DELIVERING SEEDS OF 'ORPHAN' CROPS: THE CASE STUDIES OF POTATO AND GROUNDNUT IN INDIA[1]

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1. INTRODUCTION

In theory, the public sector should be able to address seed needs of those farmers who do not participate in commercial seed market. Although a number of India's public seed corporations have performed effectively, there are others whose performance has been far from satisfactory despite a number of government incentives. As a dynamic private input marketing system takes hold in the country, many observers are redefining a facilitating role for the public sector in seed production (Jaffee and Srivastava, 1994). However, the ability of public sector to deliver seed at local level is a part of the debate on appropriate roles for public and private sector in seed provision. To what extent decentralization should be undertaken for seed provision at local level and what other forms of seed systems may be more effective in augmenting seed supply in marginal areas? This study hopes to contribute to the debate about development of seed system in the context of high volume, low value crops, often known as 'orphan' crops. It examines the performance of the seed system and focuses on how the information flow takes place and what incentives are required to support the emergence of a seed sector that meets acceptable criteria for equity, efficiency and diversity.

The Case Study Crops

This paper uses the examples of groundnut and potato seed for examining the various issues outlined above. Groundnut is grown in India on about 6 million hectares with an annual production of about 8.30 million tones (2003-04). The yield is low (about one ton per hectare) and highly unstable in nature. The case study of groundnut focuses on Anantapur

district of Andhra Pradesh (AP), which occupies about 59 percent of the total area under groundnut in the state (1.49 million ha). Majority of the farmers grow groundnut under rainfed conditions.

Potato is grown in India on 1.3 million ha with an annual production of 25 million tones. The study focuses on the state of Uttar Pradesh (UP) where potato is grown on 0.42 million ha under irrigated conditions. The case study crops are perfect examples of 'orphan' crops as seed rate is very high and seed cost forms nearly one-third of the total variable cost of cultivation. Seed replacement rate is very low (4 percent in potato and 11 percent in groundnut) (Table 1).

2. COMMERCIAL SEED: PARTICIPATION OF PUBLIC AND PRIVATE SECTORS

The components of a seed delivery system are plant breeding, provision and multiplication of source seed, quality control and distribution. Extension activities aimed at variety promotion also forms part of seed system. This section discusses participation of different agencies in these elements of seed provision.

Plant Breeding

Like any other self-pollinated crop, plant breeding in groundnut and potato is dominated by public research organizations, and there is hardly any private activity to improve their plant population. At the national level, there are organizations of Indian Council of Agricultural Research (ICAR) responsible for plant breeding and associated research, and to coordinate such activities of other state-level organizations. Some State Agricultural Universities (SAUs) also have plant breeding programs, but the intensity of their efforts is more for

groundnut. Specific agro-climatic conditions are required for breeding of potato and these are found in few locations. Besides ICAR/SAU system, groundnut is benefited from the research efforts of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), based in Hyderabad, which has developed a number of improved breeding lines and varieties. Some of these lines are used in the national program, or released as varieties. The Bhabha Atomic Research Centre (BARC) has developed a few varieties, which are officially released and notified by the government for cultivation, and some of them have useful trait like higher oil content. Potato crop has also benefited from introduction of foreign varieties, or germplasm through the International Potato Centre (CIP). More recently, some foreign varieties are introduced in India by private sector to cater to specific needs of the processing sector.

Public Seed Production

Groundnut

Since 1990, about 60-70 thousand tones of groundnut seed is produced and sold every year in the country. Nearly half of this seed is produced and sold in AP, with slight decline in the quantity of seed distributed in the early 2000s. In the years of drought, or shortfall, there is significant increase in public seed operations for meeting farmers' demand for seed. For example, seed production in Andhra Pradesh was the highest (about 26,300 tones) in the drought year 2002-03.

Formal seed system for groundnut is dominated by government and other para-statal agencies. The State Seed Corporations deal with groundnut seed which constitutes major share of their total seed business. In addition to the seed corporations, there are some other para-statal or cooperative organizations dealing with groundnut seed. In Andhra Pradesh, AP Co-operative Oilseed Growers Federation Limited (APOILFED) is directly involved in seed

business. A similar situation was found in Gujarat where the National Dairy Development Board was engaged in the seed business. This process started when farmers approached these agencies to buy groundnut for seed purposes. This practice provided some advantage to farmers and they could buy groundnut pod of a desired variety (spread or bunch type), enabling them to frequently change varieties to be grown and also get seed in the year of shortage.

The operations of both the public seed agencies (APSSDC & APOILFED) are similar and they coordinate their seed activities with support from the government. The target of seed production is set by the government and the responsibility is shared by the seed agencies. Of the total seed sold in AP (26300 tones in 2002-03), more than half was sold by APOILFED because of its capacity to handle large volumes.

In the case of groundnut, although some breeder seed is produced, seed chain is not complete, and most of the seed sold is truthfully labeled (TL) seed. Since there is not much problem with deterioration of genetic purity in groundnut, seed agencies find it easy to procure seed from large producers and traders. The amount of seed distributed by these sources is contingent upon financial support from AP government for seed procurement and distribution in a given year. The government also provided subsidy and nearly one-third of the seed price was covered by subsidy in 2004. The proportion of seed produced with contract growers is very small and the process is like any other crop.

Potato

In the case of potato, State Seed Corporation or other public agencies are not effective because of low seed multiplication rate and problem in storage and distribution of seed. The source seed is produced by the Central Potato Research Institute (CPRI) and sold to government department as per the indents received. The seed is multiplied on government

farms, and the foundation seed thus produced is shared with seed producer farmers. The horticulture department supervises seed multiplication on farmers' field and help farmers to sell the seed. The official statistics shows that 3,200 tones of commercial potato seed was sold in UP in 2002-03. In some states like Himachal Pradesh (HP), 24,300 tones of potato seed was sold in the same year. Except horticulture departments of state governments, there is no other public agency, or any non-profit organization engaged in potato seed. The only exception is the state of HP where a primary cooperative society is multiplying and selling potato seed. The seed is produced in kharif season in the temperate hill zones and is sold immediately after harvest so that it can be planted in rabi season in the northern plains.

Private Seed Production

Private seed activities are almost negligible for groundnut and limited but expanding for potato. There are several reasons for this. First, profit margin is low in groundnut seed, partly because the seed is supplied by the public agencies at subsidized rates. Second, investment requirements for procurement and storage are huge because of voluminous nature of seed. Third, there is high risk because of high probability of damage during storage and handling of seed, and volatile seed demand. The demand for groundnut seed fluctuates due to high rainfall variability (high demand in good rainfall year), while the demand for potato seed is positively linked with market price which is unstable in nature.

There are several private seed activities in potato in the North India, in general, and UP in particular. Until late 1980s, there were many private seed producers in Himachal Pradesh because its climate is suitable for producing disease free seed. This seed was sold in the northern plains. However, with the increase in demand for vegetables, potato seed production was replaced by commercial production of potato and other vegetables for urban markets. This shifted potato seed production to the northern plains. The private seed producers vary in

scale of their operation and some big players supply seed to southern and eastern states also. All the seed players get source seed from CPRI and multiply on their farms. This is sold directly to other farmers just after harvest, or through cold storage usually owned by a third party.

Value Chain and Private Seed

Value chains are emerging rapidly in potato. This has not only increased the demand for improved varieties and quality seeds, but also offered incentives to commercial seed sector to participate in the value chain. There is increasing demand for potato varieties suitable for processing and private seed producers have tied up with the processing industry to supply seed to their contract growers. CPRI also shifted breeding priorities to develop processing-grade potato varieties in collaboration with the processing industry. Some major players in the industry introduced foreign varieties and managed their seed and commercial production under contract farming. This also helped them to protect their varieties.

Technological advancement, viz. tissue culture, has provided much needed advantage to potato industry in India. It has significantly increased the seed multiplication rate, and improved quality by producing disease (virus) free seed. This activity has attracted lot of private interests. There are tissue-culture based private seed companies selling source and commercial seeds. These companies are targeting domestic as well as export market. Since tissue-culture based seed is not yet approved for certification, these seed companies are not able to take advantage of benefits (of certification and tax incentives) provided to other commercial seed producer. Despite this problem, the share of this hi-tech potato seed is likely to increase substantially in future and potato could soon be out of the category of 'orphan' crops.

Seed Certification and Quality Control

Seed certification is managed by the Seed Certification Agency of respective state which charges fee for its services. The certification of seed includes inspection of seed multiplication plot at scheduled intervals and testing of harvested seed for germination, moisture content and purity. The Indian seed laws also allow sale of TL seed, which is sold with a label describing the minimum standards to which the seed must conform. Almost entire seed of both the crops is sold as TL seed. In the case of potato, seed produced by the co-operative society is certified, and government managed seed is mainly TLS.

In terms of quality control, there is no specific measure taken in TL seed of groundnut, except selection of pod based on physical appearance. The criteria for procurement are - 74 percent shelling, 8 percent moisture and 2 percent inert matter. Private producers however do undertake extra efforts to ensure quality of seed using better crop management and seed storage practices. In the case of potato, major quality concern is producing virus-free seed. Utmost care is taken by CPRI to supply virus-free source seed to government departments and private seed producers. Seed producers follow required management practices like halm cutting to control virus infection. Investment in tissue culture facilities is another example of private sector's concern to supply virus-free seed.

3. FARM LEVEL SEED MANAGEMENT

Information on the acquisition and management of seed by farmers indicates how effectively they are being served by a formal seed system, and gives an idea of what can be done to improve the performance of the system. Here we discuss sources of seed, information about new varieties, how the farmers choose variety and what are their seed management practices. These findings are based on a survey of 72 farmers carried out in Anantapur district of AP for

groundnut, and 96 farmers in Firozabad and Barabanki districts of UP[3] in the 2004-05. The sample farmers were selected randomly and the sample represented farmers from different size-holding categories.

Varieties Grown

Potato and groundnut occupy 58 and 80 percent of crop area sown, respectively (Table 2). As regards the varieties grown, there is a bit concentration of varieties - more than 80 percent of the area under both the crops is sown with their two dominant varieties. In case of groundnut, TMV2 is the most popular variety, covering 54 percent of the area. This is very old variety developed by Tamil Nadu Agricultural University and preferred by farmers because of its ability to perform well in drought conditions. JL24, Polachi and TAG24 are other dominant varieties. In potato, Kufri Bahar 3797 is the top ruling variety with 75 percent crop area. Rajendra-1 is another variety popular in eastern part of UP.

Sources of Seed

Farmers acquired 35 percent fresh groundnut seed from commercial sources, and 65 percent of seed requirement was met from the traditional sources, viz., own farm-saved seed exchange. In potato, however, the share of farm-saved seed (60 percent) is much higher than the commercial seed (Table 2). After getting fresh commercial seed, farmers multiply it on their farm and use it for a few cropping seasons. This is offered for sale in the next season after meeting his requirements. That is why proportion of area planted with commercial seed is comparatively low (21 percent). The farmers buy fresh seed mostly to get pure seed of the popular varieties. The percentage of farmers acquiring seed because of exhaustion of all the stock is also quite high in potato (30 percent). Only 12-15 percent farmers acquire seed with a

[3] Since UP is a big state, two districts from different agro-climatic zones were taken for farm survey.

view to change the variety. These are farmers who have got some commercial interests as well as resources (mainly irrigation) for seed production and multiplication.

Information about Varieties

The quality of information flow determines the efficiency and competitiveness of seed system. Therefore, it is important to know how farmers learn about new varieties and to what extent their feedback reaches the research system. Extension agencies are expected to play an important role in the two-way flow of information between farmers and plant breeders. The survey results, however, indicate very poor performance of extension agencies (Table 3). In the absence of effective extension mechanism, majority of the farmers (80 percent or more) get to know about a new variety from fellow farmers. Since plant breeding is still in the public sector and there is no commercial interests at present in both the crops, there is a case to strengthen information flow though public extension machinery.

Choice of Variety

Farmers' preference for varieties is governed by a number of factors. Important among these are: good yield (even under moisture stress conditions), better quality and tolerance to biotic stresses. In addition, high oil content and dual purpose (pod and fodder yield) are other preferred traits for groundnut. In groundnut, TMV 2 is preferred because of its ability to perform in severe moisture stress (drought) conditions, while JL 24 is preferred for its bold-type kernel used for table and export purposes. Kufri Bahar 3797 variety of potato is preferred by farmers because of less damage to tubers in transportation, besides good yield and quality. Most of the farmers demand variety by name suitable to soil type, weather condition and market demand. But, they insists on physical examination of seed to ensure seed quality. Price is, however, an important criterion to buy groundnut seed (Table 3).

Seed Quality

The seed quality issues reflect on farmers' knowledge about different parameters and institutions involved in seed quality assurance. Seed certification is meant to give an assurance on seed quality. There is no problem with genetic purity of seed as both crops are self-pollinated and possibility of off-type is minimum. However, physical quality of groundnut seed offered by the formal system was not as good as expected for commercial seed. Poor germination and poor physical conditions like disease infestation and broken and shrink kernels were the main quality problems. Though the redressal mechanism (say, district consumer forum) is available for dealing with such cases, very few farmers are aware about this and hardly make use of it. It may also be noted that more than three-quarters of the seed with quality problems was procured from the formal sources (government), and thus it was no better than the seed taken from fellow farmers. However, in case of potato, seed purchased from fellow farmers and cold storage had more instances of quality problems (Table 4).

Seed Saving Practices

Since groundnut and potato are self-pollinated crops, their seed can be recycled for sowing in the next season. Between 64 to 93 percent of the farmers often use recycled seed in one year or the other (Table 4). In 2004, a majority of the farmers used farm-saved groundnut seed, which was 42 percent of the total seed used. In addition, 23 percent of the seed was taken from fellow farmers, thereby raising the share of recycled seed to 65 percent. In potato, the share of farm-saved seed was as high as 79 percent. Majority of the farmers recycle seed for 2-3 years before they get fresh seed. However, there is a reduction of about 5-8 percent in groundnut yield when seed is recycled for one year, which increases to 13 percent when recycling is done for two consecutive years. The corresponding reduction in potato yield is 7-

8 percent. In spite of yield reduction, seed recycling would be more economical as long as the loss is less than the seed cost.

4. OPTIONS FOR SEED SYSTEM DEVELOPMENT

What could be the best mechanism to efficiently deliver seed of self-pollinated crops like groundnut and potato? What should be the role for public sector, NGOs and private producers and how the synergy can be developed among different stakeholders so that seed system functions in a smooth way. We have tried to answer these questions here. Technological interventions needed to address quality and other problems in the seed chain are also explored.

Roles of the Public and Private Sectors

Since more than half of the seed was acquired off-farm, formal seed system must meet this demand which is quite high by any standard. Given the nature of seed business, there is not much incentive for commercial private sector in the provision of seed, and therefore there is a clear case of government intervention. Public seed corporations should take lead in the seed supply to farmers. These agencies should complete the seed chain and focus on seed multiplication in favorable conditions, so as to increase seed yield. Much of this could be realized by coordination of seed activities of different states. Second major problem arises with source seed, especially for those varieties developed by the institutions like ICRISAT and BARC which are not covered under breeder seed production program of the government. These institutions may directly train farmers or seed agencies for production of quality seed.

In comparison of other crops, seed cost is very high for the case study crops, and farmers in marginal environments do not have adequate resources and incentive to invest in seed. The policy of AP government to subsidize groundnut seed has no doubt improved farmers' access

to commercial seed. But at the same time, it discouraged small local seed producers as they find it hard to compete with public seed agencies selling subsidized seed. Therefore, private groundnut seed producers should be identified and encouraged by suitable incentives, or should be provided benefit of subsidy like done in other crops. Private seed producers can play a significant role in augmenting the seed supply. Augmenting supply of source seed and training them in use of improved seed management practices would go a long way in improving seed supply. Research institutions may even work with these producers for on-farm testing and promotion of new varieties. This is particularly important when the government extension system is constrained by a host of factors and finds it difficult to educate farmers about new varieties.

Another major opportunity for private sector's participation is provided by expanding markets for quality products. This is clearly noticed in case of potato. For groundnut, these markets are kernels for table purpose in domestic and export market, high oil content groundnut, and export of groundnut cake. Since these markets enjoy considerable price premium, there is incentive to maintain product quality, and quality seed has an important role to play in this. In the event of supply chain becoming stronger for these markets, input companies may enter in seed business and integrate with the supply chain. This has taken place in rice, potato and vegetables, and can be replicated in groundnut also. Entry of APOILFED in seed business is another example of this process of diversification of the seed system.

Technological Imperatives

Technological innovations could provide much of the needed support required for development of the seed system. The public research system should accelerate its efforts in critical elements of the seed system. First on this is development of improved varieties

suitable to different production environments and purposes. High oil and fodder yield and tolerance to moisture stress are the most preferred traits for groundnut. Addressing the problem of Aflatoxin through crop improvement, or crop management practices is another major concern of farmers, traders and consumers alike. It is very unlikely that even IPR regime will attract private investment in groundnut breeding, and therefore, it shall remain a responsibility of the public sector. The public research system, both national and international, has allocated considerable amount of resources to address the major research problems and any success in these efforts would boost the groundnut economy in general, and seed system in particular. The second technological challenge is to improve seed multiplication rate and ensure seed quality. This is a Herculean task for plant scientists, particularly for seed technologists. Potato also faced this problem, which was successfully addressed through tissue culture technique. There is not only reduction in investment and seed cost, but also marked improvement in seed quality. The problem associated with crop management in seed plots and handling of seed during storage and distribution are major concerns. Low cost, user-friendly techniques will go a long way in improving quality of seed produced by decentralized seed system.

5. CONCLUSIONS

This paper has examined groundnut and potato seed systems and farmers' seed acquisition and management practices. Although a number of actors are involved in plant breeding, and multiplication and distribution of seed, there are inefficiencies in the system. The variety replacement rate is very low and farmers get little information about new varieties from public extension or seed system. Although the seed replacement rate is higher than other self-pollinated crops, formal seed system is able to meet hardly one-third of the seed requirement. Concerted efforts are required to augment seed supply, improve seed quality and promote

new varieties. Technological innovations should address (a) major production constraints, (b) control the problem of aflatoxin, and (c) improve multiplication rate and quality of seed. It is very unlikely that these crops will attract private investment in plant breeding even under the IPR regime. Therefore, public research system should continue to shoulder the responsibility of plant breeding, and develop partnership with private sector to strengthen decentralized seed activities. The state seeds corporations should also strengthen their seed business with focus on better seed multiplication and quality management. Coordination among public seed agencies may provide opportunities for cost reductions, augmenting supply in deficit regions, and offering greater choice to farmers. The government should look for linking marginal production regions with the national and global market. This would help develop value chain, especially for premium market, which may eventually attract corporate sector in the product, as well as seed market. Finally, crop production environments are small and fragmented for some crops, and one variety may not be suitable for a state, or couple of states. One needs to monitor how provisions in the new seed legislation, particularly the requirement of compulsory registration, or protection, would affect the seed system in general, and participation of the private sector in particular.

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Table 1: Trends in potato and groundnut production and seed replacement rate, all India

Particulars	Year	Potato	Groundnut
1. Area (M ha)	2003-2004	1.37	6.00
2. Production (MT)	2003-2004	25.00	8.30
3. Yield (Tones/ha)	2003-2004	18.25	1.38
4. Compound growth rates			
Area	1990-2004	2.63	-2.86
Production	1990-2004	4.09	-1.95
Yield	1990-2004	1.49	0.95
5. Seed replacement rate (%)	2002-2003	4.23	11.44
6. Average seed cost (Rs./ha)	1997-2000	9425	2350
7. Average share of seed cost in total operational cost (%)	1997-2000	34	30

Source: Government of India (2004 & 2005)

Table 2: Variety adoption and source of commercial seed

Particulars	Potato (UP)	Groundnut (AP)
1. Proportion of net sown area under the crop	58	80
2. Proportion of area under top one variety	75	54
3. Proportion of area under top two varieties	83	94
4. Proportion of seed acquired off-farm in 2003-04	40	58
5. Sources of seed (% of quantity)		
Commercial	21	35
Other farmer	19	23
Farm saved	60	42
6. Reasons for acquiring off-farm seed (% of cases)		
To get pure seed of same variety	58	67
To change variety	12	15
Consumed or sold all stock	30	18

Source: NCAP farm survey 2004-05

Table 3: Farmers' sources of information about varieties

(% of cases)

Particulars	Potato (UP)	Groundnut (AP)
1. Sources of information		
Fellow farmer	87	80
Extension system/agencies	02	16
Others	11	04
2. Preferred variety characteristics (top two)		
Good yield	28	31
Better quality	30	23
3. Criteria for seed purchase		
Variety name	43	32
Physical examination of seed	41	27
Price of seed	08	26

Source: NCAP farm survey 2004-05

Table 4: Seed quality and recycling

(% of cases)

Particulars	Potato (UP)	Groundnut (AP)
1. Proportion of poor quality seed	04	26
2. Sources of poor quality seed		
Government	-	84
Fellow farmers	50	11
Cold storage/input dealer	50	05
3. Major quality problems		
Poor germination	-	42
Poor physical conditions	-	58
Impure seed (mixing of other varieties seed)	100	-
4. Proportion of poor performance due to wrong variety selection	Nil	24
5. % yield reduction due to wrong variety selection	Nil	68
6. Recycling		
Proportion of farmers who recycle fresh seed	93	64
% yield reduction if seed recycled once	6.9	6.8
% yield reduction if seed recycled twice	8.3	13.2

Source: NCAP farm survey 2004-05