Pigeonpea Seed Production System of Smallholder Farmers: An Assessment in Odisha, India

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Abstract

Smallholder pigeonpea farmers in Odisha always rely on self-saved seeds of preferred landrace with long maturity period of 7 months and exploiting this for a period of 2-4 years or more. These model of seed system continuously resulted in low yield (250-500 kg/ha) due to seed deterioration. Seed production at farmers' level with the provision of new package of technology such as providing farmers preferred high yielding varieties and hybrids, on the ground training on cultural production and management, and integrated pest and disease management has contributed in increase in productivity (780 kg/ha), improving livelihood, and income of farmers in the project sites (Rayagada, Kalahandi, and Nauparha). Institutionalizing the seed system model through the 'one village one variety' concept has brought about the production of 1610 tons of various certified seeds. The assessment also revealed that higher investment in seed production resulted in higher seed yield and income. Likewise, farmers seed growers with medium land classification showed the best B;C ratio with Rs 3.38 per Rs 1 invested. Moreover, it can be deduced from the B:C ratio of all land classification that seed production is economically viable for smallholder farmers to venture in improving their livelihoods. However, there are still limitations that needs to be addressed to ensure the sustainability of the seed delivery system of the project. The most pressing constraint of pigeonpea production is the damage caused by pests and diseases and the lack of farm inputs; trainings/awareness meetings/exposures are required to educate farmers on new pigeonpea technologies; and the need to regulate prices of pigeonpea seeds is a major concern for smallholder farmers to obtain benefit from their pigeonpea cultivation.

Key words: smallholder farmers, seed production, pigeonpea, seed system

Introduction

Pigeonpea (*Cajanus cajan* L.) is one of the most important grain legumes of Odisha farming community that contributes largely as food, feed, fuel wood and sustainable farming system. Odisha is located on the eastern coast of India and large section of farmer communities are in the rainfed upland ecosystems which remained isolated from improved cultivars and management practices for various reasons. Majority of the smallholder farmers grow pigeonpea of long-duration type and are considered landraces with very low seed replacement ratio of 2-3% because the proportion of quality seeds available each year is only 10-12% of total production. Aside from these constraints, the productivity is less than 500 kg/ha (well below the national average of 700 kg/ha) with lots of impurities (Mula and Saxena, 2013 and 2014).

To sustain seed requirement of smallholder farmers, 80-90% of planting materials are largely sourced from farmers' own-saved seeds, co-farmers, relatives or in adjacent blocks/districts and this is continuously utilized for about 2-4 years (Mula, 2012).

Smallholder farmers because of their subsistence level are hardly involved in seed production. Only a handful of these farmers have become truthfully labeled seed producers because improved seeds have not reached the majority of individuals in the farming communities creating a gap of both in understanding and meeting project goals (Holmesheoran et al, 2012).

The rainfed areas of Odisha have enormous potential for expansion of high-yielding short- and medium-duration pigeonpea varieties and hybrids. In this respect, the project 'Introduction and Expansion of Improved Pigeonpea (*Arhar*) Production Technology in Rainfed Ecosystem of Odisha' was implemented in 2011 for a period of four years. The project was implemented through a farmer's participatory approach towards developing a sustainable livelihood through village-level seed delivery system via improved pigeonpea production technology to achieve self-sufficiency of having pure seeds of farmer-preferred high yielding varieties and hybrids.

Materials and Methods

The assessment was conducted in June 2013 covering three districts (Rayagada, Kalahandi and Nauparha) to 161 farmer seed growers. Quantitative and qualitative data were obtained through a survey. The survey not only includes topics on adoption of improved pigeonpea production technology to enhance livelihood systems but also on seed delivery system specifically on its institutional arrangements that tells how partnership can enhance project performance. With this, the assessment specifically:

a. Determined the extent of adoption of the package of technologies by the smallholder farmer seed growers;
b. Identified the gaps, constraints, and lessons for improving the delivery of interventions and activities; and
c. Elicited and analyzed critical areas on the long term sustainability of the project outcomes/impacts and suggested recommendations to maintain long-term sustainability.

Analysis was carried out with the use of SAS software (SAS/STAT 9.3 User's Guide, 2013). All variables were tested for normality assumption by using Shapiro-Wilk Test. For cases where normality assumptions were violated, a non-parametric test, Wilcoxon Signed-Rank Test was used to determine significant differences. For variables that follow normality assumption, the usual t-test was performed. Projection of pigeonpea production and area was estimated through the compound annual growth rate (CAGR).

Results and Discussion

Traditional Smallholder Farmer Seed System. Prior to the implementation of the project, 100 % of smallholder farmers rely on their saved seeds of pigeonpea landraces to grow continuously as their seed material for 2-4 years or even more (Figure 1). Farmers depend on their existing seeds and would trade seeds between and among co-farmers and relatives or even other villages when their seeds deteriorates in producing adequate yield. Informal trading or

exchange provides farmers new cultivars but majority are always deteriorated landraces with long duration maturity to about 7 to 8 months. Likewise, smallholder farmers in the target area hardly made profit from growing pigeonpea. The income is meager with only Rs 10,000 - 15,000 per hectare due to low productivity estimated at 250 - 500 kg/ha (Mula et al, 2014). Even though few farmers who have access to a subsidy program of new varieties for commercial purposes of the Department of Agriculture, the pure seeds deteriorate and or contaminated after a year because this is sown alongside their landraces as revealed in Figure 1. This is in conformity with the findings of Holmesheoran et al, 2012.

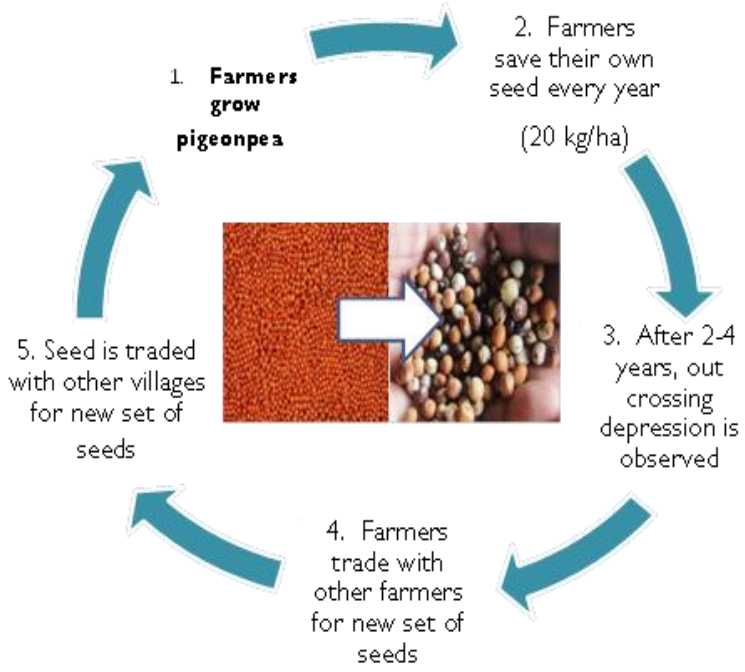

Figure 1. Smallholder pigeonpea farmers seed system tradition.

One Village One Variety Seed System Model. Pigeonpea is a cross pollinated crop that is why contamination occur due to non-isolation during seed production. In order to sustain good quality seeds, the project initiated the institutionalization of a viable seed system through the concept of 'one village one variety' model thus eliminating the danger of outcrossing with other varieties.

The integration of both the formal and informal seed sector helps much in providing access to quality seeds since the formal seed sector alone cannot ensure timely supply of huge volume of quality seeds required by the farmers. The project started by identifying villages and smallholder farmers to engage in seed production of farmer preferred varieties and hybrids suited to their soil type. Figure 2 showcases the flow of maintaining and sustaining quality seeds of farmer preferred varieties and hybrids through the integration of the formal and informal seed sectors. This model generated a total 1610 tons of various seed class from 2011 to 2013 (Mula and Saxena, 2012a; 2013; 2014).

Breeder and parental lines of hybrid seeds were supplied continuously by ICRISAT to selected progressive farmer seed growers to multiply as Foundation and Hybrid seeds. The

Foundation seeds produced was distributed to selected set of smallholder farmer seed growers for exponentiation of Certified or Truthfully Labelled (TL) seeds.

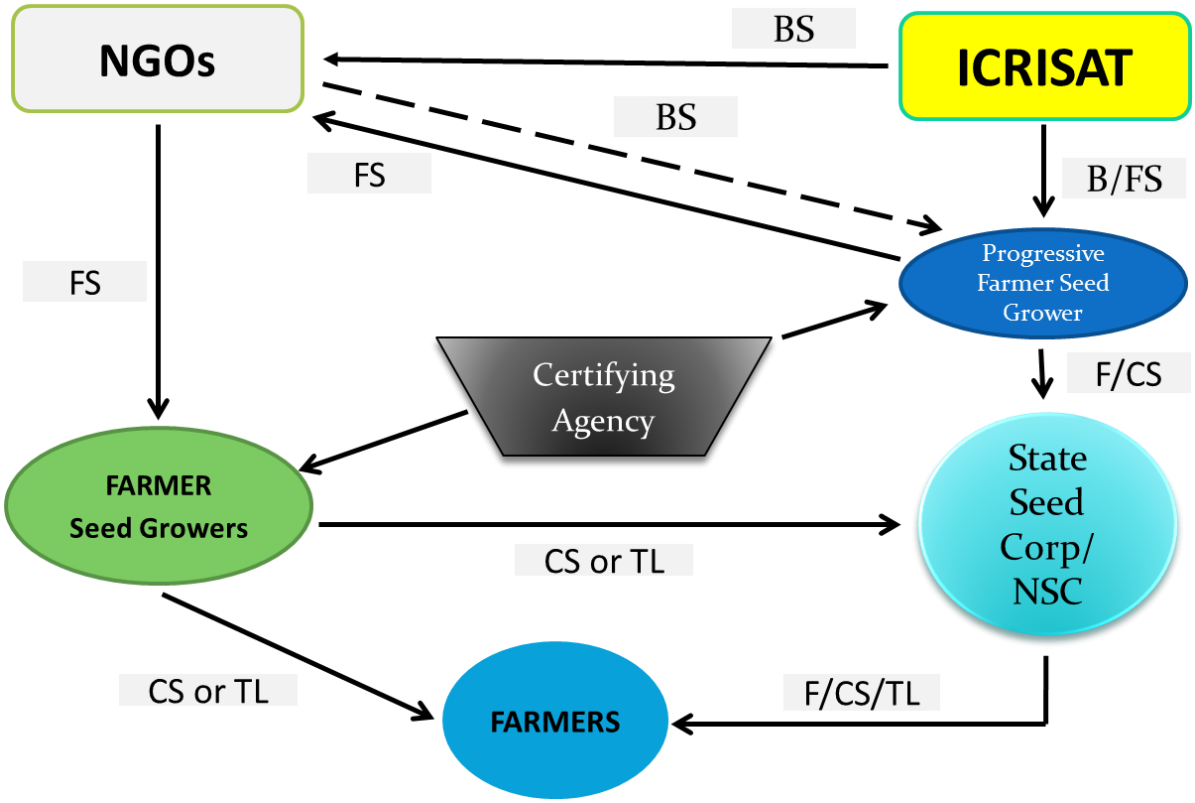

Figure 2. Institutionalized seed system model in Odisha (2012-2013)

The role of non-government organizations (NGOs) is very critical in identifying and monitoring the activities and educating smallholder farmers as seed growers. The state seed corporations or other small players in seed procurement are task to purchase the quality seeds produced by the farmers. The benefit of partnering with the certifying agency (Odisha State Seed and Organic Product Certification Agency) led to the maintenance of good quality seeds of farmer preferred cultivars through monitoring and strictly adopting the cultural management practice such as isolating the seed production sites by at least 300 meters for varieties and 500 meters for hybrids, away from other cultivars. Smallholder farmers of the entire village were motivated to plant the same variety through extension education and the development of collaboration between the formal and informal organization. This contributed much in having a system that allows the long-term benefits of improved varieties and hybrids by the smallholder farmers for longer period of time, which is corollary to Nagarajan et al.'s (2007) approach.

Cost of Seed Production and Income. In any crop seed production activity, farm inputs are necessities to meet the required optimum yield and quality, and purity of seeds. The cost of producing seeds in the three districts varies due to different farm sizes namely marginal (<1 ha), small (1-2 ha), semi-medium (2-4 ha), and medium (4-10 ha) (Table 1).

Marginal land. Majority of smallholder farmer seed growers are having land area of less than one hectare except for Kalahandi (Table 1). The cost of producing various class of seeds is high in Naupada at Rs 10,364 per hectare while the lowest is recorded in Kalahandi (Rs 10,024/ha). However, the net income is more observed in Rayagada (Rs 23,709/ha) due to higher productivity of 675 kg/ha as compared to Kalahandi (405 kg/ha) and Naupada (570 kg/ha).

Small land. Seeds produced in this type of land projected an increase in cost of production in Naupada (Rs 24,208/ha) as compared to Kalahandi (Rs 12,127/ha). However, the effect of having less farm inputs resulted in reduced productivity of farmers in Kalahandi (456 kg/ha) as compared to Naupada (1,354 kg/ha).

Semi-medium land. In Kalahandi, farmer seed growers with an area of n 2 to 4 ha spent an average Rs 13,028/ha seeds which resulted in higher seed yield of 682 kg/ha.

Medium land. Very few farmers are under this category. The average of which is 4.8 ha (Table 1). The assessment showed that cost of production was highest in Rayagada estimated at Rs 62,809/ha as compared to Kalahandi district at Rs 14,927/ha. Nonetheless, the effect of this farm inputs proved to be more beneficial in Rayagada due to increase in seed yield at 1,372 kg/ha.

Benefit Cost Ratio. The B:C ratio on total cost basis was calculated to determine the benefit derived by farmer seed growers involved in seed production. Results revealed that farmers seed growers with medium land classification showed the best B;C ratio with Rs 3.38 per Rs 1 invested in Rayagada (Table 1). However, it can be deduced from the B:C ratio of all land classification that seed production is economically viable for smallholder farmers to venture in for improving their livelihoods.

Limitations in Seed Production

Seed production at farmers' level has contributed in improving livelihood and incomes of farmers in the project sites. In addition to better income and nutrition, farmers where educated specifically in improving the quality of their seeds. However, there are still limitations that need to be addressed to ensure the sustainability of the seed delivery system of the project. The most pressing constraint of pigeonpea production in the three districts is the damage caused by pests and diseases and the lack of farm inputs (Table 3). Government subsidies specifically for farm inputs such as fertilizers, pesticides and sprayer are regarded important as expressed by smallholder farmers. In Naupada, trainings/awareness meetings/exposures are required to educate farmers on new pigeonpea technologies while in Rayagada, the need to regulate prices of pigeonpea seeds is a major concern for smallholder farmers to obtain benefit from their pigeonpea cultivation.

Table 3. Limitations in seed production.

Particulars	Kalahandi (n= 44)		Nuapada (n= 102)		Rayagada (n= 15)	
	No.	%	No.	%	No.	%
A. Cultural management						
Irrigation problem	-	-	68	32	-	-
Pest and diseases	4	9	17	17	14	93

Lack of inputs (fertilizer, pesticide and sprayer)	6	16	102	47	11	42
Delayed seeds supply	35	92	-	-	-	-
Isolation distance	1	3	-	-	-	-
Labor availability	4	9	-	-	-	-
B. Marketing						
No fixed price	-	-	-	-	15	58
C. Others						
No training/awareness/exposure	-	-	45	21	-	-

Conclusion

The traditional seed system model of smallholder farmers rely on self-saved seeds and utilizing this for a period of 2-4 years or more. These model continuously resulted in low yield (250-500 kg/ha) due to seed deterioration. With the project 'Introduction and Expansion of Improved Pigeonpea (Arhar) Production Technology in Rainfed Upland Ecosystems of Odisha', seed production at farmers' level were provided with new package of technology such as providing farmers preferred high yielding varieties and hybrids, training on cultural production and management, and integrated pest and disease management has contributed in increase in productivity (780 kg/ha), improving livelihood, and income of farmers in the project sites (Rayagada, Kalahandi, and Nauparha). Institutionalizing the seed system model through the 'one village one variety' concept has brought about the production of 1610 tons of various certified seeds. The assessment also revealed that higher investment in seed production resulted in higher seed yield and income. Likewise, it can be concluded from the B:C ratio of all land classification that seed production is economically viable for smallholder farmers to venture in improving their livelihoods.

However, there are still limitations that needs to be addressed to ensure the sustainability of the seed delivery system of the project. The most pressing constraint of pigeonpea production is the damage caused by pests and diseases and the lack of farm inputs; trainings/awareness meetings/exposures are required to educate farmers on new pigeonpea technologies; and the need to regulate prices of pigeonpea seeds is a major concern for smallholder farmers to obtain benefit from their pigeonpea cultivation.

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Table 1. Yield, Seed Production Cost, Net Income, and Benefit Cost Ratio

Location	Area	Quantity of seed	Yield	Price	Gross income	Cost of production (Rs/ha)												Total production cost	Net income	B:C ratio
	ha	kg/ha	kg/ha	Rs/kg	Rs/ha	Seed cost	Sowing	Cultivation	Fertilizer	Fertilizer labor	Pesticide	Pesticide labor	Weeding	Irrigation	Harvesting	Threshing	Others	Rs/ha	Rs/ha	
Kalahandi																				
Marginal (n=5)	0.45	9	405	65	26330	2160	889	939	1591	543	692	395	543	543	889	840	593	10024	16306	1.61
Small (n=20)	1.02	21	456	64	29344	5040	945	722	1815	568	803	148	400	303	747	636	358	12127	17217	1.70
Semi-medium (n=18)	2.42	20	682	65	44330	4800	906	851	1976	796	653	425	700	316	919	686	425	13028	31302	1.45
Medium (n=1)	4.05	20	741	65	48165	4800	988	1729	2964	-	1235	-	741	-	1729	741	-	14927	33238	1.45
Nuapada																				
Marginal (n=95)	0.47	12	570	60	34511	2880	1212	1370	1821	595	561	397	1425	254	1026	783	148	12472	22039	1.57
Small (n=6)	1.18	23	1354	62	82354	2174	3088	3055	4899	906	1564	1153	3582	0	1482	2058	247	24208	58146	1.45
Rayagada																				
Marginal (n=15)	0.40	10	675	52	34992	2400	609	2034	790	659	914	-	972	873	-	732	1300	11283	23709	1.48
Medium (n=1)	4.86	25	1372	65	89180	6000	4117	3086	5146	1235	2470	1235	14820	7410	12350	4940	-	62809	26371	3.38

Legend:
Marginal - < 1.01 ha
Small - 1.01 - 2.00 ha
Semi-medium - 2.01 - 4.00 ha
Medium - 4.01 - 10.00 ha