Village Seed Banks: An Integrated Seed System for Improved Seed Production and Supply – A Case Study

Information Bulletin No. 87

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International Crops Research Institute for the Semi-Arid Tropics

Citation: Ravinder Reddy Ch, Nigam SN, Parthasarthy Rao P, Shaik Ahmed, Ratnakar R, Ashok Alur, Ashok Kumar A, Reddy BVS and Gowda CLL. 2010. Village Seed Banks: An integrated seed system for improved seed production and supply – A case study. Information Bulletin No. 87. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 40 pp. ISBN: 978-92-9066-533-5 Order code: IBE 087.

Abstract

Quality seed of improved varieties is an important basic input for enhancing productivity of any crop species. Existing mechanisms to meet the groundnut seed requirements of small-scale farmers are not adequate and have serious limitations. Private seed sector is reluctant to produce and market seed of open pollinated varieties/ self pollinated crops such as groundnut for economic consideration. A joint venture project between the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the Department of Rural Development (DRD), Government of Andhra Pradesh was launched in Mahbubnagar district in 2009 with the objective to improve access to and availability of good quality seed of farmer-preferred improved groundnut varieties particularly to smallholder farmers at affordable prices and at the right time to enhance crop productivity income and household food security. Efforts to improve the performance of the agricultural sector should include seed production, storage and delivery system at village level rather than in urban centers. The baseline studies in the project area identified key problems related to groundnut seed supply system. Lack of timely availability of good quality seeds of high-yielding varieties is one of the major constraints contributing to stagnant yields of groundnut crop in the project area where it is grown in postrainy season under irrigated conditions. The other constrains include lack of proper storage facilities at farm/household level, storage insect pests, and farmers' perception of better performance of seed obtained from outside over locally produced seed. The project devised alternate seed systems, which ensure availability of quality seed of improved varieties at local level and integration of informal seed enterprises and farmers in the seed production and supply systems to enable timely availability of quality seed at the door-step of farmers. The concept of village seed banks was promoted and successfully validated in the project villages in Mahbubnagar district in Andhra Pradesh. It not only ensured timely availability of quality seed of farmer-preferred varieties at affordable price at local level but also enhanced crop productivity and local seed enterprises leading to higher incomes to farmers. The village seed model can be replicated elsewhere and to other crops as well.

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2010

Acknowledgments

We gratefully acknowledge the funding support for this publication from the ICRISAT- DRD project on “Improving Rural Livelihoods through Integrated Agricultural Development in Mehabubnagar District of Andhra Pradesh” by the Department of Rural Development, Government of Andhra Pradesh, India. We acknowledge the external reviewers Dr. Vilas A Tonapi and Prof. M Surya Mani for their valuable comments and suggestions.

Contents

Foreword

Seeds are the hope for the future of mankind on this planet. They are a key component in the conservation and ownership of biological diversity. Sustainable seed supply and implementation of seed security is one of the major activities outlined in the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture. A secure seed supply system enables access by farmers to adequate, good quality seeds of the desired type, at the right time, at the right place, and at the right price.

Farmers' seed systems have stood the test of time for centuries, enabling the evolution of modern agriculture. The informal seed sector has ensured conservation of agro-biodiversity at gene, ecosystem and farmer levels for ultimate food security. Recent analysis has revealed the crucial role women have played in sustaining the informal seed sector, and more widely, in sustaining food security. However, the informal seed sector is solely dependent on local resources and inputs, and seed supply at this level can be very vulnerable to disaster and socio-political disruption. This underlines the urgent need to strengthen local seed systems with innovations.

The hybrid seed industry in the private sector has focused on those species and crops that bring in profits. The informal sector, on the other hand, has concentrated on those crops and seed systems which underpin local food production. This includes crops that are predominantly self-pollinating and also open-pollinated varieties of cross pollinated crops. Most international support to strengthen seed systems focuses mainly on the formal seed sector; hence it is high time matching support was available to the informal seed sector. National seed policies, too, must be geared towards strengthening and sustaining the informal seed sector.

In this context, the concept of Village Seed Banks, which advocates self-sufficiency in the production and distribution of quality seeds, is fast gaining ground. Village seed banks operate with utmost transparency and social responsibility and foster trust between fellow seed farmers, under peer supervision. Many attempts are on to revive this age old concept to reduce farmer's dependence on external inputs.

The existing seed multiplication and delivery systems in Mahabubnagar district of Andhra Pradesh, India were surveyed and documented. Based on the existing informal seed systems in the project villages, model village seed banks were developed and tested in five mandals of the district. This novel effort makes a solid case for strengthening alternative seed systems and seed delivery models that address the needs and vulnerabilities of small farmers in the ever-changing political and socio-economic scenario at the national and international fronts.

This information bulletin is an attempt to review and document the successful results of the Village Seed Bank model tested in Mahabubnagar district. I am sure it will serve as a valuable source of information to those engaged in strengthening local seed systems to usher in ultimate food security in the semi-arid tropics of India.

William D Dar
Director General, CRISAT

I. Introduction

Good seed is the foundation of good agriculture. A seed system is well functioning if it efficiently and effectively meet farmers' demand for quality seed. Rules and regulations such as variety release procedures, intellectual property rights, certification programs, seed standards and contract laws influence the structure, coordination and performance of a seed system. Given the critical role that improved varieties play in increasing agricultural production – both crops and livestock – a key question is how to facilitate the development of a seed system that is capable of generating, producing and distributing seed of varieties that meet the needs of resource-poor small-scale farmers in a cost-effective and timely manner. Developing a seed system based on greater integration, broader participation and decentralization is an attractive, technically interesting and purposeful strategy.

It is only in the last 10 years that farmer seed systems have gained recognition as valuable elements of agricultural development. There exists comparatively little literature that systematically describes farmer seed systems. Only a handful of studies have closely examined such systems for any particular crop. Yet their significance to agricultural production cannot be overlooked. Farmer seed systems – also referred to as local seed systems or the informal seed sector – provide over 80 per cent of the total quantity of seed sown in developing countries (Almekinders et al. 1994; Cromwell et al. 1996).

II. Types of seed systems

Seed systems can be grouped broadly into two types:

1. Formal seed systems, and
2. Informal seed systems

Both systems have their own strengths and limitations.

1. Formal seed systems

Formal seed systems are easier to characterize as they are deliberately constructed, involving a chain of activities leading to clear products – Certified

seed of verified/notified varieties (Louwaars 1994). The chain usually starts with plant breeding and selection, resulting in different varieties, hybrid parents including hybrids and materials leading to formal cultivar release and maintenance. The framework for performance analysis of the formal seed sector has been discussed by several authors (Pray and Ramaswami 1991; Cromwell et al. 1992; Friis-Hansen 1992). The guiding principles in the formal system are maintenance of varietal identity and genetic purity and production of seed with optimal physical, physiological and sanitary quality. The central premise of the formal system is that there is a clear distinction between seed and grain. This distinction is less clear in informal seed systems.

Limitations of formal seed systems

- The formal seed sector has difficulty in addressing the varied needs of small farmers in marginal areas as they offer only a limited range of varieties.
- The public sector formal seed system is unable to meet the huge demand of seeds of legumes and oilseeds. Small farmers in remote rural areas are generally bypassed due to poor logistics in seed diffusion.
- The private sector formal seed system is reluctant to produce the seed of self-pollinated crops and open-pollinated varieties particularly in legumes and oilseeds due to business considerations and very low seed replacement rate.
- Prohibitive seed prices are a limitation for resource-poor farmers.
- Formal seed systems are sensitive to natural disasters and political or other turmoil.

2. Informal seed systems

Village seed systems or farmer seed systems or local seed systems are different names for the informal seed system, in which farmers procure seed by different methods and practices depending on the situation and location. In an informal seed system, farmers themselves produce, disseminate and access seed directly from their own harvest, through exchange and barter among friends, neighbours and relatives; and through local grain markets. Encompassing a wide range of variations, local systems are characterized

by their flexibility. The varieties disseminated may be landraces or mixed races and may be heterogeneous mixture of different varieties. In addition, the seed is of variable quality in terms of purity and physical and physiological parameters. While some farmers treat seed specially, there is not always a distinction between seed and grain.

Limitations of informal seed systems

- Varietal integrity and genetic purity are not assured.
- Seed quality is often suboptimal due to biotic stresses and storage problems.
- Seed exchange is limited to a geographical area and is governed by cultural barriers.
- Crop failures or low yields have a tremendous effect on the availability of seed and local prices.
- When a local seed system collapses, it is not easy to restore it in a short time. In such a situation, local varieties (land races) are easily lost and are replaced by relief-supplied seeds, which may or may not be locally adapted.

III. Existing scenario of informal seed sector

Depending on farmers' mode of procuring seed for their own use, several kinds of informal seed systems exist in project villages (Table 1). Very often farmers save their own seed by selecting from their produce and grade and store it for use in the next season in their own fields or share it with other farmers. Another major source of seed is the village shandy, where seeds are not identified by variety/cultivar; rather, grain is graded to some extent and sold as seed during sowing time or just after the first shower. Seeds are also sourced from local markets in nearby towns. Another source of seed is market yard middlemen (grain brokers), who procure grain and sell it as seed. Oil mills which procure grain for oil extraction also sell it as seed during sowing time. Seeds are also sold by fertilizer and pesticide dealers. They sell unnamed seed of local varieties and branded seed produced by seed companies. Small-scale farmers depend largely on such dealers for input (fertilizer, pesticides, seeds, etc.) needs, which are sold to them on a credit basis with repayment soon after the harvest but at exorbitant rates of interest (sometimes 36%).

Sometimes input dealers procure produce from farmers' fields but at lower than market price and after deducting the cost of the inputs lent.

Farmer-to-farmer seed exchange and local seed markets are not linked to systems engaged in the improvement of seed quality. Locally operating institutions such as NGOs, extension services, Krishi Vigyan Kendras (KVKs), social organizations and farmers' associations can play an important role in improving farmers' access to quality seed. They could promote improved production, marketing and distribution practices in traditional/farmer seed systems. This may need forging linkages between research organizations for supply of Breeder seed and village seed systems. For such integration to be sustainable, these organizations need training and market development support.

IV. An integrated seed system for improved seed production and supply – A case study

An ICRISAT-led consortium has demonstrated in other project areas that farmers can produce high quality seed using Foundation seed material and be successfully engaged in production, grading, storage and distribution of seed leading to increased crop productivity and employment opportunities in the villages. Self-help groups (SHGs) can manage village seed banks (VSBs), and generate more income at the village level, along with increased productivity of grain and fodder in large rainfed areas (Ravinder Reddy et al. 2006; Roothaert et al. 2006). If given an appropriate enabling legal framework, organizations such as NGOs, extension services, KVKs, social organizations and farmers' associations can help in linking VSBs (Ravinder Reddy and Wani 2007) to research institutions and, importantly, small commercial seed companies working in similar agroecosystems locally and regionally. To disseminate improved or national varieties, links between VSBs and sources of Foundation seed are important. Even more critical are the linkages that give VSBs access to new varieties that are not available from traditional seed producers.

Interventions and capacity building activities relating to establishment of VSBs in Madhya Pradesh, Rajasthan and Andhra Pradesh (Sreenath Dixit et al. 2005) and empowered community-based organizations (CBOs) to manage VSBs in groundnut, chickpea, sorghum and soybean (Ravinder Reddy et al. 2006; 2007) during the last 5-8 years have yielded significant positive results.

A joint venture project between the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the Department of Rural Development (DRD), Government of Andhra Pradesh was launched in Mahbubnagar district with the objective to improve access to and availability of good quality seed of farmer-preferred improved groundnut varieties at affordable prices and at the right time to enhance income and household food security.

The question addressed in the project –funded by DRD, Government of Andhra Pradesh and implemented through the Society for Elimination of Rural Poverty (SERP), – were: How can farmers be assured of timely supply of quality seed at affordable price? How can informal seed enterprises be integrated into seed production and supply systems to ensure timely availability of quality seed at the farmer's doorstep? The project also attempted to illustrate pathways to a science-based integrated seed supply system geared toward enhancing productivity. With increasingly rapid changes taking place in the technical, socioeconomic and policy environments, how these innovations are implemented forms an important issue.

V. Process

The project implementation involved the following steps.

a. Reconnaissance survey in project villages

    i) Existing groundnut seed systems
    ii) Constraints of existing seed systems

b. Development of alternate seed systems

    i) Farmer-participatory varietal selection
    ii) Village seed banks

c. Capacity building
d. Institutional linkages
e. Source of capital

a. Reconnaissance survey

Five nucleus villages, each with four satellite villages, were selected for the project implementation in Mahbubnagar district in Andhra Pradesh (Table 1).

Table 1. Cluster villages selected for establishing village seed banks in Mahbubnagar district, Andhra Pradesh.

Mandal/Cluster	Nucleus village*	Satellite villages
Wanaparthy	Khassim Nagar	1. Appaipalli 2. Dattaipalli 3. Chimangutapalli 4. Ankur-Venkatapur
Gopalpet	Jayanna Thirumalapur	1. Munnanur 2. Polikpad 3. Chennur 4. Budharam
Peddamandadi	Mojerla	1. Peddamandadi 2. Manigilla 3. Alwal 4. Dodaguntapalli
Pebbair	Kambalapur	1. Kanchiraopalli 2. Sriramgapur 3. Nagarala 4. Tatipamula
Ghanapur	Malkapur	1. Manajipet 2. Shapur 3. Rukkannapali 4 Mohd Hussainpali

* Seed bank established in the nucleus village.

i) Existing groundnut seed systems: To get an overall picture of the existing groundnut seed systems in the project area, a survey was conducted by interviewing informal farmer groups using the Rapid Rural Appraisal (RRA) method in selected cluster villages in each mandal. Informal group discussions were conducted with farmers who were classified into small (<2 ha), medium (2-5 ha) and large (>5 ha) farmers on the basis of their landholding. Further, individual interviews were conducted with village leaders, NGOs and progressive farmers. A good representation of small, medium and large farmers engaged in livestock and agriculture as their main occupation were

thus identified and informal farmer groups were created. The project area had an average of 69% small farmers, 25% medium farmers and 6% large farmers (Table 2). Small and medium farmers formed the majority of farmers growing postrainy season (Nov-Feb) groundnut in these project villages.

Table 2. Composition of farmers in terms of landholdings in project villages in Mahbubnagar district, Andhra Pradesh.

Mandal/Cluster	Village	Percentage of farmers*		
		Small farmers	Medium farmers	Large farmers
Wanaparthy	Khassim Nagar	66	24	8
Gopalpet	Jayanna Thirumalapur	68	28	4
Peddamandadi	Mojerla	78	13	9
Pebbair	Kambalapur	69	26	5
Ghanapur	Malkapur	63	31	5
Average		69	25	6

* Small farmers <2 ha; medium farmers 2-5 ha; large farmers >5 ha.

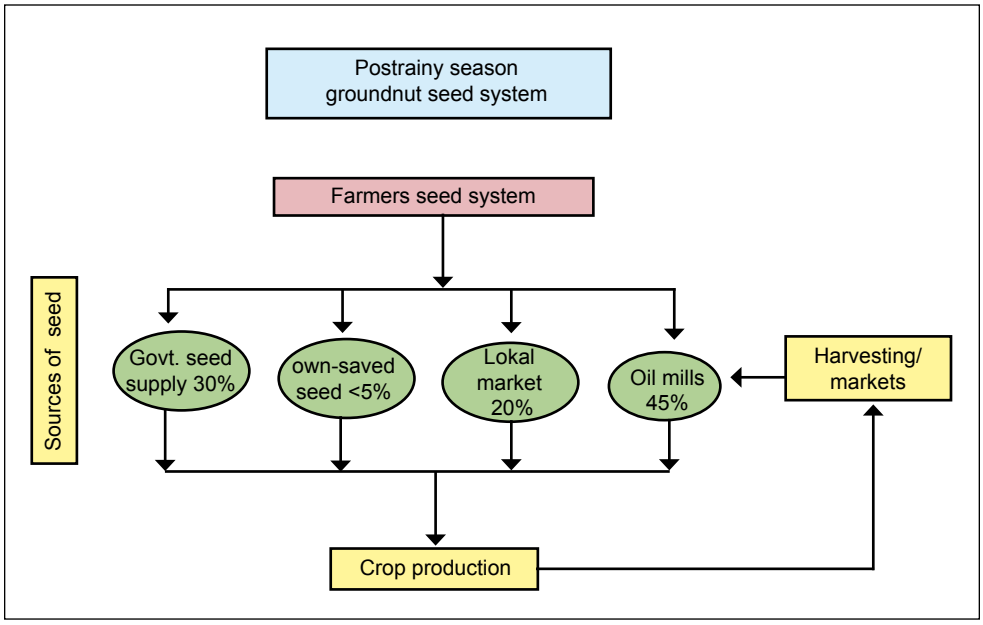

Fig.1. Existing groundnut seed systems in five clusters of Mahabubnagar district. AP.

It was evident from the farmers' responses that sourcing of seed was predominantly from the local markets (Table 3).

Table 3. Characteristics of groundnut seed supply systems in project villages in Mahbubnagar district, Andhra Pradesh.

Characteristics	Prevailing seed supply system
Seed supply channels	- 97% of farmers procure seed from local markets (oil mills; grain brokers) and formal public sector (subsidized seed) - <3% used own-saved seed
Formal public sector	- Andhra Pradesh State Seeds Development Corporation - Cooperative sector - HACA - ANGRAU, Hyderabad - MARKFED- Oilseeds Federation
Formal private sector	Absent
Informal sector	- Market middlemen (grain brokers) - Oil millers - Fertilizer dealers (not branded products)
Seed replacement	- High - Preferred every year because of belief that seed produced elsewhere yields a good crop
Grain to seed price ratio	1:1.6

There was little awareness of improved groundnut varieties in these villages where groundnut is a major crop grown in the postrainy season (Table 4). Farmers grew an unknown variety called "Local "with an average yield of 2000-2400 kg pod ha^{-1} under irrigated conditions in the postrainy season.

Table 4. Groundnut varieties grown by different farmer groups in the project villages in Mahbubnagar district, Andhra Pradesh.

Farmer group	Awareness of improved varieties	Percentage of farmers growing	
		Local varieties (unnamed)	Named varieties
Smallholder farmers (<2 ha)	***	100	Nil
Medium-scale farmers (2-5 ha)	***	100	Nil
Large-scale farmers (> 5 ha)	**	97	<3

*** > 90% of farmers not aware of improved varieties; ** > 70% of farmers not aware of improved varieties.

Informal seed systems for postrainy season groundnut in Mahabubnagar district have shrunk due to various factors. The Government of Andhra Pradesh had to step in to fill this gap with its subsidized seed supply through different formal seed supply agencies like the AP State Seeds Development Corporation (APSSDC), the Hyderabad Agricultural Cooperative Association (HACA), MARKFED and the Oilseeds Federation. Seed sources are related to wealth status of the farmers. Big and rich farmers, comprising 6% of the community, maintain their own seed stocks, and small farmers have to buy seed every year. The situation in project villages, where storage and borrowing of farm-saved seed has declined due to recurrent droughts, has been further aggravated by poverty and prevalence of storage pests such as the groundnut bruchid (*Carydon serratus*) apart from farmers' lack of knowledge of safe and scientific storage practices. There is a blind belief among groundnut farmers in the project villages that seed produced in other areas yields better than seed produced in their own land. Hence, a majority of farmers in these villages, irrespective of the size of their landholding, have become dependent on the government's subsidized seed supply. Sixty to seventy percent of farmers depend on this source but it meets only 30-40% of their total seed requirement. The government supplies a fixed quantity (90 kg) of seed (pods) to each household irrespective of their need. Therefore, farmers look to other sources including oil mills and local groundnut traders, or buy seed within the village from better-off farmers to meet their seed requirement.

Framers use high seed rate (200-250 kg kernels ha^{-1}) while the normal seed rate is (150 kg kernels ha^{-1}), leading to close planting (the Chikku method) with a high plant population. The high seed rate is meant to compensate for poor germination and seedling mortality due to seedling rot/root rot diseases. The cost of seed input constitutes 25-30% of the cost of production (excluding family labor) given in Table 7. The government's seed distribution is carried out through the formal supply system. The process adopted by public sector corporations for seed distribution is to call for tenders from seed traders to supply groundnut seed in a particular area and the lowest bidder gets the supply contract. However, as there are specifications laid down by the government regarding the variety to be supplied in a particular agro climatic zone, the contract supplier usually procures the seed as per availability from the unorganized markets, oil mills, groundnut traders and even individual farmers. The seed is cleaned, graded (sometimes), packed and supplied to farmers without specifying the name of the variety. This often results

in farmers receiving and sowing a mixture of several varieties and poor quality seed (Fig 2). With this situation aggravated by frequent droughts and other constraints in the seed supply chain, efforts to increase farmers' productivity and income are not meeting success in the project area.

Fig. 2. Seed supplied by formal seed sector, (30-40% poor quality seed).

The formal seed sector particularly private seed companies has shown little or no interest in groundnut seed multiplication because of low seed multiplication ratio, bulkiness of the seed and quick loss of seed viability. Further, high transportation and processing, bagging and certification costs make the seed expensive for farmers and less profitable to the private sector. Both, traditional seed systems (informal seed sector) and corporate and cooperative sectors (formal seed sector) are currently not adequate to meet farmer needs in the case of groundnut seed in selected project villages in Mahbubnagar district in Andhra Pradesh.

ii) Constraints of existing groundnut seed systems in project villages: Baseline studies done under the project identified key problems related to seed supply systems in groundnut (Parthasarthi Rao et al). Non-availability of quality seed of high yielding varieties in time was one of the major constraints contributing to stagnant groundnut yields in the project area – which is characterized by postrainy season cultivation under irrigated conditions.

Constraints to own-saved seed

- Storage insect pests and lack of proper infrastructure for storage at farm/ household level discourage farmers to save their own seed for the next season. They feel it is safer to dispose off their produce and procure seed every year from the local market or depend on the government's subsidized seed supply.
- Farmers also have financial and debt-servicing pressures which contribute to distress disposal of produce soon after the harvest.
- Farmers believe that using their own seed repeatedly year after year is detrimental and that seed from an outside source yields better than their own-saved seed.

Constraints to government seed supply

- Given the bulkiness of groundnut seeds (pods), logistics are expensive and difficult to organise. Accordingly, the quantities supplied by the State Government to different parts of the district do not always match local demand.
- Due to procedural delays, the timely supply of seed is not assured. Often the seeds arrive when sowing season has already started.
- The State Government supplies only 90 kg of seed (pods) per farmer at a subsdised rate irrespective of the extent of their landholding. This subsidised seed supply meets no more than 30-40% of the total seed requirement of farmers.
- Often the seed supplied is a mix of different varieties and of poor quality..
- Given the high costs and other overheads, the subsidised seed supply is not sustainable.

Constraints of local seed suppliers

- Local seed suppliers, especially oil mill owners, procure produce for oil extraction , but, during the rainy season the same is sold as seed to farmers at a higher price.
- Local seed suppliers sell kernels and not pods. During shelling there is damage to seed, which affects germination. Further, kernels are rarely graded or chemically treated by the suppliers.

- Seed obtained from local suppliers or oil mills is usually a mixture of varieties and of poor quality.
- Due to poor seed quality (mixture of broken, shrivelled and seed coat-damaged seeds) farmers are forced to use high seed rate (200-250 kg kernels ha^{-1}). Generally, farmers follow closer spacing coupled with thick planting (chikku method).
- There is no practice of seed treatment by local suppliers nor farmers. Seldom do big farmers take up seed treatment with Dithane M 45 recommended by seed dealer which is a wrong choice.

An analysis of existing seed systems, seed multiplication and seed delivery modules for groundnut in the project villages brought out the constraints that needed to be dealt with to making them viable and dynamic in the long run. Strategies to address these constraints were formulated to arrive at suitable solutions. The distinction between the problems of seed availability and seed access to small and medium-scale farmers was assessed, and the seed access emerged as a tough issue to answer. Most of the constraints were found strongly linked to information relating to poverty. Lack of knowledeg of agricultural technologies for groundnut such as crop production, cultivation aspects, pests and diseases, storage pests and their control strategies were identified as crop-specific constraints in the local seed system.

b. Development of alternate seed system

Integrated seed supply systems are mechanisms to supply seed of new improved varieties to farmers by combining the methods of both formal and informal seed sectors (Ravinder Reddy et al. 2007). Variety use and production of quality seeds and storage by farmers under local conditions, and seed exchange mechanisms are the three principal components of a dynamic integrated seed system that can form the most important groundnut seed source for small-scale farmers in the project villages. In fact, the strengths and weaknesses of local seed systems indicate that they and the formal seed systems are complementary.

Innovative, community-based seed production through VSBs (Ravinder Reddy 2007) and community seed banks (Lewis and Mulvany 1997) and distribution strategies coupled with supportive policies will have a positive effect on smallholder farmers' access to the products of national

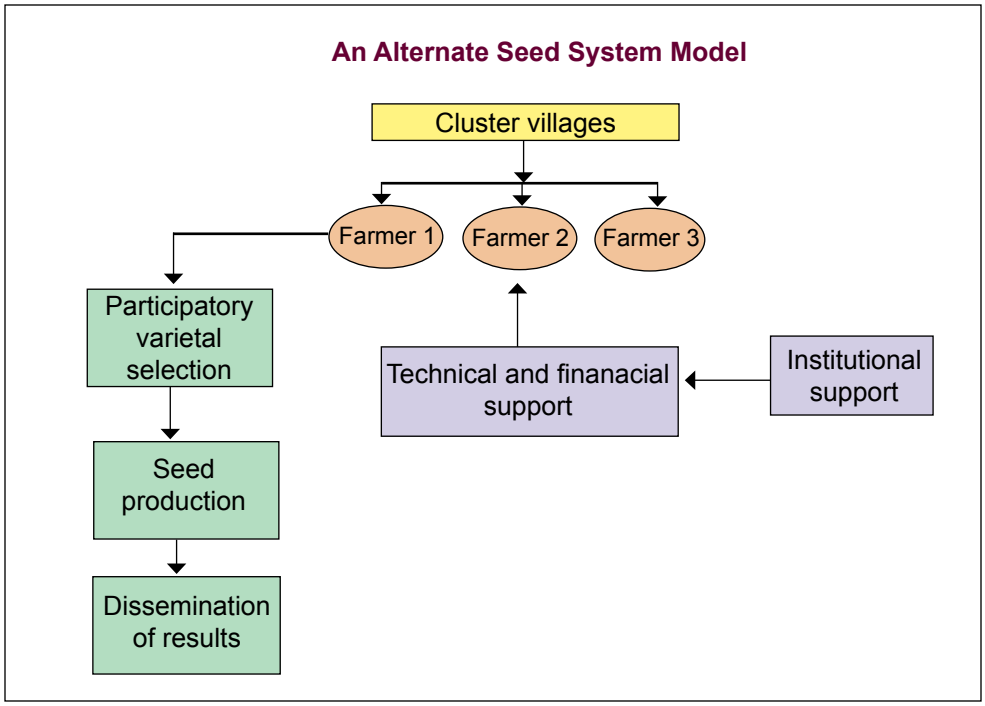

Fig. 3. Farmer-participatory varietal selection (Step 1).

and international research centers. An alternate integrated seed system incorporating VSBs has been developed to mitigate the constraints of postrainy season groundnut seed non-availability to farming communities in the project clusters in Mahbubnagar district in Andhra Pradesh.

The alternate seed system model envisages integration of formal and informal seed systems to achieve the objective of providing quality seed of improved groundnut varieties at the right time and at reasonable price to small-scale farmers. However, it was essential first to identify farmer-preferred variety (ies) before the implementation of the alternate seed system. Thus, the model was implemented in two steps: farmer-participatory varietal selection and establishment of VSBs.

i) Farmer-participatory varietal selection: Interested and resourceful farmers were identified in the project villages to take up trials/demonstrations of selected improved varieties under the guidance of scientific staff from the consortium institutions (Fig 3).

The premises of step 1 were: (i) Resourceful farmers are capable of imbibing technology faster – along with the capacity to absorb shocks, if any – than small-scale farmers; (ii) External finance is not required, and resourceful farmers can absorb expenses pertaining to seed production; iii) Resourceful farmers can afford to take a risk in conducting the trials; (iv) The general tendency of small farmers is to follow examples set by big farmers and village leaders; and (v) The word of resourceful farmers on improved varieties and yields spreads easily in the village, and hence dissemination of results is faster and more effective.

ii) Village seed banks: The concept of VSBs envisages village self-sufficiency in production of quality seed by and distribution to farmers. VSBs operate under peer supervision with utmost transparency, mutual trust and social responsibility toward fellow farmers. Though this is not an entirely new concept to villagers, it is being promoted to reduce their dependence on external nonreliable sources, including government subsidized seed distribution. The VSBs as a micro seed enterprise at the village level can be efficient. Some will have the potential to expand into specialized, small- or medium-sized local seed enterprises.

Fig. 4. Sensitizing farmers about village seed banks in the grama sabha.

The concept of VSBs was discussed elaborately in grama sabhas to sensitize the stakeholders (Fig. 4). Farmers were mostly positive about the improved varietal trials, but felt uncomfortable when the model spelt out self funding for procurement of seed and storage of seed. Earlier experiences with village seed systems and successful community initiatives at ADB and TATA-ICRISAT sites in Vidisha and Guna districts in Madhya Pradesh, India, and of ICRISAT-APRLP projects (Ravinder Reddy et al. 2007; Sreenath Dixit et al. 2005) provided an insight into the concept and helped identify gaps so that the concept could be refined and implemented in this project. The concept of VSBs was promoted in the project cluster villages.

The experience gained relating to the performance of improved varieties was discussed in village assemblies (grama sabhas). The activities to be carried out in Step 2 were discussed in focus group meetings in all the nucleus villages. Seed produced in the summer season (Step 1) were distributed to other interested farmers to grow in the postrainy season on the principles of the VSB concept (Fig. 6). Village seed bank committees (VSBCs) selected seed growers (farmers) for the postrainy season in the nucleus villages. The ICRISAT team conducted a couple of focus group meeting with SHGs to create awareness and explain the objectives of the VSBs (Fig. 5). They were invited to invest in the VSBs as a micro seed enterprise for procuring seed

Fig. 5. Focus group meeting on village seed banks; ICRISAT scientists with groundnut farmers at Khasim nagar village, Wanaparthy mandal, AP.

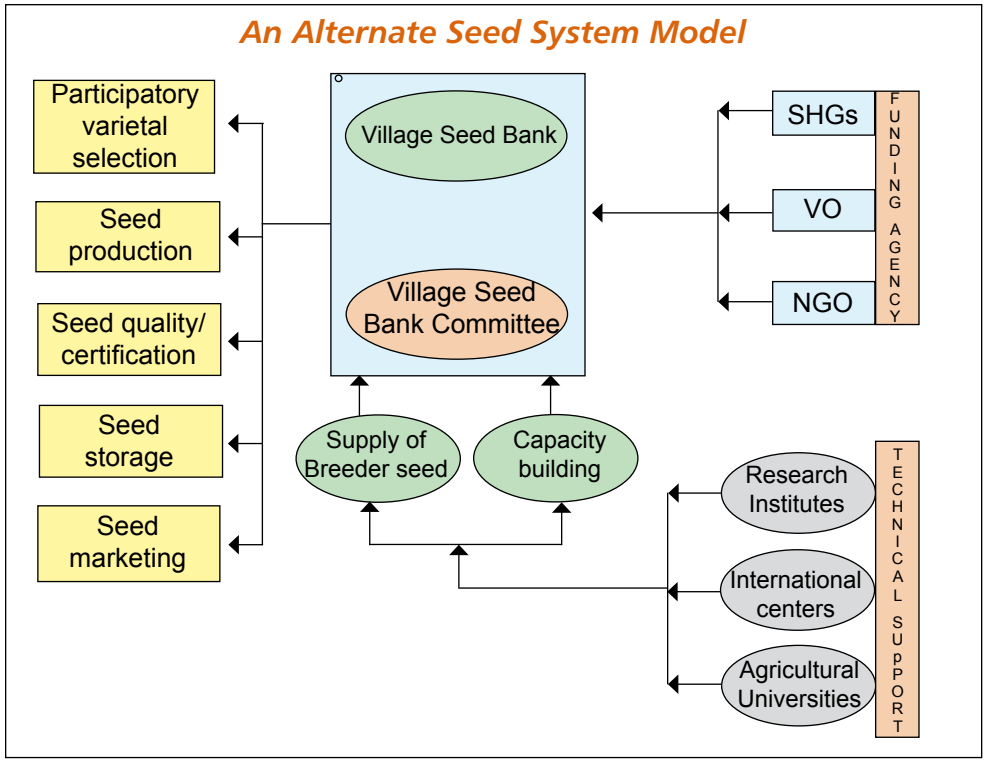

Fig. 6. Flow diagram showing the organization of a village seed bank (Step 2).

produced in the village and storing it in the VSB for sale next season. This had two-pronged benefits to the communities: a dividend for the SHGs and good quality seed supply to farmers.

***Village seed bank committees*:** The main function of these committees is to help reduce seed production and delivery costs of groundnut seed and at the same time help farmers reduce their individual cost of production, processing and marketing. Once they become self-reliant, the associations serve as useful mechanisms to broaden the outreach of development programs at little or no additional cost (Fig. 7). They help build rural social capital by establishing self-help linkages and encouraging broad-based collective action on village level seed enterprises. Our attempt at institutional development of farmers' associations or VSBCs in the project areas yielded a number of lessons and possibilities for future expansion.

Fig 7. Interactive meting with village seed bank committee members.

The tasks of the village/cluster-level activists, drawn from SERP, included mobilization of farmers and training of local facilitators. The following guidelines were used for developing and strengthening VSBCs. (Fig. 8).

- Make farmers understand the advantages of cooperation and associations.
- Allow all sections of the farm community to join the project.
- Understand small farmers' strengths, potentials and weaknesses in procuring seed.
- Empower women farmers (SHGs) to join the association to increase their potential in organizing and investing in developing micro seed enterprises.
- Link farmers' associations to research institutions/organizations for procuring Foundation seed for seed production.
- Build capacities of farmers in crop production, production of quality seed and scientific storage methods.

c. Capacity building

For successful implementation of effective and efficient alternate seed systems at village level, it is essential that all stakeholders are properly trained in skills required in crop management, seed production, processing

Fig. 8. Training program for strengthening farmers' associations and VSBCs.

and storage and in running cooperative enterprises engaged in seed production, storage and marketing.

d. Institutional linkages

The baseline survey conducted indicated the overall dimension of productivity constraints related to farmers' institutions, improved production technologies, access to improved cultivar seeds and access to institutions.

Evidently, improvement of farmers' livelihoods depends on the strength of their coming together. Access to resources is influenced by the extent to which farmers are organized and the institutional arrangements available, and finally the contextual social and political structure that prevails. Farmers' organizations, therefore, would have a vital role to play in rural change. One of the aims of this project is to help increase farmers' access to improved varieties and availability of seed and improved production technology that can improve farm productivity. This role was in the past held by agricultural extension services and research institutions. Now public spending on extension and research is shrinking, and institutional changes, such as privatization of farm services, have thrown it open to many new actors.

Rural communities are often heterogeneous in their technical demands – apart from the fact that many local decision-making systems are not well-organized, or are dominated by elites of the local area. Farmers' associations appear an attractive approach for articulating such demands. Trained farmers' associations with access to resources, inputs (seed) and markets, will directly help in cutting uncertainty and transaction costs, and empower them to make choices relating to the feasibility, productivity and profitability of village-level seed enterprises. It would also help to pinpoint asymmetric access rules, and allow farmers to raise their voice and have it heard.

This project identified a few areas for immediate collaboration in developing a common understanding of the issues of seed availability and technology development for enhancing productivity as they relate to the needs of the rural poor. For instance, sharing of experiences between scientists and farmers, higher levels of coordination with various research institutes, NGOs, KVKs, for ongoing field operations and support for initiative-linked activity, focusing on the involvement of various institutions to interact with farmers' associations and linking them to development of farmers' learning platforms.

e. Source of capital

To sustain the VSBs, regular inflow of finances are essential for procurement of seed from seed producers and storage in godowns for eight months till the next crop season and to meet interest on the capital raised. VSBCs were strengthened in managing seed banks as a micro seed enterprise through investments from seed bank members, committee office-bearers, and SHGs. A micro seed enterprise business model was developed (Fig. 9) to attract investors in the village, especially SHGs (Fig. 10). These SHGs can get loans from scheduled banks at a low interest rate (0.25%) and they can invest in VSBs as a profitable venture. Apart from this, SHG members are also the members and office-bearers of VSBCs, responsible for managing VSB activities by involving themselves from the beginning of the venture. This addresses the sustainability of VSBs by involving farmers in production, procurement, storage and distribution of seed. Variation in the procurement price and selling price of seed in the market has a wide gap because production, grading, transportation and storage take a major chunk of the selling price because of the bulkiness of groundnut seed. No private seed company has shown interest in trading in groundnut seed as profit margins are very low. Taking the advantage of this factor, seed production,

grading and storing of seed within the village by farmers has a major sliding advantage in this model. Hence it may be profitable as a micro rural seed enterprise.

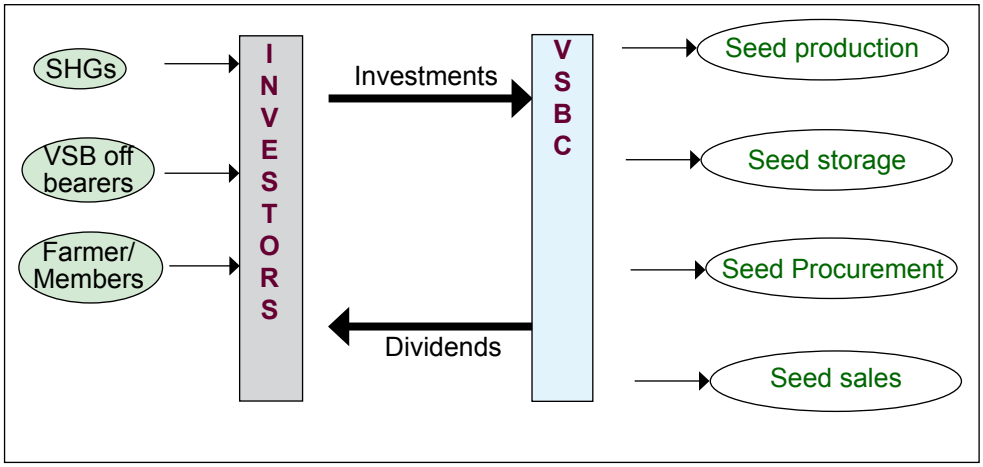

Fig. 9. Fund flow diagram for a village seed bank.

Fig.10. Sensitizing the SHGs on VSB as a micro seed enterprise.

VI. Operationalization of Alternate Seed System in Mahbubnagar district in Andhra Pradesh

a. Farmer-participatory varietal selection: To promote uptake of improved groundnut varieties having farmer-preferred characters and market traits, Foundation seed of selected varieties of groundnut was procured from various research institutions (consortium partner institutions) including ICRISAT. The seed was provided at subsidized rates to selected farmers in nucleus villages to take up on-farm trials in the summer season of 2009 with their local varieties used as control with the assistance of the village and cluster representative of SERP. A total of 15 farmers were identified, three from each village, and given seeds of five improved varieties – ICGS 44, ICGV 00350, Kadiri 6 (K 6), APNL 888, ICGV 91114 – in March 2009 (Table 5). These trials provided an opportunity for the selected farmers to evaluate the varieties under their own management conditions and to make a selection using criteria determined on the basis of their preference for specific traits (Fig. 11). Regular monitoring visits were undertaken to the trial sites during the cropping season and off-type plants were removed before harvest. Farmers were able to observe the different varietal characteristics (genetic and morphological) expressed by the varieties grown in their fields. Seed produced in the summer season was shared with other interested farmers for sowing in the 2009/10 postrainy season.

Fig. 11. Farmer-participatory trials with improved groundnut varieties (scientist-farmer on-farm interaction).

Table 5: Farmer-participatory varietal selection cum demonstration with improved groundnut varieties in nucleus villages in Mahabubnagar district, Andhra Pradesh, 2009/10 postrainy season.

Nucleus village	Variety	Yield per plot (kg)*	Percent increase in yield over local variety
Khasim Nagar	ICGS 44	861	121
	ICGV 00350	831	113
	K 6	636	63
	ICGV 91114	596	53
	APNL 888	-	
	Local	389	-
Jayanna Thirumalpuram	ICGS 44	631	113
	ICGV 00350	642	116
	APNL 888	380	28
	ICGV 91114	581	96
	K 6	-	-
	Local	296	-
Mojerla	ICGS 44	626	58
	ICGV 00350	618	56
	APNL 888	-	-
	ICGV 91114	-	-
	Local	594	-
Kambalapur	ICGS 44	533	26
	ICGV 00350	800	90
	APNL 888	-	
	ICGV 91114	-	-
	K 6	-	-
	Local	520	
Malkapur	ICGS 44	725	86
	ICGV 00350	839	115
	APNL 888	-	-
	ICGV 91114	-	-
	K 6	-	-
	Local	389	-

*Plot size 2000 m^2, average of three replications (ie, average of three villages).

At the end of the season, VSBCs, VOs and the farmers were involved in the evaluation of the varieties included in the trial (Fig. 12). Men and women farmers were grouped separately and their preferences were documented. This created awareness about the new varieties and gave farmers an opportunity to select their varieties based on the criteria they themselves determined. The criteria used by the farmers for the selection of varieties were based on a combination of the following attributes: pod yield, haulm yield, seed size and color, plant vigor, growth habit, tolerance to pest and diseases and stay green character and capacity to withstand moisture stress. Among the five varieties included in the trial, farmers selected two varieties, ICGV 00350 and ICGV 44 (Table 6), which gave 26% to 121% more yield than the local variety at different locations (Table 5).

Fig. 12. Farmers selecting the varieties based on their prefered traits.

Table 6. Varieties and traits in groundnut preferred by participating farmers in project villages in Mahbubnagar district, Andhra Pradesh.

Cluster	Farmers' preference
Khassim Nagar Jayanna Thirumalapur	First preference: ICGS 44. Second preference: ICGV 00350. Farmers preferred the uniform pod size, tolerance to leaf spot and sucking pests in ICGS 44 and its stay-green character useful for fodder purposes, when compared to ICGV 00350. They also noticed the loss of some pods in the soil during harvest in the latter variety.
Mojerla Kambalapur Malkapur	First preference: ICGV 00350. Second preference: ICGS 44. Farmers liked more number of pods per plant in ICGV 00350 compared to ICGS 44 and the stay green plant character and tolerance for moisture stress. Compared to local variety (8 irrigations), it needed only 6 irrigations. Women farmers preferred a short-duration variety to avoid end-of-season moisture stress to the crop. Lack of water in the bore wells due to insufficient rains in the rainy season, limits the water availability in the postrainy season as the crop approaches maturity.

Benefit-cost analysis of groundnut production in the postrainy season is given in Table 7.

Table 7: Cost of cultivation of postrainy season groundnut in different mandals of Mahabubnagar district, Andhra Pradesh.

S. No.	Operation*	Average cost of production (five mandals ₹ ha^{-1})
1	Land preparation: Two ploughings and leveling for sowing	3750
2	Seed cost: 200 kg kernels ha^{-1} @ Rs. 50 kg	10000
3	Sowing labor	2500
4	Intercultural operations (twice)	6250
5	Manual weeding (once)	2500
6	Fertilizers: Basal dose (a complex 28:28:0) 250 kg; Potash 25kg top dressing with Urea 38kg; Gypsum 250kg (at flowering time) (including labor charges)	3310
7	Pesticides: two sprays of Insecticide ; application of Carbofuran granules 12.5 kg; fungicide spray once (including labor charges)	1875
8	Irrigations (including labor charges)	2200
9	Harvesting	3250
10	Pod picking & collection	3500
11	Pod drying & cleaning	500
12	Total cost of production	39635
13	Average yield (kg ha^{-1})	2000
14	Market expenses @₹.70 for 100 kg	1750
15	** gross income ha^{-1}	60000
16	Net profit ha^{-1}	18615

** Market price at the time of sale ranged from ₹. 29 to 31 kg^{-1} (average price ₹.30 kg^{-1})

* General farmers crop production practices with local variety

b. Village seed bank: The concept of VSBs was received with enthusiasm by the SHGs, village organizations (VOs) and farmer groups. The proposal for constituting a village committee to manage the seed bank was taken forward by the village sarpanch (village head) by conducting a grama sabha for electing the seed bank office-bearers and members. Initially grama sabhas were conducted to sensitize farmers to the seed bank concept, followed by focus group meetings in nucleus villages. SHGs participated actively to undertake the procurement of seed from farmer seed producers to store in the seed bank as a business model. Presidents of SHGs became members of the VSBCs with 30% representation and participated in the selection of the other members and office-bearers. The committee members were trained in various activities of cooperative societies (such as rules and regulations, book-keeping, accounts, audit, electing the executive body and tenure of the committee, etc). The roles and responsibilities of the VSBCs were charted out during the gram sabhas. These included: (1) Selecting seed producers, (2) Procurement of seed from seed producers, (3) Selecting proper storage space in the village, (4) Fixing the procurement and selling prices of seed, and (5) Mobilizing funds by promoting memberships and investment in the VSBs. The VSBC passed a resolution to ensure the quality of seed and redistribution of procured seed to the village member farmers. Their responsibilities also included decisions regarding allocation of seed quantities to each farmer in the nucleus village and satellite villages (four villages around the nucleus) in the cluster.

Fig. 13. VSBC procures seed and stores in the seed bank within the village.

The seed of selected varieties was procured by the committees and stored in the village seed banks (Fig. 13). The seed procurement price was fixed by the VSBCs on the basis of the market price at harvest time. It was decided to pay Rs. 100 per quintal above the market price. The seed producer benefited by getting a higher than market price and also saved on expenses like loading, transportation, market taxes and labor charges, etc. for selling the produce in the market yard. This usually amounts to Rs 70-90 per 100 kg of pods. The details of quantity of seed procured by the VSBCs and the investment made by the community are given in Table 8.

Table 8. Quantity of seed procured by VSBCs and the amount invested by the communities in Mahbubnagar district, Andhra Pradesh.

VSB (Cluster village)	Quantity of seed procured (kg)*	Amount invested by VSBC/ SHG members (Rs)
Khassim Nagar	11,360	3,40,800
Jayanna Thirumalapur	3000	90,000
Mojerla	1120	33,600
Kambalapur	1080	32,400
Malkapur	1480	44,400
Total	18,040	5,41,200

* *Varieties ICGV 00350 and ICGS 44.*

The VSBC along with the members conducted meetings during August 2010 to fix selling price of seed. The VSBCs of different villages differed in fixing selling price which ranged from ₹ 3500 to ₹ 4500 per 100 kg seed (pod) (Table 9). The total quantity of seed procured and sold by the VSBs to 177 farmers in 25 project villages was 18 tons (Table 10). Net profit realized by the seed banks ranged from ₹. 260 to ₹ 153402 (after deducting expenditure incurred for seed storage and processing) (Table 9). It was estimated that area under improved varieties will be 87 ha with an estimated production of 262 tons of seed (pod) in the year 2011 (Table 10).

Table 9. Total quantity of seed procured and sold by VSBs.

S. No.	VSB (Cluster village)	Quantity of seed procured (t)	Expenditure incurred for seed procurement[a] (₹)	Expenditure incurred for processing, seed storage and sale (₹)[b]	Total Amount invested by VSB (₹)[c]	Total sale amount (₹)[d]	Net profit (₹)
1	Khassim Nagar	11. 36	3,52,160	2938	3,55,098	5,08,500 (4500)*	1,53,402
2	Jayanna Thirumalapur	3.0	93,000	1840	94,840	1,20,000 (4000)*	25,160
3	Mojerla	1.12	34,720	1286	36,006	44000 (4000)*	7994
4	Kambalapur	1.08	33,480	1260	34,740	35,000 (3500)*	260
5	Malkapur	1.48	45,880	1390	47,270	56,000 (4000)*	8730
	Total	18. 04	5,59,240	8714	5,67,954	7,63,500	1,95,546

a Cost of seed procurement price was ₹. 3100 for 100 kg seed (pod)(fixed by respective VSBCs)

b Expenditure towards, storage bags, pest control, labor charges, and rent for store house

c Investment from the members of seed bank for seed procurement and storage expenditure

d Selling price ranged from ₹ 3500 to ₹ 4500 for 100 kg seed (pod) (fixed by respective VSBCs)

* Numbers in parenthesis are the selling price of seed fixed by respective VSBCs.

Table 10. Seed distribution and estimated area under improved varieties in postrainy season 2010.

S.No	VSB (Cluster village)	Quantity of seed distributed (t)	No. of farmers	Estimated area under improved varieties in 2010 (ha)	Estimated quantity of seed available for next season (2011)* (t)
1	Khassim Nagar	11. 36	98	56	168
2	Jayanna Thirumalapur	3.0	25	15	45
3	Mojerla	1.12	18	5	15
4	Kambalapur	1.08	17	4.5	13.5
5	Malkapur	1.48	19	7	21
	Total	18. 04	177	87.5	262.5

* Assuming average yield @ 3.0 t ha^{-1}

c. Capacity building: Imparting training to stakeholders was part of each activity to strengthen farmers' capabilities to tackle the situation technically and manage through appropriate decisions. A number of training programs were conducted on improved production techniques (ridges and furrow method of sowing, seed treatment, sowing by seed cum fertilizer drill, intercultural operations, optimum plant population, spacing), seed storage technology, and IPM, etc in the project villages to enhance production. Young educated farmers were given printed technical information (bulletins, flyers and posters) on improved cultivation practices, seed production and certification, integrated pest and disease management (IPDM), grain storage methods and management.

Fig. 14. Demonstration of low cost paper towel method of germination test in the village.

A training program on seed treatment and a demonstration of low cost seed germination test were conducted in all nucleus villages for VSBC members and lead farmers (Fig. 14). The germination test is simple, inexpensive and reliable. It can be conducted at the farmer level without any additional facilities or equipment. It requires old newspapers and a plate. Four layers of a newspaper are spread on the floor and sprinkled with water to wet the paper. Groundnut seed are placed on the paper 2 cm apart and rolled and placed on the plate and incubated at room temperature for 3-5 days. The

paper should be kept wet every day. The germination count was taken five days after incubation (Table 11). There was no significant difference between the newspaper method and the paper towel germination method (Fig. 15), which is expensive and more difficult to get the materials at village level.

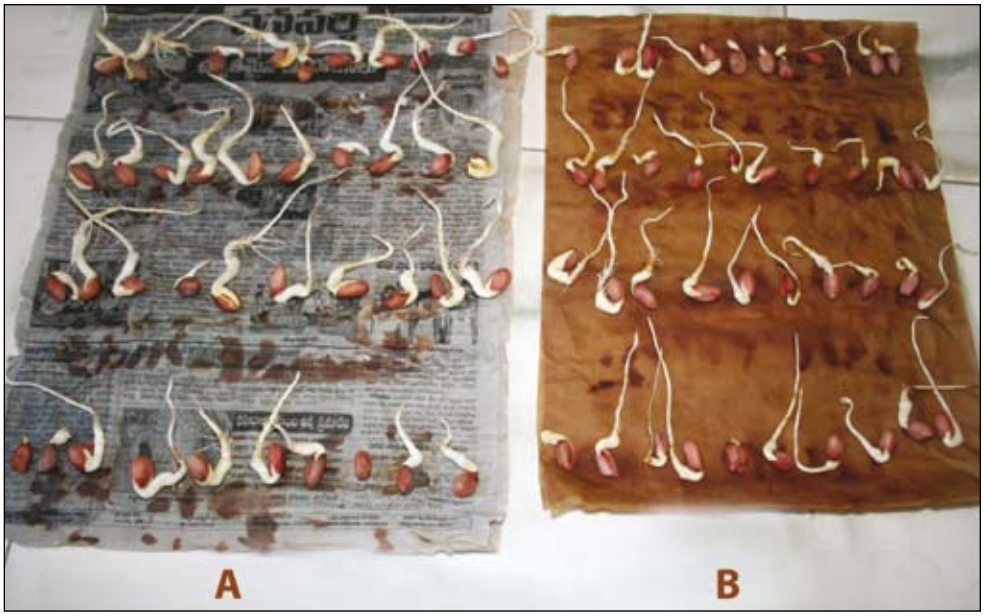

Fig. 15. Result of germination test, showing no difference in two methods tested: A–Newspaper method and B–Paper towel method.

Table 11. Seed treatment and low cost seed germination test in groundnut.

Treatment	Germination (%)**		
	Newspaper method*	Paper towel method	Farmer's field**
Benlate + Capton (1:1)[b]	88	89	83
Dithane M 45 (Farmers' practice)[a]	74	78	73
Control (no treatment)[a]	72	69	71
Control (no treatment)[b]	93	95	94

* Germination test conducted in farmers' houses using newspaper sheets; ** Seed sown in one row (5 m) in farmers' fields (seed counted prior to sowing).

a. Seed procured from oil mill (local market).

** Four replications (farmers as replications).

b. Seed provided from ICRISAT.

d. Institutional linkages: The VSBC members were trained and linked with various institutions like Regional Agricultural Research Stations (RARS) for supply of Breeder seed and technical backstopping. For procedural and legal advice on farmers' associations, they were linked with the Hyderabad Cooperative Society Ltd. to ensure administrative sustainability.

e. Advantages of village seed banks and their potential impact:

Implementation of VSB concept offers several advantages. These are:

- Availability of seed of improved varieties in sufficient quantities within the village itself
- Assured and timely supply of seed material to farmers
- Decentralized seed production
- Availability of improved-variety seed at lower prices
- Improved seed delivery to resource-poor farmers
- Reduced dependence on external seed sources and effective curbs on spurious seed trade
- Good opportunity for SHGs to invest and develop a village seed enterprise
- Encourages village-level trade and improves village economy
- Social responsibility of seed production and delivery system
- A step toward sustainable crop production
- Avoids introduction of diseases carried through seed (seed-borne pathogens) produced and imported from other agroecoregions
- Scope for farmer-participatory varietal selection and feedback to the scientific community on the performance of cultivars
- Availability of true-to-type varieties and healthy seed within the reach of farmers at affordable prices
- High sustainability of VSBs because of farmers' involvement from the beginning of VSB establishment and in seed production, storage and marketing through their own investment and sharing the benefits

The estimated impact of VSBs in the project villages was approximately 25% increase in yield and the overall income of the farmer enhanced by 34% (Table 12).

Table 12: Projected impact of village seed banks in the project area in Mahbubnagar district, Andhra Pradesh.

S.No.	Particular	Details
Total area under groundnut crop in the project villages (25)		4000 ha
Existing situation		
1	Seed required for sowing 4000 ha (250 kg pod ha^{-1})	1000 tons pod
2	Cost of seed in the market @ ₹ 50,000 t^{-1}	5 cr $annum^{-1}$
3	Average productivity with local variety	2 t ha^{-1}
4	Total production (0.8 t X 4000 ha)	8000 t
5	Total revenue from sale (Selling price per ton = ₹ 30,000)	24 cr $annum^{-1}$
VSB model		
1	Seed (improved variety) required for sowing 4000 ha (200 kg pod ha^{-1})	800 t
2	Cost of seed production and procurement by VSBs (₹ 31,000 t^{-1})	2.48 cr $annum^{-1}$
3	Selling price of seed in the VSB @ ₹ 40,000 t	3.2cr $annum^{-1}$
4	Average productivity with improved variety	3 t ha^{-1}
5	Total production (3 t X 4000 ha)	12000 t
	Total revenue from sale (Selling price per ton = ₹ 30,000)	36cr $annum^{-1}$
Overall benefit from VSBs		
1	Increase in productivity	1t ha^{-1}
2	Increase in gross income	₹ 30,000 ha^{-1}
3	Savings on seed cost	₹ 4,000 ha^{-1}
4	Additional revenue for project villages due to improved varieties supplied by VSBs.	12 cr $annum^{-1}$
5	Benefit to VSBs – a micro seed enterprise at village level	0.72 cr $annum^{-1}$

In spite of several advantages of village seed banks, there are some constraints which can come in their way of successful promotion and implementation. These are:

- Lack of willingness of farmers to adopt quality seed production practices
- Need for additional investment for inputs in seed production
- Need for buy-back assurance to farmers from FA/SHGs/NGOs
- Lack of proper seed storage facilities and management at village level
- Lack of availability of funds with FA/SHGs/NGOs for seed procurement, packing, storage and transportation
- Difficulty in fixing minimum support price for seed procurement
- Absence of technical support for seed production and its monitoring including quality control
- No or limited availability, access and procurement of Breeder seed from research institutes for seed production at regular intervals

VII. Conclusions

An effective means of improved groundnut seed distribution is farmer-to-farmer seed exchange. This may be primed to a limited extent by the supplies of improved seed from public agencies, agricultural research stations and NGOs to farmers in easily accessible villages. However, such a system is very slow and has its limitations. To speed up the flow of seed of adapted, acceptable, improved groundnut varieties to farmers, there is a need to form a network between research institutes, agencies involved in quality control and various NGOs, community-based organizations (SHGs, farmer schools, farmer youth clubs, farmer associations) interested in various aspects of seed production and utilization. For crops like groundnut, the basic demand of a farmer is timely availability of quality seed of improved varieties at affordable price at local level. The most economical way is to produce seed at the village level through community-based seed systems and sell it to local communities without incurring the extra costs of transportation, processing and certification. Village-based seed banks provide an alternative solution to this problem and help farmers become self-reliant in their quality seed requirement. This initiative needs organized communities, institutional

technical backstopping and continued interaction between various institutions, policymakers and stakeholders to strengthen local seed systems to enhance groundnut productivity in the project villages. The VSB is an efficient and sustainable model that can be out scaled to other crops and other areas. Due to use of quality seed of farmer-preferred varieties, the crop productivity enhances leading to overall positive impact on the livelihoods of farming communities.

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About ICRISAT

The International Crops Research Institute for the Semi-Arid-Tropics (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, and 644 million of these are the poorest of the poor. ICRISAT and its partners help empower these poor people to overcome poverty, hunger and a degraded environment through better agriculture.

ICRISAT is headquartered in Hyderabad, Andhra Pradesh, India, with two regional hubs and four country offices in sub-Saharan Africa. It belongs to the Consortium of Centers supported by the Consultative Group on International Agricultural Research (CGIAR).

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ISBN: 978-92-9066-533-5 Order code: IBE 087 324-2010