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Integrated Seed Systems for Sustainable Food, Feed and Fodder Security in Semi-Arid Tropics of India

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Abstract

Seed is the most important input component for productive agriculture. A well-functioning seed system is defined as one that uses the appropriate combination of formal, informal, market and non-market channels to efficiently meet farmers' demand for quality seeds. The fact that a bulk of rural livelihoods are drawn from crop-livestock sector and that crop residues are the main stay for animal feeding reflect the importance of crop agriculture not only from food production point of view but poverty reduction as well. A majority of livestock kept by rural households is well integrated into the prevailing crop systems. In low rainfall dry land agriculture areas, food feed cereal, millet and legume crops are the main sources of income and food for farmers besides fodder for their animals. Farmers' demand for seeds, particularly those of poor farmers therefore depend on multiple criteria. Given the critical role that improved varieties play in increasing the conventional crop production, a key question is how to facilitate the development of an integrated seed system that is capable of generating, producing and distributing improved seed varieties that meet the needs of resource and resource-poor farmers in a cost-effective way. The study is an attempt to review and document the existing seed multiplication and delivery systems in four dry land agriculture districts of Andhra Pradesh namely Anantapur, Kurnool, Mahbubnagar and Nalgonda. Analyzing the problems associated with different seed systems in the Districts, the paper makes a case for alternative seed systems that address the needs and vulnerabilities of small farmers.

Introduction

Every country needs a robust seed system to guarantee the sustainability of its agriculture and to ensure that the products of modern plant breeding and local farmer ingenuity are widely available. Agriculture in India is over 5000 years old. Farmers have been breeding, selecting and collecting enough seeds all along to meet their requirement. The very survival of Indian agriculture for centuries is a testimony to the sound wisdom on seed production and storage the agrarian community has been nurturing over time.

About 70 percent of rural households keep cattle, which are well integrated into the cropping system. Mixed crop-livestock systems support majority of livelihoods in the countryside. Farmers requirement of seeds depend on the agro ecological features of the area they live in and the accessibility or otherwise for supplementary water for irrigation. Generally better-off farmers go by the sale value of the grain and resort to cropping systems accordingly. However, the poor farmers and other small producers give weightage to the straw yields and quality of straw from the grain crops.

Diversifying resource base through crop livestock systems spread the risk for small farmers on the one hand and gives an opportunity to utilize their family based resources more efficiently on the other. Also the mixed cropping, inter cropping practices of farmers dictate the type of cultivars and the level of biodiversity to be maintained and supported through seed production systems. The complexity and vulnerability of small farmer/poor farmer systems demand seed production and delivery systems that are consistent with their needs and demands. More than 80% of crops in developing countries are sown from seed stocks selected and saved by farmers (Delouche, 1982; Osborne and Faye, 1991; Jaffe and Srivastava, 1992; Almekinders et al., 1994) These systems have been variously called a farmer-managed seed system (Bal and Douglas, 1992); Informal seed system (Cromwell, 1992), traditional seed system (Linnemann and de Bruijn, 1987) and local seed system (Almekinders *et al.,* 1994).

The past four decades have witnessed some drastic changes in ways farmers manage their seed requirement. The decentralized seed production and distribution system practiced over centuries has seen major reversal in terms of production and supply. With the advent of hybrid technology, the farmers require to replenish their seeds every season from external sources (such as public sector research institutions and private seed producers) to harness the hybrid vigor. This has, no doubt, helped increase the production manifold. At the same time, it has also increased farmers' dependence on external agencies. As a result, the once informal and decentralized village seed industry has attained a highly centralized status. It is almost impossible for the organized seed sector to meet farmers' demand in terms of several crops and varieties cultivated across country. Besides, the huge demand outstripping the limited supply has lead to a serious problem of spurious seeds finding their way into the markets and farms with the attendant ills and consequences.

This paper is an attempt to review the seed production and delivery systems in four districts of Andhra Pradesh with the ultimate objective of suggesting alternative seed systems that are supportive of livelihoods of poor livestock keepers in mixed cropping systems.

Food, feed and fodder seed systems in Andhra Pradesh

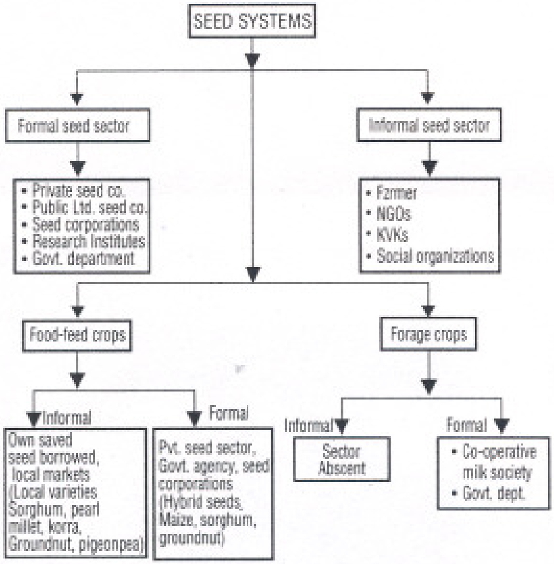
Seed systems in Andhra Pradesh, like the rest of the country, consist of public, private and civil sectors. While the private sector is increasing its share in the market, it is the civil sector (farmers own-saved seed and exchange) that produces most seed for the majority of staple food crops in Semi-Arid tropics of the State. An inventory in India (Turner, 1994) concludes that there are only a few major crops where more than 10% of the demand is supplied by formal seed sector.

The existing seed systems of food-feed and fodder crops in four districts namely Mahbubnagar, Nalgonda, Kurnool, and Anantapur districts which typically represent the semi-arid tropics (SAT) of Andhra Pradesh state, were studied during 2004 (Ravinder Reddy, 2004b) using the informal participatory techniques and tools. Focus group discussions (FGD) with homogenous groups of farmers like small farmers, medium farmers and large farmers were separately held in eight representative villages across the districts. Informal, open ended style of discussions were adopted where farmers were facilitated to take a lead in explaining their viewpoint. A 3-member group facilitated and documented the FGD. The total framework for seed systems prevailing in the four Districts is presented below.

General features of the four Districts

a. Cropping systems

Two of the districts represent south Telangana region (Mahaboobnagar and Nalgonda) and two represent Rayalseema(Ananthpur and Kurnool). The four districts represent the typical semi-arid rainfed conditions of the Deccan Plateau in South India and are characterized by hot summers with low rainfall and relatively moderate winters. Rice, sor-



ghum, maize, pearl millet, korra (Foxtail millet), pigeonpea, cotton, castor, groundnut and vegetables are the important crops of the region. Usually pigeonpea, pearl millet, and sorghum are grown as intercrops in groundnut cropping system and pigeonpea is grown as intercrop in sorghum at Mahaboobnagar and Nalgonda districts. Crops grown in traditional system are primarily for subsistence. Farmers produce a broad range of crops and varieties not only to meet their subsistence need but also fodder for their livestock. The cropping system survey undertaken as part of seed systems study further revealed that varieties of sorghum, pearl millet, groundnut and pigeonpea represent the age old seed sown year after year unchanged for the past 10 years.

Table 1. Agro-ecological features of the project area

	District		
Feature	Nalgonda	Mahabubnagar	Kurnool
Physiography	North Telangana Plateau	North Telangana Plateau	South Telangana Plateau (Rayalaseema) and Eastern Ghats
Soils and Available Water holding Capacity (AWHC mm/m)	Deep loamy and clayey mixed Red and Black soils with medium to high AWHC (100-200)	Deep loamy and clayey mixed Red and Black soils with medium to high AWHC (100-200)	Deep loamy to clayey mixed Red and Black soils with medium AWHC (100-150)
Agro Ecological Sub Region (AESR)	Hot Moist Semi-Arid ESR	Hot Moist Semi-Arid ESR	Hot Dry Semi-Arid ESR
Average annual temperature °C	26.4	26.9	28.1
Average annual rainfall (mm)	742	754	630
Onset of monsoon	06 June	05 June	04 June
Withdrawal of monsoon	01 November	05 November	10 November
SW monsoon rainfall (mm)	554	611	449
NE monsoon rainfall (mm)	120	92	112
PET (mm)	1615	1666	1725
LGP	120-150 days	120-150 days	90-120 days

(Source: Kesava Rao, 2005)

An important output of cropping systems is the stover/straw that supplements the natural grazing of livestock. Fodder is less susceptible to drought than grain production as some fodder can be harvested even in years when grain production fails. This undoubtedly influences the choice of crops and varieties and is well illustrated by the farmers of project area – Mahaboobnagar, and Nalgonda district farmers grow yellow seed sorghum varieties which yield relatively little grain but give optimum fodder yield. Similarly, Kurnool, and Ananthpur farmers grow local groundnut varieties.

b. Soils and climate

Deep loamy and clayey mixed red and black soils dominate the districts. General features of the districts are presented in Table 1. Andhra Pradesh is divided into eight sub-agro-ecological regions based on soil and climatic conditions (NBSS&LUP, 1996-97). Nalgonda district falls under zone number 7.2 with annual precipitation range from 560-850 mm, Kurnool in zone number 7.1 with annual rainfall range from 436 to 616mm. Rainfall is the major factor that determines yield and total crop production, as most of the cultivated area is rainfed. Though the southwest monsoon sets over the region almost at the same time, the withdrawal is extended by about 10 days in some parts of Kurnool district. Among the three districts, Kurnool receives low annual rainfall of about 630 mm in which about 450 mm is received during the SW monsoon season. Seasonal rainfall distribution indicates that Mahaboobnagar district with low NE monsoon rainfall is more drought-prone in the late crop-growing season.

Sources of seed and seed delivery systems

a. Food-feed crops

Survey of project area reveals that traditional seed systems are location specific and also varies greatly within farmers' communities. Approximately 80-90% of all planting material except groundnut seed, used by the farmers in the project villages is, by and large, farmers' own saved seed (Figure 1)

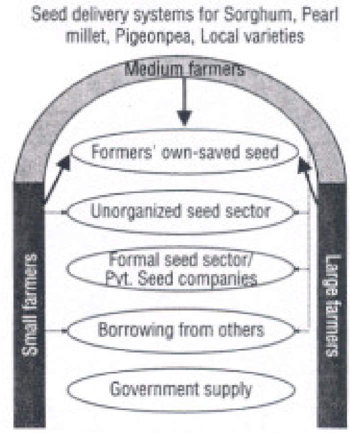
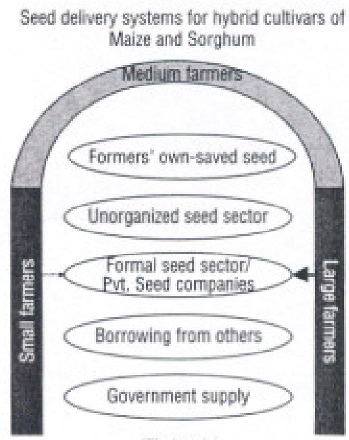


Figure 1.



Figire 2.

However, the afore-mentioned statement regarding the seed source masks significant differences between crops, villages, and socioeconomic conditions and farmer groups. Food feed crops and often major staple crops like sorghum, pearl millet, korra and pigeonpea are generally derived from home-saved seed for reasons of cost and convenience. On other hand, in crops like maize and sorghum where hybrid varieties are used, usually by some farmers from large and medium groups, the seed is obtained almost entirely from private seed companies (Fig 2.). In some cases farmers have discovered that such hybrid seed can meet their needs for one or two further multiplications before replaced it is by fresh seed.

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A detailed overview of farmers seed sources and seed distribution channels is often relatively complex with farmer groups obtaining seeds of different crops and varieties from different sources at different times, however, it is possible to identify three main groups of farmers with regard to seed sourcing behavior.

- Seed secure that can fulfill their own seed needs
- Source seed off-farm from time to time out of choice
- Source seed off-farm from time to time out of necessity

Seed secure farmers will tend to maintain their own varieties with limited influx of new varieties. Curiously, most of the Mahaboobnagar area farmers growing sorghum did not express any particular preference for improved varieties with white seed coat, because of insecurity of yield, low preference for food, highly susceptible for climatic vagaries, biotic and abiotic stresses. On the other hand the farmers of Nalgonda area have shown some positive reaction for adopting improved varieties of sorghum and maize. This would suggest that variety awareness is not always as well developed in traditional farming communities (Table 2). It may also reflect the fact that in traditional self-contained seed systems, the same genetic material may be easily available from neighbors, thus reducing the risk of seed procurement and accesses.

Farmers sourcing seed off-farm will usually obtain seed from other farmers and often farmer communities identify certain individual farmers as reliable sources of good quality seed. The proportion of farming community involved as seed producers cum distributors is very small, this type of activity is more evident in distribution of groundnut seed in Ananthpur district. Furthermore, it is often difficult to establish whether these local seed suppliers are making a conscious effort to produce high quality seed or if they are simply well endowed farmers who always have surplus grain to sell as "seed" during the next planting season. Seed sources have been related to wealth status, with rich farmers maintaining their own seed stocks but poor farmers needing to buy or borrow seed every year. Groundnut seed systems operating in Kurnool villages are somewhat different from that of Ananthapur area in seed storage and distribution. The cropping system, soils, and climatic pattern are also differing between these two districts of Rayalaseema region (Table 1). Majority of large and a few medium farmers of kurnool save their own seed and lend the surplus seed to small farmers with an understanding that one and half times the quantity of seed borrowed will be returned. Whereas in Ananthapur area storage of farm saved seed and borrowing of groundnut seed is vanishing due to continuous drought, poverty, problems with storage pest like groundnut bruchid (*Carydon serratus*), and a sense of insecurity among seed

Table 2. Farmers knowledge on seeds of improved varieties of food-feed crops

Farmer group	Mahaboobnagar district [a]	Kurnool district [b]	Nalgonda district [c]	Anathapur district [d]
Small farmer(< 5 acres)	*	*	**	*
Medium farmer(5-10 acres)	*	*	**	*
Large farmer(>10 acres)	*	**	***	*

a= Sorghum, Maize,. Groundnut, Pigeonpea.
b= Groundnut, Pearl Millet, Sorghum, Korra, Pigeonpea.
c= Maize, Sorghum, Pearl Millet, Pigeonpea.
d= Groundnut, Pigeonpea.
* Poor; ** Average; *** Good

lenders due to occurrence of frequent droughts in the area. Hence, farmers in Ananthapur district, irrespective of their land holding sizes, are increasingly depending on government subsidized seed supply (Ravinder Reddy 2004c). Hence, farmers look to other sources like oil mill companies, local groundnut traders, or purchase with in the village from big farmers to fully meet their seed requirement (Fig 3). About 60- 70% of farming community in the District depend on government seed supply, which hardly meet 30-40% of their total seed requirement (Fig 4 and 5)

Seed delivery systems for Groundnut crops

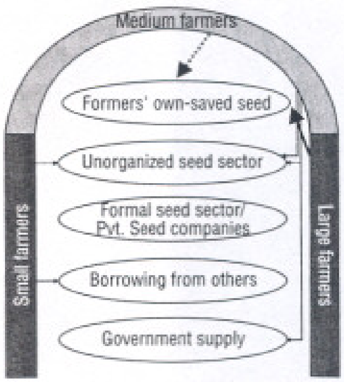

Figure 3.

Seed delivery systems for forage crops

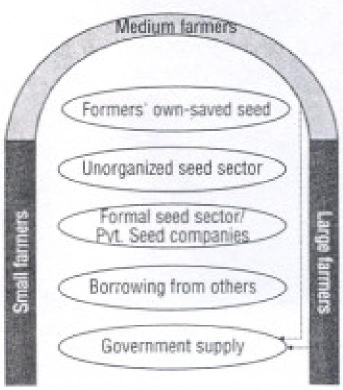

Figure 4.

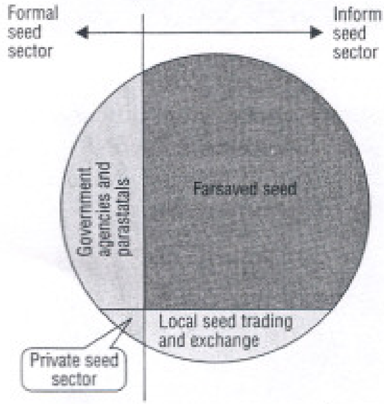

Fig 5. Generalized representation of seed supply in project area

Figure 5.

Groundnut seed distribution by government plays an important role during drought years. A.P. State Seed Development Corporation (APSSDC) also plays a major role in groundnut seed multiplication and distribution in the state. The process adopted by the government for seed distribution, is by calling tenders from seed traders for supplying groundnut seed in a particular area and lowest bidder will get the tender to supply seed. The important aspect here is to note that there is no specification of variety to be supplied to a particular agro-climatic zone. The bidder procures seed from the unorganized markets, oil mill companies, or groundnut traders. Seed is cleaned, graded, packed and supplied to farmers without any tag of variety name. This system of seed distribution clearly indicates that the farmers often sow mixtures of varieties and the cycle continue every year. Frequent occurrence of droughts during the last ten years and the resultant government-organized seed supply lead to mixtures of different varieties of seed being delivered to farmers. This is particularly so in Ananthapur district in the case of groundnut, which is the major crop.

Groundnut seed supply in Kurnool and Ananthpur districts is represented diagrammatically in Fig 6. About 40% of farming community avail subsidized government seed supply. The formal seed sector of groundnut is from government and seed Development Corporation. Informal sector comes from own-saved seed, borrowings from others and the local seed trade occupies a major share (about 60%) in the District.

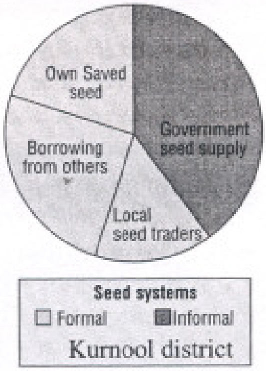

Figure 6.

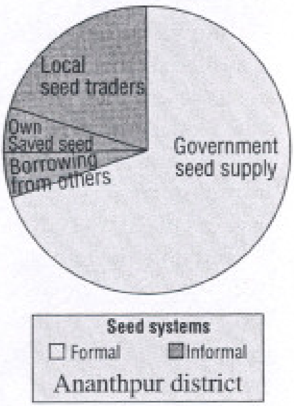

Figure 7.

Figure 6. Generalized representation of groundnut seed supply

1. own- saved seed

- Seed availability has become a serious issue because during the last 10 years farmers could raise one good crop only once in every three-years.
- Farmers feel storage is a serious problem because of pod borer. Hence many small farmers feel it is safer to dispose all pods and depend on government supply for seed.
- Farmers also have other financial and debt servicing pressures which also contribute to distress- disposal of the produce
- Farmers believe in not using their seed again and again or their belief that seed brought from outside is better than their own – was one of the reasons for not saving the seed
- That farmers are aware of the opportunity cost of money and therefore would not like store some thing in November which they require only after 7-8 months later was also advocated as a reason for seed disposal at a time when rates are competitive.
- Small farmers feel hard pressed to buy seed paying hard cash. It is the medium and large farmers who, by default use their own-saved seed. Also when small farmers depend on large farmers for seed, the latter take advantage of the situation and the deal turns out exploitative.
- Incidence of drought influences the demand for seed in the subsequent year also because during drought farmers might realize some yield but the dry and shriveled kernel may not serve as seed for the next season.

2. Government seed supply

- There is a restriction of 120kg of seed per farmer irrespective of extent of landholding beyond which government will not issue subsidized seed
- Government has not been able to procure beyond 35-40% of the total requirement of seed.
- Government procurement does not differentiate between varieties. It is likely that the seed supplied could be a mix of different varieties.
- Given the bulky nature of pods logistics are expensive and difficult to organize. Accordingly the quantities supplied to

Recommendations for sustainable seed systems in semi-arid tropics

1. Farmer to farmer seed exchange and local seed markets are popular throughout the project area but are not adequately linked with systems for improved seed. It is important that public sector research organisations which are strong on varietal production are linked with the informal seed supplies. Locally operating institutions, such as NGOs, extension services, KVKs, farmers associations and other CBOs could play an important role in effecting this link.
2. Farmer seed producers can be efficient and some will have potential to expand as specialised, small or medium sized local seed enterprise (Ravinder Reddy, 2005). For these interventions to be sustainable, they must be based on training and market development and not on direct government subsidies.
3. Sustainable, competitive groundnut seed systems will require substantial re-orientation 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 to develop 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 source of seed. Indirect subsidies may still be important for competitiveness among enterprises.
4. Programs will need to be vigilant in eliminating subsidised seed distribution that restricts development of sustainable local seed sector. Key to success in strengthening informal seed systems will be improving farmer and seed producer by providing access to information on product and seed prices and market options.
5. Development of alternative seed systems for groundnut seed production and distribution at Ananthapur and Kurnool districts is an urgent need. The formal seed sector has shown little or no interest in seed multiplication for crops like groundnut, with high seeding rate and low multiplication rates. Transportation, processing, bagging, and certification costs make the seed expensive for farmers. Community based or Village based seed production and distribution schemes have gained increased popularity in recent times (Ravinder Reddy, 2004a). The concept of village based seed bank involves improved seed and technical assistance focused on targeted pilot villages in order to train farmers in seed production, storage, seed health and distribution.

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