contribution in seed multiplication for crops like groundnut with high seeding rates and low multiplication rates. However, transport, processing, bagging and certification costs make the seed too expensive for smallholder farmers. For such crops, the most economical way would be to produce seed at the village level through community-based seed systems and sell it to local communities without incurring the extra costs of processing and certification. Village-based seed banks provide an alternative solution to this problem and help farmers become self-reliant. This initiative needs both organized communities and institutional technical backstopping to strengthen local seed systems. Efforts toward upscaling seed banks resulted in encouraging learning outcomes.

About ICRISAT®

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a nonprofit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Future Harvest Centers of the Consultative Group on International Agricultural Research (CGIAR).

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