FINAL REPORT

MID-TERM IMPACT ASSESSMENT STUDY

Introduction and Expansion of Improved Pigeonpea *(Arhar)* Production Technology in Rainfed Upland Ecosystems of Odisha

Rosana P Mula, Myer G Mula, R Santha Gopalan, Saroj Das, RV Kumar and KB Saxena

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June 12, 2014

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Odisha

Subject: Final Report on Mid-Term Assessment of the ICRISAT-DoA Govt of Odisha Project on Introduction and Expansion of Improved Pigeonpea (*Arhar*) Production Technology in Rainfed Upland Ecosystems of Odisha'

Dear Mr Gopalan,

Greetings!

We are pleased to submit the final report of the Mid-Term Assessment of the ICRISAT-DoA Govt of Odisha project entitled 'Introduction and Expansion of Improved Pigeonpea (*Arhar*) Production Technology in Rainfed Upland Ecosystems of Odisha'. This in-house assessment was conducted in 2012-2013 together with the NGO partners of this project.

In summary, the mid-term assessment revealed remarkable achievements of the project where improved ICRISAT varieties (including two hybrids) along with improved management practices like line sowing in ridges, judicious and correct timing of pesticide and fertilizer application outweighed the performance of local landraces. The benefit-cost ratio by district and over-all, including non-project farmer-participants showed a significant increase. The productivity increase was estimated at 70% as against landraces and the increase in net income was estimated between 170-190%.

Women participation improved especially in seed storage and in some specific activities such as *dal* processing. The investment gain of 308% – for the two major components: (a) Improved Pigeonpea Production Technology (IPPT) and (b) Seed production (SP) – showed the viability of the project. Even the projected increase in area and yield for 2015 and 2020 indicates the potential of the project.

Areas for improving the delivery and sustainability of the initial project achievements were also identified. Some suggestions to maintain the long-term sustainability of the project are: (a) ensuring the purchase of quality seeds produced by the project, (b) better marketing scheme/facilities and (c) aggressive capacity building approach to include training/exposure.

This is a case in point where the remarkable improvement in livelihoods of farmers in the five districts of Odisha can be largely attributed to ICRISAT in partnership with DoA, Govt of Odisha.

Thank you and looking forward for your continued support to the project especially in addressing the recommendations/suggestions generated by the mid-term assessment.

With warm regards,

William D Dar
Director General

cc: Dr Saroj Das, Director for Pulses, Govt. of Odisha
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This work has been undertaken as part of the CGIAR RESEARCH PROGRAM ON Grain Legumes

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Acknowledgments

We would like to extend appreciation to all those who generously contributed to the mid-term assessment of the project entitled “Introduction and Expansion of Improved Pigeonpea (*Arhar*) Production Technology in Rainfed Upland Ecosystems of Odisha”.

Special mention goes to Department of Agriculture (DoA), Government of Odisha (Govt of Odisha) and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Management. The research has been an amazing experience knowing that ICRISAT technology has really made a significant difference in the lives of smallholder farmers. We express our profound gratitude to DoA, Govt of Odisha for their tremendous support and for the opportunity to know more about Odisha and its wonderful people.

Similarly, profound gratitude goes to Sarat Kumar Tripathy (State Coordinator), Santosh Kumar Mohanty (Rayagada and Boudh District Coordinator), Purna Singh (Kalahandi District Coordinator) and Yashobanta Naik (Nuapada and Bolangir District Coordinator), who were a group of truly dedicated practitioners. We are also hugely appreciative to all the respondents, especially for sharing their views and opinions so willingly.

Last but not the least, appreciation goes to Abishek Rathore and M Ravikanth for statistical analysis; S Nedumaran for providing projection estimates; and to T Mohini, Niharika Lenka, and Kanika Mishra for their help in completing the report.

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Executive Summary

The rainfed areas of Odisha have enormous potential for expansion of high-yielding short- and medium-duration pigeonpea varieties and hybrids. However, the majority of farmers in these rainfed upland ecosystems do not have access to improved pigeonpea cultivars and management practices. With this view, the project 'Introduction and Expansion of Improved Pigeonpea (*Arhar*) Production Technology in Rainfed Upland Ecosystems of Odisha' was implemented in 2011 for a period of four years. The project was implemented through a farmer participatory approach towards developing sustainable livelihoods in the state through improved pigeonpea production.

The mid-term assessment for this project was conducted in June 2013. The total number of respondents for the assessment study was 823, consisting of five districts for Improved Pigeonpea Production Technology (IPPT) and Farmer Participatory Varietal Selection Trial (FPVST), three districts for seed production (SP), three for *dal* mill, and two for godowns.

As part of the assessment, the team carried out a detailed study of various topics of importance to the pigeonpea project such as technologies, benefit cost ratio (BCR), gender participation and other socio-demographic information. Report from the assessment presented problems and constraints faced during project inception and degree of satisfaction to capacity building activities, Information, education and communication (IEC) strategies, degree of satisfaction on roles of key stakeholders, major factors/constraints in the delivery of pigeonpea technologies and diffusion.

The study was conducted in areas with a wide range of socio-demographic mixture of people ranging from all age groups, gender, marital status and educational qualifications. Increased women participation was identified to be part of the project activities. The women participants learned line sowing as well as improved seed storage practices and at the same time participated in various cultural management practices. The respondents were introduced to a number of technologies which were not practiced earlier like introduction of new high yielding varieties (medium duration, specifically ICPL 14002 (*Asha)* and ICPL 14001 (*Maruti*)), seed rate from farmer practice of 20-25 kg/ha into 12 kg/ha, application of fertilizer (100 kg DAP/ha), application of insecticide, weeding, intercropping and line sowing. It was found that the respondents were benefitted with the introduction of these technologies and a positive result was obtained in their response. A distinct/noticeable increase was seen in the productivity estimated at 70% as against landraces and in net income approximately 170-190% of the respondents after the adoption of the aforesaid technologies in the management practices of pigeonpea. Gleaned from the summary table on project benefit, the investment gain is approximately 308% or four times the investment for IPPT and SP components.

As a whole, the results obtained till date are very promising and suggestions like more training and exposure, organized marketing scheme, hybrid trials, etc, are under consideration and to be implemented accordingly. The positive achievements of the project brings to light the need for continuous and increased support for the project not only because of the current investment gain but also due to projected increase in production especially in Rayagada and Boudh for year 2015 and even in year 2020.

Introduction

The project entitled "Introduction and Expansion of Improved Pigeonpea (*Arhar*) Production Technology in Rainfed Upland Ecosystems of Odisha" was implemented in 2011 with duration of four years. The project was initiated with the concerted effort of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Department of Agriculture (DoA), Government of Odisha (Govt of Odisha) and local non-government organizations (NGOs). The objective was to introduce and expand the production of high yielding pigeonpea varieties through a farmer participatory approach for sustainable livelihoods in the state. The project is farmer-driven, farmer-implemented, and farmer-owned. The researchers and extension agents play a catalytic and guiding role through the provision of technical options to farmers and by helping them to make appropriate choices. The report highlights parameters of success, concerns and constraints that have hindered the attainment of the project objective and have suggested recommendations to maintain long term sustainability and expansion of the project in other areas of Odisha or even India.

With the project coming to its third year of implementation, an assessment activity is important to determine whether there was any change(s) brought about by the project as a result of the various activities implemented. Hence, a mid-term impact assessment was conducted in June 2013 to gather insights on effect(s) of the interventions to farmers, which are important metrics not only to determine best ways to sustain achievements but also for the upscaling process (ie, extending the project to other parts of Odisha and incorporating other components). Results of the mid-term assessment have shown significant success of the project and that a plan for expansion is in the offing.

This forward looking bid was carefully given attention in order to make the most of the remaining resources and give meaning to the target beneficiaries – the rural smallholder farmers.

Objective

The primary objective of the ICRISAT-DoA Govt of Odisha pigeonpea project is to introduce and expand the production of high yielding ICRISAT pigeonpea varieties (and partly hybrids) by initiation, selection and promotion through a farmer participatory mode. Hence, the proposed assessment attempted to pinpoint parameters of success, concerns and constraints that have hindered the attainment of the project objective.

Specifically, this proposed impact assessment:

1. Determined the extent of adoption of the package of technologies by the farmers that includes: high yielding disease resistant varieties (and partly hybrids),
2. Identified the gaps, constraints, and lessons for improving the delivery of interventions and activities. This would include seed delivery system, capacity building, linking to production with dal processing and marketing, and
3. Elicited and analysed critical areas on the long term sustainability of the project outcomes/ impacts and suggested recommendations to maintain long term sustainability.

Attention to differences across locations was made for better insights to improve project activities of future projects of similar nature. Indicators were identified to articulate evidence of project contribution.

Scope of work

The assessment was an in-house activity with strong participation of local partners specifically the NGOs with whom ICRISAT partnered for implementing this project. As mentioned earlier, the scope of work dealt with the extent of adoption of the technologies introduced by ICRISAT and the direct effects of these technologies in the productivity of the crop and current farming system.

Prior to the initiation of this work, the team who conducted the assessment study discussed the content and process with key scientists involved in the project. This led to a better elucidation of the mechanics, identification of the most appropriate indicators, and agreement on the outcome of the impact study, and full support of the proposed study.

Approach

Quantitative and qualitative data obtained through a survey was a joint effort of local staff, knowledgeable on the project and the crop and with a social scientist from ICRISAT. Pre-testing of the survey form was also done to enhance the accuracy and effectiveness of the instrument. During the pre-testing stage, the social scientist had the opportunity to discuss the impact assessment research before concerned local institutions; its rationale, the survey instrument and expected output.

Progress reports were referred to in order to have better understanding of the project and its specific components.

***Survey instrument*.** The survey instrument was prepared in close consultation with ICRISAT scientists involved in the project. The instrument was pre-tested and translated in the *lingua franca* (Oriya) to facilitate data gathering.

The survey not only included topics about the adoption of improved pigeonpea production technology to improve livelihood systems but also on one major component of the project, the seed delivery system, specifically on its institutional arrangements. This will be able to shed light on how partnership can enhance project performance. Insights from all these will be helpful in future undertakings.

Data analysis. Analysis was carried out by 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 Discussions

Project components

The total number of respondents for this study is 823. The specific number of respondents per component is shown in Table 1. For IPPT, there were 645 respondents; SP, 161 respondents; FPVST, 12 respondents; *dal* mill, three respondents; and godown, two respondents (Figure 1).

Table 1. Number of respondents per district.

Particulars	Bolangir	Boudh	Kalahandi	Nuapada	Rayagada	Total
IPPT	106	67	153	216	103	645
SP			44	102	15	161
FPVST	1		4	5	2	12
Dal mill			1	1	1	3
Godown			1	1		2
Grand total	107	67	203	325	121	823

Figure 1. Map of Odisha showing the districts covered in the study.

1.0 Improved Pigeonpea Production Technology (IPPT)

The total number of respondents for IPPT is 645 covering 15 blocks (Bangomunda, Bolangir; Kantamal, Boudh; Bhawanipatna, Dharamgarh, Golamunda, Kesinga, Lanjigarh, and Narla in Kalahandi; Boden, Kahariar, Komna, and Sinapali in Nuapada; and Kalyanisingpur, Kolnara, and Rayagada in Rayagada) (Figure 2).

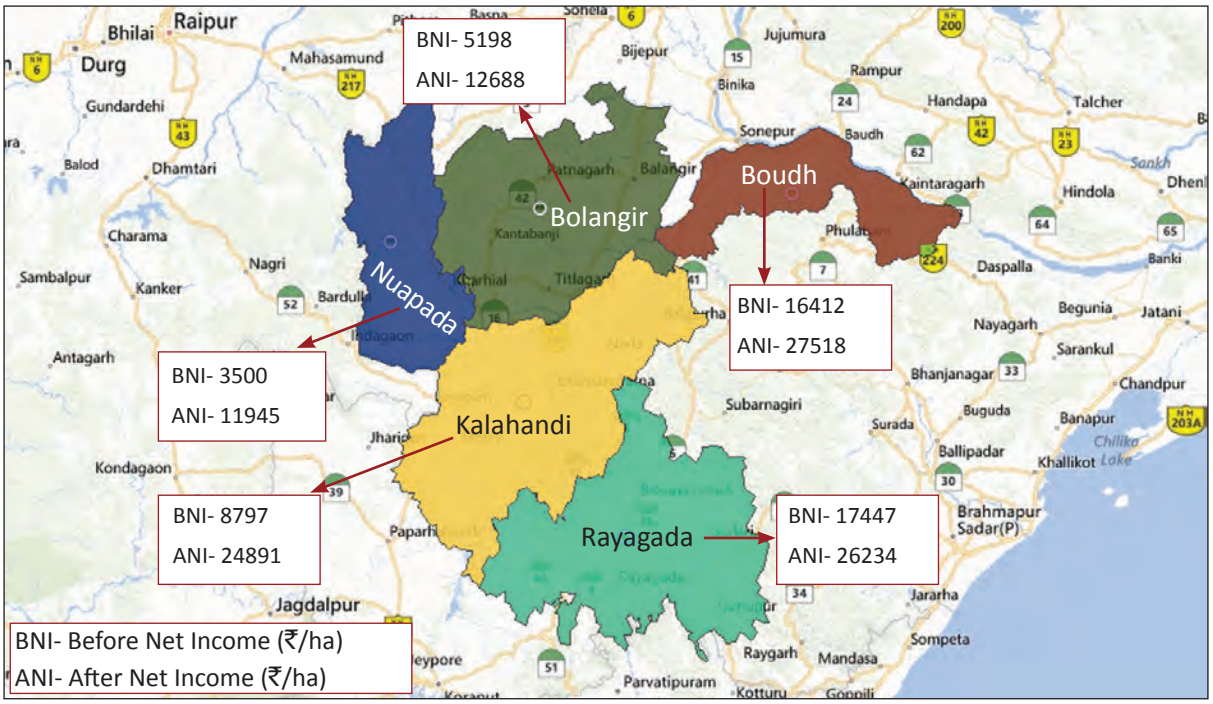


Figure 2. Map of the project sites for IPPT showing before and after net income.

1.1 Socio-demographic information

Farmer-respondents in all the districts mostly belonged to the age range of 25-64 years (Table 2). The districts of Bolangir and Rayagada have farmer-respondents that belonged to 45-64 age range whereas Boudh, Kalahandi and Nuapada had 25-44 age range. This

Table 2. Socio-demographic information.

	Bolangir (n=106)		Boudh (n=67)		Kalahandi (n=153)		Nuapada (n=216)		Rayagada (n=103)	
Particulars	No.	%	No.	%	No.	%	No.	%	No.	%
Age group										
18 - 24	-	-	1	1	-	-	2	1	-	-
25 - 44	33	31	38	57	84	55	112	52	37	36
45 -64	46	43	22	33	61	40	90	42	66	64
65 -74	23	22	6	9	8	5	11	5	-	-
Above 75	4	4	-	-	-	-	1	-	-	-
Gender										
Male	103	97	67	100	143	93	206	95	102	99
Female	3	3	-	-	10	7	10	5	1	1
Marital status										
Married	105	99	58	87	151	99	211	98	103	100
Single	1	1	9	13	2	1	5	2	-	-
Educational qualification										
$1^{st} - 5^{th}$	18	17	27	40	28	18	48	22	75	73
$6^{th} - 10^{th}$	37	35	18	27	89	58	104	48	5	5
Above 10^{th}	10	9	3	4	11	7	17	8	1	1
Illiterate	40	38	-	-	15	10	38	18	-	-
No response	1	1	19	28	10	7	9	4	22	21

implies a young group of farmers in the study sites and this brings to light the need for more support for them especially if we are to ensure sustainable production of food and of nutritional quality. In the recently concluded International Year of Family Farming, participants expressed the need to raise the level of awareness of the demographic issue in farming especially on the importance of young farmers to continuing the revered family farming model and securing the future of global food production (European Council of Young Farmers).

Majority of the respondents are males (Bolangir, 97%; Boudh, 100%; Kalahandi, 93%; Nuapada, 95%; and Rayagada, 99%) with a few females (Bolangir, 3%; Kalahandi, 7%; Nuapada, 5%; and Rayagada, 1%). Almost all respondents are married and have some degree of education.

1.2 Membership to organizations

Among the five districts, it is in Boudh where 6% of the total respondents expressed membership to self-help groups (SHGs). The main reasons for their involvement include: saving, better money collection, access to information about relevant agri and rural development news, and access to provision for some household needs. As gleaned from Table 3, there is more number of farmer-respondents who are non-members and reasons given are: the lack of interest among respondents in almost all the districts, lack of awareness in Kalahandi, lack of resources (some money to save) and due to community disputes in Nuapada. Other reasons include age limit for obtaining membership, and SHGs have become inactive. Others were disinterested to express their views.

Table 3. Membership to organizations.

	Bolangir (n=106)		Boudh (n=67)		Kalahandi (n=153)		Nuapada (n=216)		Rayagada (n=103)	
Particulars	No.	%	No.	%	No.	%	No.	%	No.	%
Membership in SHG/organization										
Yes	59	56	4	6	29	19	73	34	52	50
No	47	44	63	94	123	80	140	65	51	50
No response	-	-	-	-	1	1	3	1	-	-
Role in SHG/organization										
Member	49	83	4	100	12	41	54	74	44	85
Officer	9	15	-	-	6	21	19	26	8	15
No response	1	2	-	-	11	38	-	-	-	-
Activities in SHG										
Saving	-	-	-	-	-	-	15	21	5	10
Money collection	55	93	-	-	8	28	5	7	-	-
Education, awareness on agriculture and rural development	1	2	4	100	1	3	42	58	14	27
Provision of household necessities	1	2	-	-	2	7	4	5	7	13
No response	2	3	-	-	18	62	6	8	26	50
Reasons for non-membership										
No interest	47	100	-	-	92	75	79	56	30	59
Lack of awareness	-	-	-	-	25	20	-	-	-	-
Lack of resources	-	-	-	-	-	-	23	16	-	-
Lack of community peace	-	-	-	-	1	1	29	21	-	-
Others	-	-	-	-	-	-	9	6	7	14
No response	-	-	63	100	5	4	-	-	14	27

1.3 Farming resources

Farm size and availability of irrigation. Farm size of respondents ranged from marginal (less than 1 ha) to medium (4.01-10.00 ha) category (Table 4). Farm size in Bolangir, Boudh, Nuapada and Rayagada is mostly small (1.01-2.00 ha) with a few having medium (4.01-10.00 ha) size. Kalahandi registered the highest number of farmers with semi-medium (2.01-4.00 ha) farm size and also of medium category. The classification used in grouping farm size of respondents is based on the data used by the Directorate of Economics and Statistics, Odisha.

Table 4. Farming system.

	Bolangir (n=106)		Boudh (n=67)		Kalahandi (n=153)		Nuapada (n=216)		Rayagada (n=103)	
Particulars	No.	%	No.	%	No.	%	No.	%	No.	%
Farm size										
Marginal	4	4	15	22	1	1	80	37	36	35
Small	101	95	31	46	39	25	114	53	52	50
Semi-medium	1	1	19	28	82	54	20	9	14	14
Medium	-	-	2	3	19	12	-	-	1	1
No response	-	-	-	-	12	8	2	1	-	-
Irrigation										
Yes	77	73	27	40	47	31	10	5	61	59
No	29	27	40	60	106	69	206	95	42	41
Type of irrigation										
Bore well	38	19	5	7	2	1	-	-	-	-
Dug well	39	20	5	7	32	21	2	1	-	-
Rain fed	29	15	38	57	114	75	206	95	43	42
Farm pond	-	-	12	18	-	-	2	1	8	8
River	-	-	6	9	-	-	1	-	-	-
Lift	-	-	-	-	-	-	3	1	-	-
Others (Canal, water harvesting, etc)	-	-	9	13	5	3	2	1	52	50

Marginal	-	< 1.01 ha
Small	-	1.01 - 2.00 ha
Semi-medium	-	2.01 - 4.00 ha
Medium	-	4.01 - 10.00 ha
Large	-	> 10.00 ha

Most of the study sites are rainfed especially in Boudh, Kalahandi and Nuapada. However, many of the respondents have irrigation facilities also (73% Bolangir, 40% Boudh, 31% Kalahandi, 5% Nuapada and 59% Rayagada) of various types such as bore well, dug well, farm pond, river and through lift.

Sources of agri-information. Diverse response on the most widely sought sources of agri-information was given by the farmer-respondents (Table 5). Interestingly, ICRISAT is considered as one of the top five sources of agri-information. It ranked 2 in four districts except Bolangir where it ranked 5. In spite of the fact that the pigeonpea project implemented by ICRISAT-DoA Govt of Odisha is less than two years in these districts, ICRISAT proved to have made significant contributions in improving farming activities.

Table 5. Sources of agri-information.

Ranking	Bolangir (n=106)	Boudh (n=67)	Kalahandi (n=153)	Nuapada (n=216)	Rayagada (n=103)
Rank 1	Radio (94%)	Farming club (43%)	ICRISAT staff (54%)	DoA and Line Department (44%)	NGO (72%)
Rank 2	Television (39%)	ICRISAT staff (36%)	ICRISAT staff (36%)	ICRISAT staff (25%)	ICRISAT staff (72%)
Rank 3	Village workers (97%)	NGO (33%)	Village workers (20%)	Farming club (19%)	DoA and Line Department (70%)
Rank 4	Farming club (80%)	NGO (27%)	Television (20%)	Radio (16%)	Television (72%)
Rank 5	ICRISAT staff (1%)	ICRISAT staff (7%)	Radio (7%)	Prints (11%)	Prints (70%)

Note: Rank assigned from the most important to the least, with 1 as the most important.

Livestock resources. Almost everyone owned diverse types of livestock such as cow, goat, and others (Table 6). It can be inferred from the table that cows and goats constitute the highest number. According to respondents, these are important assets as cows are used not only for draught power but as their source of milk and the goats, for meat and milk. Others raised ducks and herds of sheep.

Table 6. Livestock resources (%).

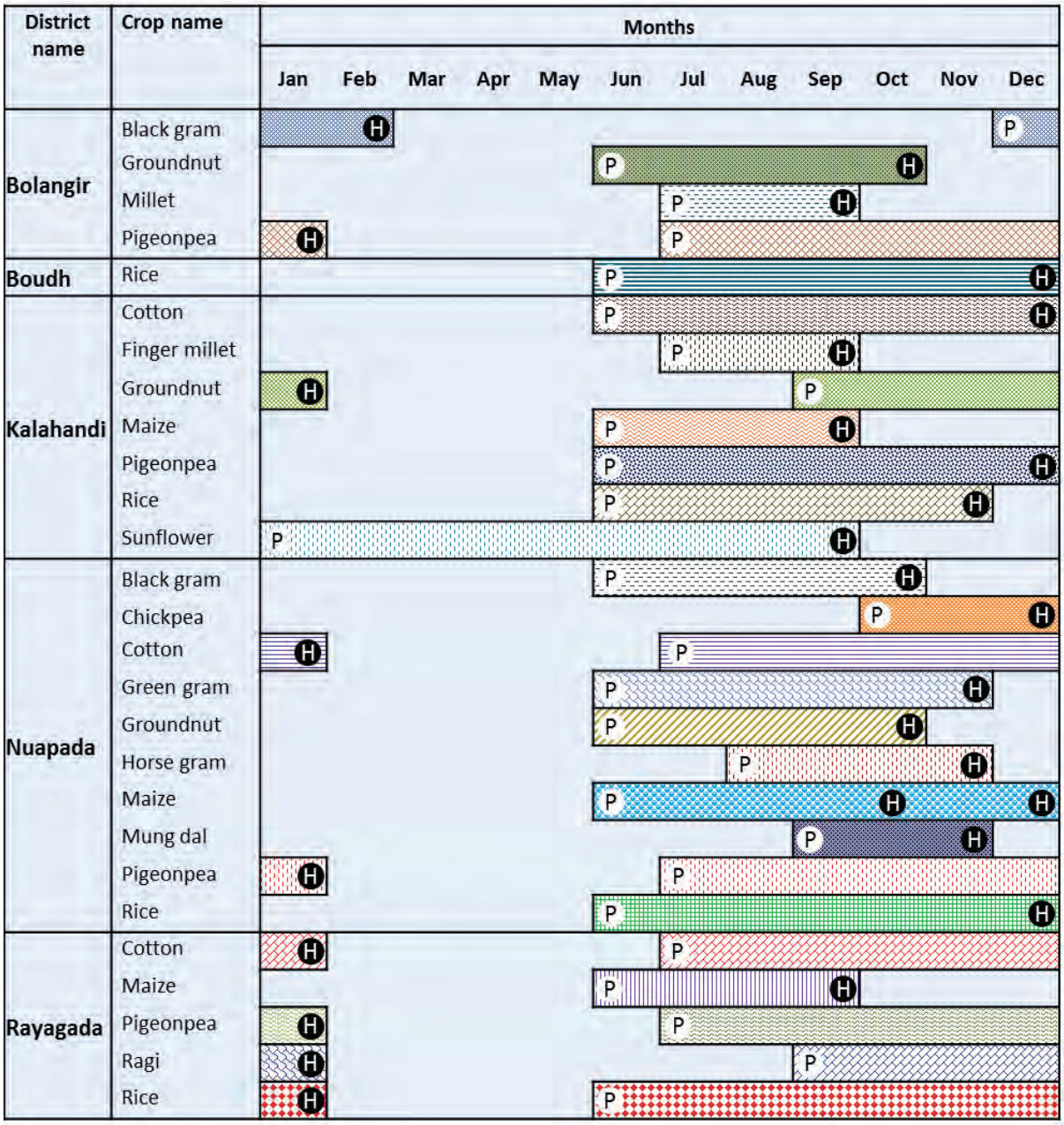
Livestock	Bolangir (n=106)	Boudh (n=67)	Kalahandi (n=153)	Nuapada (n=216)	Rayagada (n=103)
Bullock	31	3	31	34	94
Cow	95	37	92	56	71
Goat	88	54	77	48	21
Chicken	25	-	-	2	-
Others	33	70	-	15	56

1.4 Pigeonpea farming system among IPPT farmer-respondents

Cropping calendar. Pigeonpea is one of the most versatile crops that can be cultivated in most soil types as an intercrop or a sole crop. In all the districts, pigeonpea is an integral component of respondents' farming system. It is grown in the months of June–July and harvested in December–January. Other crops include other grains and cereals (Figure 3).

The most common crops grown in association with pigeonpea are black gram, cotton, finger millet, green gram, groundnut, maize, paddy and black lentil. The most prevalent intercrops are cotton (ratio of 1:4), groundnut (ratio of 1:5) and black gram (ratio of 1:5) as shown in Table 7.

Gender participation. Farming enterprise in the five districts revealed that most of the farm operations are done by men. However, there is also evidence of women's participation. Almost



P - Planting
H - Harvesting

Figure 3. Cropping calendar for CY 2012-2013.

Table 7. Intercropping pigeonpea with other crops.

	Ratio (Pigeonpea:Other crop)															
Crop	1:1	1:2	1:3	1:4	1:5	1:7	1:8	1:9	1:10	2:5	2:7	4:2	4:5	5:1	6:1	6:2
Black lentil	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Black gram	-	1	-	1	14	-	-	1	-	2	-	-	-	10	-	-
Cotton	3	3	2	99	-	2	1	-	1		1	1	-	-	-	1
Finger millet	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-
Green gram	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-
Groundnut	-	-	7	-	28	-	-	-	-	-	-	-	4	12	-	-
Maize	1	12	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Pearl millet	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paddy	-	-	2	7	3	-	1	1	-	-	-	-	-	-	2	-

all respondents claimed that men and women have almost equal share in the various farm operations. Women's participation was the least in Kalahandi district (Table 8).

Table 8. Gender participation.

Location	Gender participation (%)			
	Male	Female	Both	No response
Bolangir (n=106)	43	19	37	1
Boudh (n=67)	38	8	54	-
Kalahandi (n=153)	78	15	5	2
Nuapada (n=216)	23	11	62	4
Rayagada (n=103)	13	32	54	-

Women play a major role in pigeonpea farming. Of the various farm operations, women participated largely in planting, harvesting, threshing, cleaning seeds, seed treatment and *dal* preparation (Figure 4). The pigeonpea project increased women's participation especially in the districts of Bolangir and Nuapada. Obtaining better yield incited interest of women in pigeonpea cultivation. The tribal communities considered the project as an entry point for greater participation of women in Rayagada. Farmer-respondents claimed that technologies like line sowing and improved seed storage production were the good contributions of the project to women's increased participation (Table 9, Annex 1).

Table 9. Contribution of pigeonpea project in women's participation (%).

Particulars	Bolangir (n=106)	Boudh (n=67)	Kalahandi (n=153)	Nuapada (n=216)	Rayagada (n=103)
Increased women's participation in various cultural management practices. (ie, planting, sowing, ridging and fertilizer application)	99	12	26	99	-
Learned line sowing	-	75	-	1	-
Improved seed storage practices	-	79	-	1	-
Full women's participation among tribal communities	-	3	-	-	100
Enhanced interest of women as a result of better yield	-	4	5	-	-
Allowed purchase of personal effects including household members' requirement	-	-	33	-	-

Production cost and benefit. Prior to the pigeonpea project being implemented in the five districts by ICRISAT in partnership with the DoA, Govt of Odisha, the planting materials of farmers were mostly landraces, long duration type and cultivated using traditional cultural management practices. The yield under this condition ranged between 218–842 kg/ha fetching a net income of ₹2470–17,447 and BCR of 0.40–2.81. The average BCR is approximately 1: 1.32 (Table 10).

There is a significant increase in yield and correspondingly in income as a result of the introduction of the pigeonpea project in 2011 (Table 11). The yield almost doubled with a range

Location	Land preparation			Planting / Sowing			Fertilizer application			Spraying			Weeding			Roughing			Harvesting			Threshing			Cleaning			Seed storage			Seed treatment			Dal preparation			Seed selection for planting			Irrigation			Others		
	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B
Bolangir (n= 106)	76	-	24	4	74	23	90	-	10	89	1	10	3	42	49	78	-	22	3	-	97	7	1	92	9	18	73	15	75	9	78	2	20	19	70	11	22	1	77	93	1	4	58	-	34
Boudh (n= 67)	100	-	-	-	-	100	87	-	13	96	-	4	-	-	100	-	-	100	9	4	87	-	4	96	-	4	96	-	4	96	1	94	4	-	4	96	94	-	6	94	1	4	96	-	4
Kalahandi (n= 153)	97	1	1	77	22	1	84	16	-	75	22	1	76	24	1	82	14	-	78	18	2	74	24	-	75	22	3	75	17	6	81	12	5	82	10	7	77	11	8	75	11	11	63	1	28
Nuapada (n= 216)	30	1	69	4	4	92	30	1	69	59	2	37	2	18	80	25	-	74	3	1	96	5	4	91	3	35	62	12	26	61	39	11	49	-	59	40	41	4	53	65	-	23	28	-	27
Rayagada (n= 103)	100	-	-	7	1	92	7	1	92	14	4	83	6	11	83	5	2	93	7	93	-	6	93	1	6	94	-	7	93	-	7	-	93	6	94	-	7	-	93	6	1	93	7	-	93

○ Male △ Female ⬡ Both

Figure 4. Participation of women in pigeonpea cultivation (IPPT).

Table 10. Average area and cost of production of pigenpea (before project inception).

Location	Area Ha	Quantity of seed Kg/ha	Yield Kg/ha	Price ₹/kg	Gross income ₹/ha	Cost of production (₹/ha)										Total production cost ₹/ha	Net income ₹/ha	BCR
						Seed cost	Sowing	Cultivation	Fertilizer	Pesticide	Weeding	Irrigation	Harvesting	Threshing	Others			
Bolangir																		
Marginal (n=105)	0.40	14	218	39	8443	671	353	1577	870	741	1317	-	1180	633	988	3245	5198	1.60
Boudh																		
Marginal (n=67)	0.40	10	708	34	23861	589	683	1437	967	703	1669	-	1299	765	-	7449	16412	2.20
Kalahandi																		
Marginal (n=27)	0.54	18	842	31	22313	993	781	1320	1814	942	836	1420	835	679	558	10178	12135	1.19
Small (n=116)	1.18	21	613	39	23809	1720	741	1784	2243	2377	1075	1109	1337	1220	1044	12022	11787	0.98
Semi-medium (n=1)	2.02	24	247	35	8645	494	1579	-	-	741	-	494	1235	1235	1235	6175	2470	0.40
Nuapada																		
Marginal (n=197)	0.42	12	272	34	8413	923	1047	995	1423	1548	765	822	791	699	688	4975	3439	0.69
Small (n=4)	1.32	23	401	20	8336	1346	1019	1235	-	494	-	247	865	1729	-	4773	3563	0.75
Rayagada																		
Marginal (n=98)	0.40	10	707	34	23652	562	469	2044	549	511	597	-	760	657	371	6204	17447	2.81

Marginal	-	< 1.01 ha
Small	-	1.01 - 2.00 ha
Semi-medium	-	2.01 - 4.00 ha
Medium	-	4.01 - 10.00 ha
Large	-	> 10.00 ha

Table 11. Average area and cost of production of pigeonpea (after project inception).

Location	Area Ha	Quantity of seed Kg/ha	Yield Kg/ha	Price ₹/kg	Gross income ₹/ha	Cost of production (₹/ha)									Total production cost ₹/ha	Net income ₹/ha	BCR
						Seed cost	Sowing	Cultivation	Fertilizer	Pesticide	Weeding	Irrigation	Harvesting	Threshing			
Bolangir																	
Marginal (n=106)	0.40	7	515	39	19942	494	863	1601	1309	1081	1186	-	1945	1016	7289	12688	1.74
Boudh																	
Marginal (n=66)	0.40	8	1093	34	36797	542	952	1957	1100	743	1763	-	1411	876	9279	27518	2.97
Kalahandi																	
Marginal (n=19)	1.40	12	1069	37	37610	841	1216	1404	3540	2137	1070	1129	891	873	10297	27312	2.65
Small (n=122)	1.30	12	962	45	40761	1852	1967	1954	1155	2633	1405	1234	1429	1269	15374	25182	1.64
Semi-medium (n=4)	3.00	11	850	43	37902	1747	1050	1791	2737	1853	741	741	1482	1112	11486	24498	2.13
Nuapada																	
Marginal (n=208)	0.45	9	394	50	19459	878	1023	1317	2095	972	1416	972	1270	1017	7883	11549	1.47
Small (n=5)	1.45	10	1062	42	45695	2900	3557	3273	2590	3252	1235	1235	1606	2223	16779	28422	1.69
Rayagada																	
Marginal (n=102)	0	8	921	39	36067	499	525	2104	741	817	588	-	724	660	6361	26234	4.12

Marginal	-	< 1.01 ha
Small	-	1.01 - 2.00 ha
Semi-medium	-	2.01 - 4.00 ha
Medium	-	4.01 - 10.00 ha
Large	-	> 10.00 ha

of 515–1093 kg/ha and net income of ₹11,549–28,422 and BCR of 1.47–4.12. The average BCR was estimated at 1:2.3. This conforms with Deepak Mohanty et al. (2010) where an increase was seen in the Net Monetary Return (NMR) as well the BCR due to changes in the farming system and introduction of pigeonpea as part of it.

Based on the estimated net income (Table 12), there is a significant difference at district-wise level and all districts combined. Similarly, estimated net income according to farm size showed a significant difference at 0.05 level of significance (Figure 5). This implies the project's viability in uplifting the livelihood of smallholder farmers in these districts. It also indicates the good partnership performance of ICRISAT and DoA, Govt of Odisha in contributing to improved economic gain of pigeonpea cultivation. The fact that a farmer-participant received the 2013 best farmer award in pulses (specifically of pigeonpea) at the district, state, and national levels, speaks volumes about the impact of the ICRISAT-DoA Govt of Odisha pigeonpea project.

Table 12. Before and after net income (₹/ha).

Overall pigeonpea before and after net income (BNI/ANI)							
	Mean						
	Before			After			
Particular	Total production cost	Net income	BCR	Total production cost	Net income	BCR	Probability
All districts	6416	9555	1.49	9529	18954	1.99	<.0001
Pigeonpea before and after net income by farm size							
Farm size	**Mean**						**Probability**
Marginal	6410	10926	1.7	7806	15550	1.99	<.0003
Small	9539	8618	0.90	12953	17928	1.38	<.0001
Semi-medium	5276	12309	2.33	8232	24272	2.95	<.0001
Medium	12264	10549	0.86	17745	22165	1.25	<.0001
Pigeonpea before and after net income by district							
District	**Mean**						**Probability**
Bolangir	3245	5198	1.60	7289	12688	1.74	<.0001
Boudh	7449	16412	2.20	9279	27518	2.97	<.0001
Kalahandi*	9458	8797	0.93	15220	24891	1.64	<.0001
Nuapada*	4882	3500	0.72	8129	11945	1.47	<.0001
Rayagada	6204	17447	2.81	6361	26234	4.12	<.0001

Note: <.0001 significant at 5% probability
* Values are based on all types of farm size

Pigeonpea production utilization. Yield of pigeonpea are sold, consumed and gifted. Everyone affirmed consuming part of their production. A large bulk of the yield is sold to various markets (local market, dealers/traders, co-farmers, and to seed groups) and this constitutes an average of about 70% in Bolangir, 78% in Boudh, 65% Kalahandi, 54% Nuapada and 84% in Rayagada (Table 13).

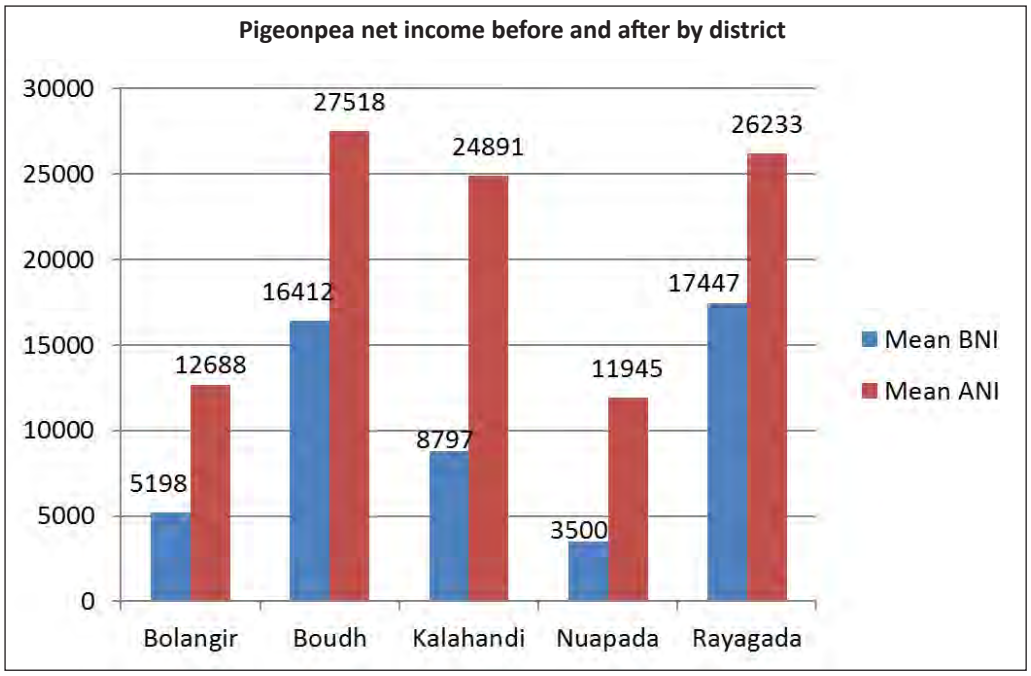


Figure 5. Pigeonpea net income before and after by district.

For those who shared part of their production, these are mostly given to relatives, neighbors and friends. This constituted an average of 5% in Bolangir, 7% in Boudh, 9% in Kalahandi, 15% in Nuapada and 2% in Rayagada. The remaining percentages are used for home consumption (Figure 6).

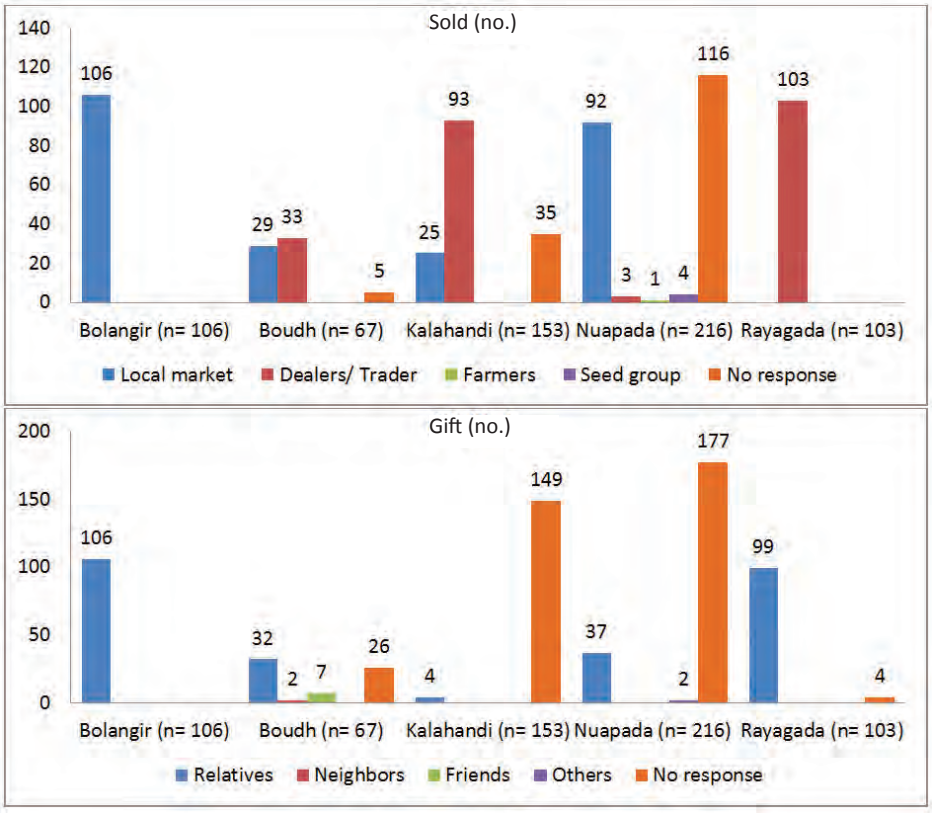


Figure 6. Pigeonpea production utilization (sold and gifted).

Table 13. Pigeonpea production utilization.

Particulars	Average %	Sold (No.)					Average %	Gift (No.)					Household consumption average %
		Local market	Dealers/ Trader	Farmers	Seed group	No response		Relatives	Neighbors	Friends	Others	No response	
Bolangir (n=106)	70	106	-	-	-	-	5	106	-	-	-	-	25
Boudh (n=67)	78	29	33	-	-	5	7	32	2	7	-	26	15
Kalahandi (n=153)	65	25	93	-	-	35	9	4	-	-	-	149	26
Nuapada (n=216)	54	92	3	1	4	116	15	37	-	-	2	177	31
Rayagada (n=103)	84	-	103	-	-	-	2	99	-	-	-	4	14

Economic engagements took place mostly in local markets. This was followed by engagements with dealers/traders who are mostly locals. However, it was recently reported that there is a growing number of dealers/traders from outside their districts. On being probed, respondents revealed that with the onset of good production, outsiders from an adjacent state such as Chhattisgarh transact with the locals in the purchase of their locally produced seeds.

Technology adoption

Varietal adoption. Varietal adoption is relatively high in all the districts except in Nuapada, and is estimated at 68%. According to farmers, the ICPL 14001 and ICPL 14002 varieties introduced by the project resulted in better yield compared with their traditional varieties. Farmer-respondents in Bolangir and almost everyone in Kalahandi and Rayagada said that ICPL 14001 yielded better. Similar remarks were made by farmer-respondents of Boudh and Rayagada, where all claimed to have benefited from cultivating ICPL 14001 (Table 14). A study in Uttar Pradesh by Dwivedi et al. (2011) concluded that the adoption of improved variety of pigeonpea is highest (75%) in terms of technology adoption.

Fertilizer application. Another technology raved by farmer-respondents in all districts is the application of fertilizer in pigeonpea. Bolangir showed 100% adoption, followed by Rayagada (97%), Boudh and Nuapada at 93% respectively and Kalahandi at 88%. Most of them remarked that the application of the recommended rate increased production.

Insecticide application. This is another technology component in pigeonpea cultivation that farmer-respondents considered essential. According to them, this practice is required to ensure good yield. They have been sensitized that insecticide application is essential during certain stages of the crop such as pod development.

Line sowing in ridges. Alongside the introduction of good seeds such as ICPL 14001 and ICPL 14002, the technology of line sowing in ridges facilitated many of the other farm operations such as weeding and intercropping. This practice, according to farmer-respondents, showed promise in increasing yield. As gleaned from the table, this is still one area requiring capacity building from project management, especially in Bolangir and Kalahandi with adoption of 45% and 60%, respectively.

Weeding. There is no doubt that weeding is a practice that needs to be done to ensure better yield. Weeds compete with nutrients and this was stressed to farmers by the project. Its adoption increased yield as disclosed by farmer-respondents (Bolangir, 92%; Boudh, 91%; Kalahandi, 98%; Nuapada, 67%; and Rayagada, 96%). It was also revealed that line sowing has facilitated weeding operation as claimed by respondents of Kalahandi, Nuapada, and Rayagada.

Table 14. Specific technologies adopted in IPPT.

Technologies	Bolangir (n=106)	Boudh (n=67)	Kalahandi (n=153)	Nuapada (n=216)	Rayagada (n=103)
Varieties	**100%**	**97%**	**90%**	**68%**	**98%**
Remarks	• ICPL 14001 is good because of better yield (100%)	• Better yield, good quality and more production (52%) • Benefited more than 100% compared with the traditional method (43%)	• ICPL 14001 has good yield (90%)	• ICPL 14002 is good (32%) • ICPL 14001 is good (34%) • Seeds were self-purchased (1%) • One packet seed is not enough for area (1%)	• Good yield (93%) • Benefited more than 100% from traditional method (5%)
Fertilizer requirement & application	**100%**	**93%**	**88%**	**93%**	**97%**
Remarks	• Increased total production (100%)	• Required certain dosage for better yield (90%) • Fertilizer not provided (3%)	• Fertilizer helped in getting good yield (58%) • Fertilizer provided by ICRISAT and SVA (27%) • No need of fertilizer in pigeonpea (3%)	• Fertilizer provided by ICRISAT and SVA (2%) • Required certain dosage for better yield (91%)	• Fertilizer helps in getting good yield (2%) • Required certain dosage for better yield (92%) • Farmers are treated systematically and timely (3%)
Insecticide application	**85%**	**98%**	**64%**	**64%**	**94%**
Remarks	• Need pesticide for better yield (85%)	• Controlled pest attack and reduced crop loss (90%) • Need pesticide for better yield (8%)	• Need pesticide for better yield (58%) • Pesticides not applied previously in *arhar* (6%)	• Provided by ICRISAT and SVA (9%) • Seeds are broadcasted (1%) • Pesticides not distributed (54%)	• Controlled pest attack and reduced crop loss (94%)

Continued

Table 14. Specific technologies adopted in IPPT *continued.*

Line sowing in ridges	**45%**	**76%**	**60%**	**65%**	**96%**
Remarks	• Adopted line sowing to accommodate intercrop and facilitated weeding (29%) • Ease for weeding and intercropping (1%) • Increased total production (15%)	• Adopted line sowing for more production (76%)	• Helped in weeding (23%) • Adopted line sowing to accommodate inter crop (37%)	• Adopted and increased production (36%) • Ease for weeding and intercropping 29%)	• Adopted to accommodate inter crops (96%)
Weeding	**92%**	**91%**	**98%**	**67%**	**96%**
Remarks	• Produced good yield (88%) • Self-hand weeding (4%)	• Adopted hand weeding for increased yield (91%)	• Weeding is necessary (58%) • Required more labor charges (1%) • Need weeding once in a month after sowing (27%) • Ease in weeding due to ridges (12%)	• Ease in weeding (10%) • Weeding is necessary for good yield (38%) • Labor problem (19%)	• Better yield (93%) • Adopted line sowing, which facilitated weeding (3%)

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Problems and constraints. Key constraints of farmer-respondents involved in IPPT are diverse across districts (Table 15). In Bolangir, delayed sowing (93%) and inadequate exposure/ awareness (94%) are expressed; Boudh, farmers selling at low price (73%) and middlemen dictating price (73%); Kalahandi, high pest infestation (68%); Nuapada, lack of inputs (29%); Rayagada shares its constraints with Boudh, farmers selling at low price (88%) and middlemen dictating price (99%).

Table 15. Problems and constraints of IPPT farmer-respondents.

	Bolangir (n=106)		Boudh (n=67)		Kalahandi (n=153)		Nuapada (n=216)		Rayagada (n=103)	
Particulars	No.	%	No.	%	No.	%	No.	%	No.	%
A. Cultural management										
1. Inadequate labor during weeding	-	-	2	3	-	-	-	-	-	-
2. Delayed sowing	99	93	2	3	31	20	-	-	-	-
3. Irrigation problem	1	1	-	-	-	-	26	12	-	-
4. No ridging	1	1	-	-	-	-	-	-	-	-
5. Lack of inputs (fertilizer, pesticide and sprayer)	3	3	6	9	-	-	63	29	-	-
6. High flower drop	-	-	4	6	44	29	8	4	-	-
7. High insect attack	-	-	4	6	104	68	8	4	-	-
8. No input provided (only seeds)	-	-	27	40	-	-	-	-	-	-
B. Marketing										
1. Farmer selling at low price	-	-	49	73	-	-	-	-	91	88
2. Prices dictated by middleman	-	-	49	73	-	-	-	-	102	99
3. No fixed price	-	-	4	6	-	-	-	-	-	-
4. No market linkage	-	-	-	-	-	-	1	0	-	-
5. Lack of storage facility	-	-	22	33	-	-	-	-	-	-
C. Others										
1. Lack of information provided	-	-	-	-	32	21	-	-	-	-
2. No training/ awareness/exposure	100	94	-	-	-	-	35	16	-	-
3. Late distribution of seeds	-	-	-	-	19	12	57	26	-	-

Involvement in pigeonpea project. Several questions were posed to farmer-respondents with the end view of identifying lessons that can serve as a springboard for improving the delivery of the project and future engagements either of ICRISAT or DoA Govt of Odisha.

Project inception. Farmer-respondents were of the view that community consultation was undertaken prior to the inception of the project (Annex 2). On the different activities, farmer-respondents claimed that sufficient consultation was made during site selection, varietal selection, conduct of demonstration, conduct of farmers and SHG training, conduct of specialized courses, and preparation of IEC materials. Insufficient consultation with the community at the inception phase was reported on activities such as conduct of experiments, purchase of requirements, and construction of facilities such as godowns. These three activities would require relatively less community consultation because decisions on these can be solicited from local representation.

Degree of satisfaction to capacity building activities. Capacity building is an essential component of any project. Respondents expressed satisfaction on the following activities: meetings/workshops, training programs, specialized courses and demonstrations. While the majority are fully satisfied, a number of respondents also claimed non-satisfaction. Moreover, a number of respondents refused to comment on this (Table 16).

Table 16. Degree of satisfaction of participants' involvement in capacity building activities.

	Yes								No	
			Fully satisfied		Satisfied		Not satisfied			
Particulars (N=645)	No.	%	No.	%	No.	%	No.	%	No.	%
Project meeting and workshop	238	37	45	19	182	76	11	5	407	63
Project presentation meeting	274	42	33	12	232	85	9	3	371	58
Project orientation cum training	198	31	36	18	157	79	5	3	447	69
Project launching cum training workshop	195	30	32	16	157	81	6	3	450	70
Project orientation meeting seminar	266	41	24	9	236	89	6	2	379	59
Farmers' specialized training course	285	44	13	5	260	91	12	4	360	56
Farmers' field day demonstration	285	44	120	42	159	56	6	2	360	56
Others	348	54	117	34	229	66	-	-	297	46

Information, education and communication (IEC) strategies. Two of the most accessed IEC materials are the booklets 'Cultural Management Practices of Pigeonpea' and 'Integrated Pest Management and Integrated Disease Management of Pigeonpea'. According to recipients, these are relevant materials to ensure success in the cultivation of pigeonpea. The translation of these materials in the *lingua franca* (Oriya) of farmer-respondents enhanced comprehension of the technologies. While printed materials are important, other media like television and radio are also regarded important. Village meetings were also mentioned as important especially in creating awareness in the community (Annex 3).

Degree of satisfaction on roles of key stakeholders. Farmer-respondents expressed their satisfaction on the delivery of roles of key stakeholders in the project including the NGOs and even progressive farmers. Some have expressed full satisfaction on this point as in Kalahandi, where it is 75%. On the other hand, some respondents have also expressed dissatisfaction, which is inevitable, but could be explored by project management to minimize or even eliminate in future (Table 17).

Table 17. Degree of satisfaction on roles of stakeholders in pigeonpea project (%).

Particulars	Degree of satisfaction	Bolangir (n=106)	Boudh (n=67)	Kalahandi (n=153)	Nuapada (n=216)	Rayagada (n=103)
Farmer Association	Fully satisfied	-	-	2	16	-
	Satisfied	100	24	75	66	4
	Not satisfied	-	1	15	13	-
	No response	-	75	8	5	96
Deputy Director of Agriculture (DDA)	Fully satisfied	-		5	3	-
	Satisfied	100	90	46	13	100
	Not satisfied	-	9	37	36	-
	No response	-	1	12	48	-
ICRISAT	Fully satisfied	-	36	85	9	2
	Satisfied	100	55	8	78	98
	Not satisfied	-	7	-	12	-
	No response	-	2	7	1	-
Others	Fully satisfied	-	-	-	4	2
	Satisfied	-	-	-	36	95
	Not satisfied	-	-	-	6	-
	No response	-	100	100	54	3

The assessment for DoA Govt of Odisha and ICRISAT were similar. There is definitely an opportunity for addressing satisfaction of communities and this explains the objective of this mid-term assessment.

***Major factors/constraints in the delivery of pigeonpea technologies*.** As gleaned from Table 18, a major constraint that affected delivery of pigeonpea technologies in the districts of Bolangir, Boudh, and Rayagada was the non-availability of labor especially in farm operations such as weeding and ridging. Several constraints in Nuapada and Rayagada were also noted and these included inferior quality of inputs – specifically seeds, involvement of middlemen, lack of awareness, and inadequate irrigation.

Probing into the problem on seed quality, farmer-respondents said that this happened in the first year of the project. Based on the discussion with ICRISAT scientists involved in the project, this incident is a lesson learned. According to scientists, seeds for the first year of operation of the project were purchased in Andhra Pradesh and Karnataka. This led to the development of a seed system model where farmers together with the pigeonpea project implementers produced their own seeds for the project. This has abated the problem of poor quality seeds.

Suggestions to sustain the achievements of pigeonpea project. Some of the suggested ways to sustain significant achievements of the ICRISAT-DoA Govt of Odisha pigeonpea project are as

Table 18. Major factors/constraints in the delivery of pigeonpea technologies.

Particulars	Bolangir (n=106)		Boudh (n=67)		Kalahandi (n=153)		Nuapada (n=216)		Rayagada (n=103)	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Labour availability for various operations (ie, weeding and ridging)	106	100	59	88	-	-	-	-	78	76
2. Sale of seeds to locals at low price	-	-	2	3	-	-	-	-	-	-
3. Inferior quality of inputs like seeds	-	-	-	-	-	-	54	25	-	-
4. Inadequate irrigation	-	-	-	-	-	-	31	14	-	-
5. Lack of storage facility	-	-	1	1	-	-	-	-	60	58
6. Delayed provision of inputs	-	-	-	-	-	-	40	19	-	-
7. Involvement of middlemen	-	-	-	-	-	-	-	-	60	58
8. Inadequate training on technology	-	-	1	1	-	-	-	-	-	-
9. Influence of local politics	-	-	2	3	-	-	-	-	-	-
10. Inputs are not supplied (fertilizer, pesticide, etc)	-	-	-	-	-	-	10	5	-	-
11. Lack of awareness	-	-	-	-	-	-	34	16	56	54
12. Lack of labor	-	-	-	-	-	-	8	4	38	37

follows (Table 19): mechanisms for more adoption of appropriate technologies like line sowing in ridges (Bolangir), good seed system and regular meetings for updates and feedback (Nuapada), support on agri-inputs such as fertilizer, sprayer, pesticide, etc (Boudh, Nuapada and Rayagada), more training and exposure visits (Boudh, Kalahandi, Nuapada and Rayagada), and better marketing facilities and linkages (Boudh, Kalahandi and Rayagada).

Secondary diffusion. Adopting a strategic site to showcase technologies where farmers are key to their management is anticipated to spark awareness, then adoption from within, and eventually, some diffusion. According to Rogers (1995), adoption of an innovation grows slowly and gradually. In this study, some neighboring farmers not covered by the project adopted the technology. In Bolangir, there were 6 such farmers; Boudh, 5; Kalahandi, 2; Nuapada, 77; and Rayagada, 13 (Figure 7). District-wise, there is a significant difference in Nuapada. In the other districts, since respondents are fewer, it is not possible to calculate the significance value. This clearly concludes that in Nuapada district, the income has increased after the introduction of interventions. In case of farm size grouping, all the respondents come under marginal group (<1.01 ha) as shown in Table 20 and Table 21. The overall data shows a significant difference between the before and after average income since the significant value is <0.05 (Table 22).

Table 19. Suggestions to sustain the achievements of pigeonpea project.

Particulars	Bolangir (n=106)		Boudh (n=67)		Kalahandi (n=153)		Nuapada (n=216)		Rayagada (n=103)	
	No.	%	No.	%	No.	%	No.	%	No.	%
1. Mechanisms for better adoption of appropriate technologies like line sowing	105	99	-	-	-	-	3	1	-	-
2. Good seed system	-	-	-	-	-	-	125	58	-	-
3. Support for some agri inputs like fertilizers, sprayers and pesticides	-	-	66	99	139	91	98	45	12	12
4. More training and exposure visits	-	-	58	87	-	-	42	19	12	12
5. Regular meetings for updates and feedback	-	-	-	-	-	-	108	50	-	-
6. Better marketing facilities and linkages	-	-	58	87	3	2	-	-	103	100

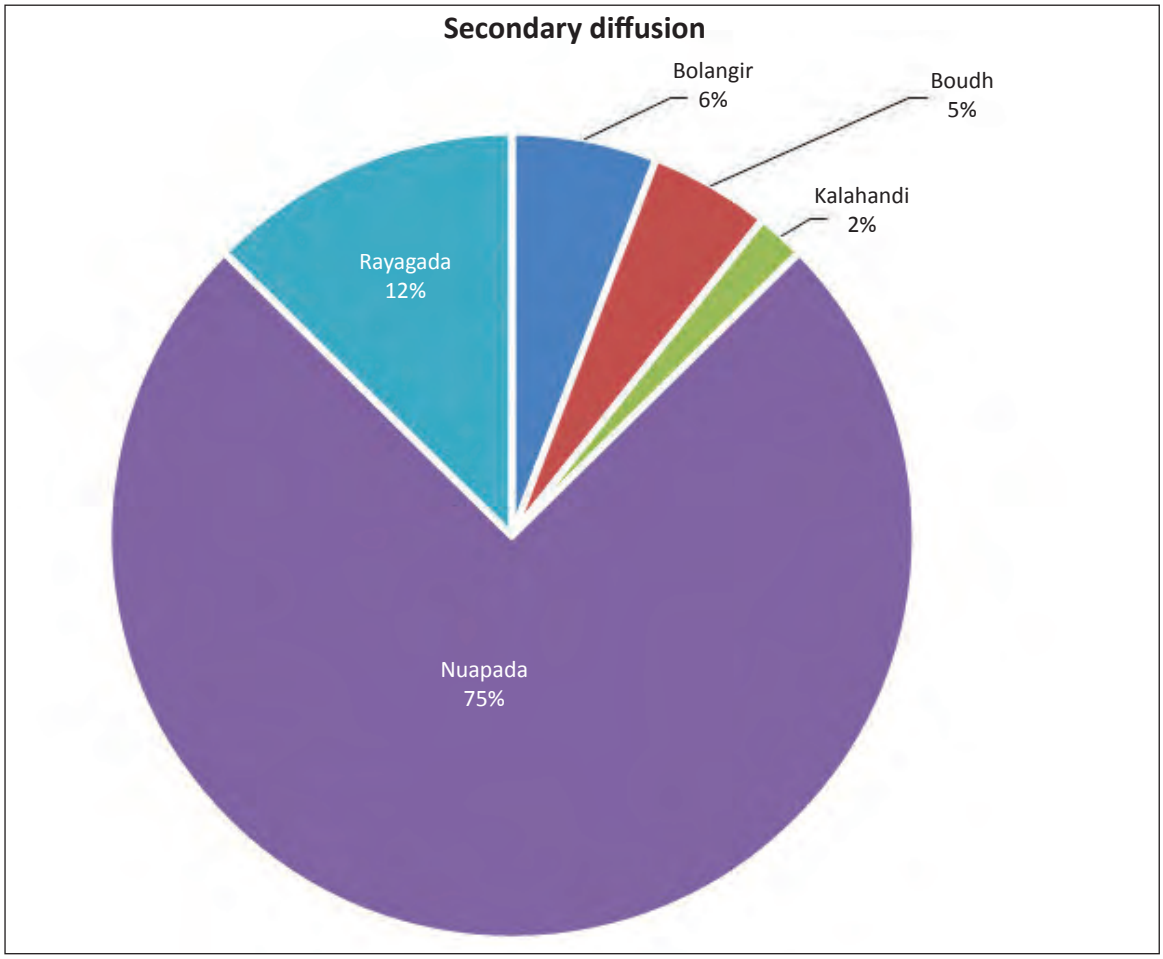


Figure 7. Pie chart showing diffusion of pigeonpea project.

Table 20. Average area and cost of production (before project inception) among non-project participants.

Location	Area Ha	Quantity of seed Kg/ha	Yield Kg/ha	Price ₹/kg	Gross income ₹/ha	Cost of production (₹/ha)										Total production cost ₹/ha	Net income ₹/ha	BCR
						Seed cost	Sowing	Cultivation	Fertilizer	Pesticide	Weeding	Irrigation	Harvesting	Threshing	Others			
Bolangir																		
Marginal (n=6)	0.40	12	175	36	6268	618	247	1482	494		988	-	1235	823	-	3211	3057	0.95
Boudh																		
Marginal (n=5)	0.40	16	251	38	9135	696	289	490	236	72	211	107	992	608	50	3750	5384	1.44
Kalahandi																		
Marginal (n=2)	0.40	16	251	38	9135	700	291	490	236	72	211	101	992	610	50	3752	5383	1.43
Nuapada																		
Marginal (n=77)	0.40	21	280	36	9386	792	706	871	860	675	746	656	832	780	556	4580	4806	1.05
Rayagada																		
Marginal (n=13)	0.39	23	409	34	11516	593	623	703	456	266	361	285	741	456	152	4636	6880	1.48

Marginal	-	< 1.01 ha
Small	-	1.01 - 2.00 ha
Semi-medium	-	2.01 - 4.00 ha
Medium	-	4.01 - 10.00 ha
Large	-	> 10.00 ha

Table 21. Average area and cost of production (after project inception) among non-project participants.

Location	Area Ha	Quantity of seed Kg/ha	Yield Kg/ha	Price ₹/kg	Gross income ₹/ha	Cost of production (₹/ha)										Total production cost ₹/ha	Net income ₹/ha	BCR
						Seed cost	Sowing	Cultivation	Fertilizer	Pesticide	Weeding	Irrigation	Harvesting	Threshing	Others			
Bolangir																		
Marginal (n=6)	0.40	8	478	36	17125	494	576	1482	-	1029	1359	-	1729	1235	-	5475	11650	2.13
Boudh																		
Marginal (n=5)	0.40	7	573	39	21810	593	603	593	346	963	494	296	1334	988	99	6308	15502	2.46
Kalahandi																		
Marginal (n=2)	0.61	12	784	40	31360	1013	1729	1606	1482	494	1853	1235	371	1729	371	11881	19479	1.63
Nuapada																		
Marginal (n=77)	0.41	11	366	52	17828	845	891	990	1233	872	1238	762	997	990	618	6578	11250	1.71
Rayagada																		
Marginal (n=13)	0.40	7	865	34	29609	525	475	1822	710	648	556	-	648	525	556	6465	23144	3.58

Marginal	-	< 1.01 ha
Small	-	1.01 - 2.00 ha
Semi-medium	-	2.01 - 4.00 ha
Medium	-	4.01 - 10.00 ha
Large	-	> 10.00 ha

Table 22. Pigeonpea income before and after among non-project participants (₹/ha).

Overall pigeonpea before and after net income (BNI/ANI)							
	Mean						
	Before			After			
Particular	Total production cost	Net income	BCR	Total production cost	Net income	BCR	Probability
All districts	4458	5019	1.12	6434	11941	1.85	<.0001
Pigeonpea before and after net income by district							
Location	Mean						Probability
Bolangir	3211	3057	0.95	5475	11650	2.13	-
Boudh	3750	5384	1.44	6308	15502	2.46	-
Kalahandi	3752	5383	1.43	11881	19479	1.63	-
Nuapada	4580	4806	1.05	6578	11250	1.71	<.0001
Rayagada	4636	6880	1.48	6465	23144	3.58	-

Note: <.0001 significant at 5% probability

The diffusion that took place in the districts, especially in Nuapada, can be attributed not only to the similarity in ecology and agricultural activities but largely to the influence of the respondents' social network. This conforms to Bandeira and Rasul (2006), Conley and Udrey (2000), and Foster and Rozenweig (1995), studies where the influence of actors such as salesmen, neighbors, and co-farmers in farmers' social networks are key towards successful diffusion (Figure 8).

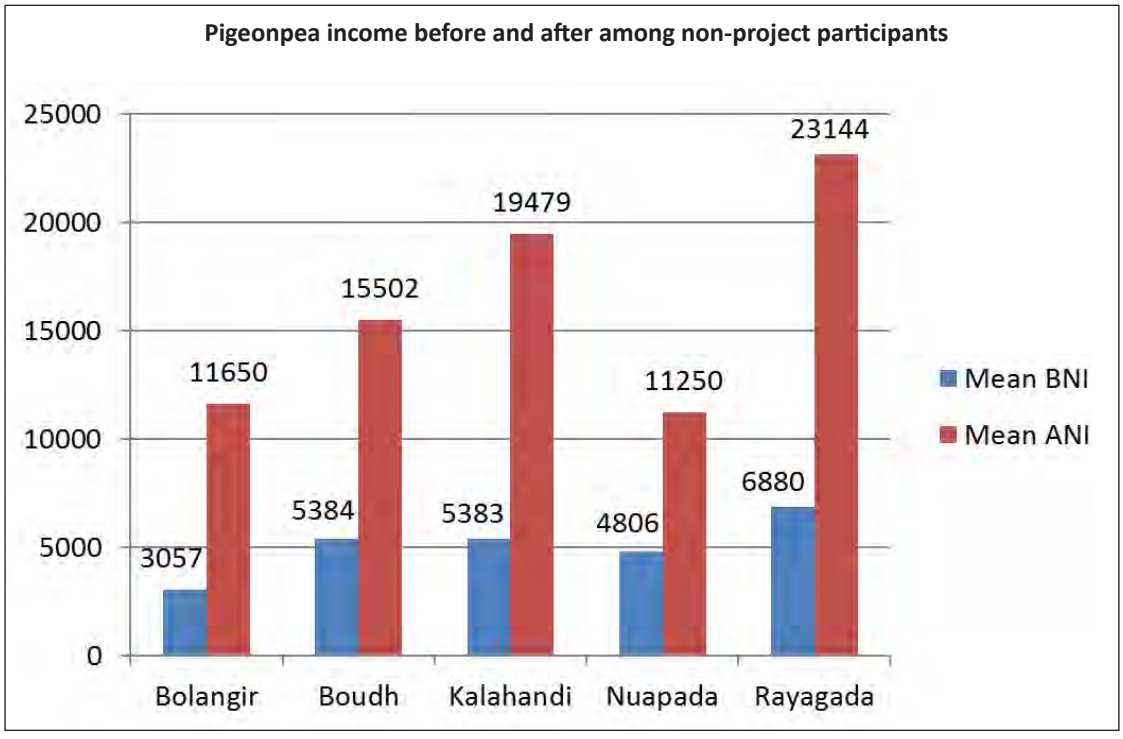


Figure 8. Pigeonpea income before and after among non-project participants.

Harnessing better diffusion through deliberate strategies must be an integral part of any project. While there are cases of technology diffusion that happen without 'push' from outside entities like government institutions and R&D organizations, institutional arrangement is essential such that it should involve local and traditional societies. ICRISAT being a strong advocate of partnership with several success stories to its claim can translate the principles and lessons learned from capacity building initiatives to guarantee diffusion and even sustainability (Rosana P Mula et al. 2013).

2.0 Farmers Participatory Varietal Selection Trial (FPVST)

The total number of respondents under the FPVST component is 12. The districts covered are Bolangir, Kalahandi, Nuapada and Rayagada (Figure 9).

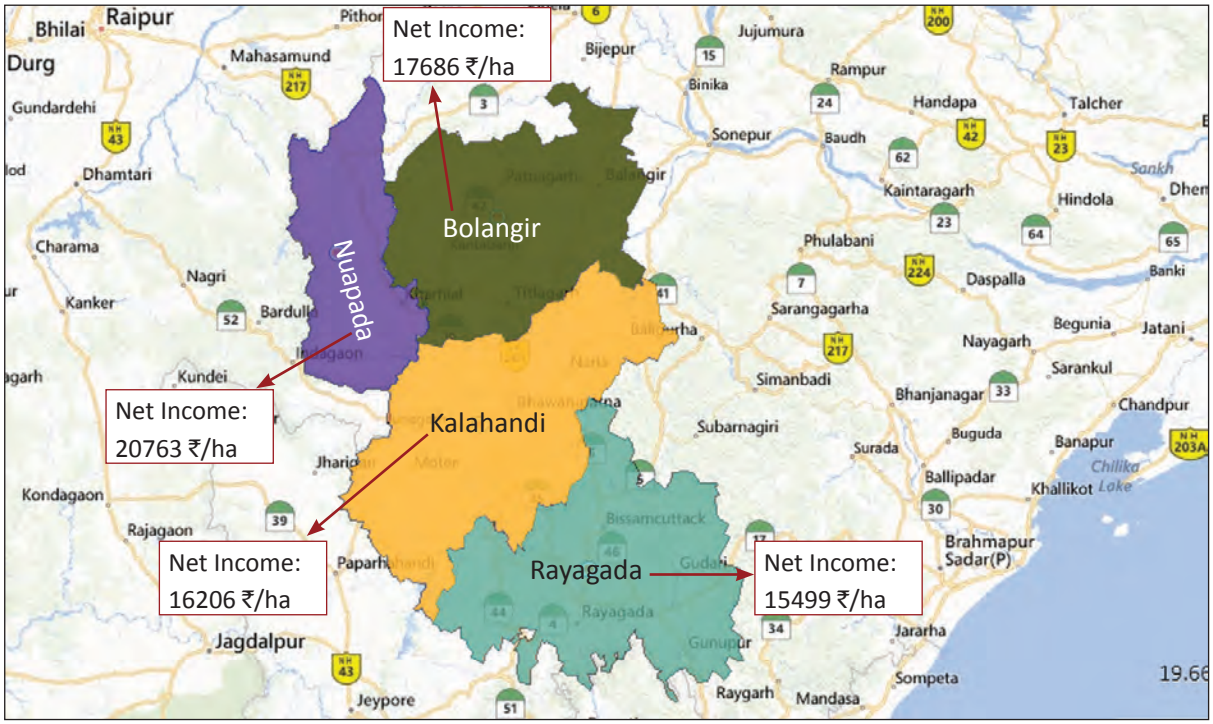


Figure 9. Map of the project sites for FPVST showing net income per district.

2.1 Socio-demographic information

Majority of the respondents under the FPVST activity belonged to the 25–44 age range. All are male, married except for one respondent from Nuapada and with education till Standard 10 (Table 23).

2.2 Membership to organizations

Membership to organizations among FPVST farmer-respondents is positive except for those from Kalahandi. Activities engaged in are provisions for informal education and access to household needs. Interestingly, FPVST farmer-respondents from Kalahandi district expressed no interest (Table 24).

Table 23. Socio-demographic information.

	Bolangir (n=1)		Kalahandi (n=4)		Nuapada (n=5)		Rayagada (n=2)	
Particulars	No.	%	No.	%	No.	%	No.	%
Age group								
25–44 years	1	100	2	50	3	30	1	50
45–64 years	-	-	2	50	2	20	1	50
Gender								
Male	1	100	4	100	5	100	2	100
Marital status								
Married	1	100	4	100	4	80	2	100
Single	-	-	-	-	1	20	-	-
Education qualification								
1^{st} - 5^{th}	-	-	-	-	1	20	2	100
6^{th} – 10^{th}	1	100	3	75	1	20	-	-
Above 10^{th}	-	-	1	25	1	20	-	-
Illiterate	-	-	-	-	2	40	-	-

Table 24. Membership to organizations.

Particulars	Bolangir (n=1)		Kalahandi (n=4)		Nuapada (n=5)		Rayagada (n=2)	
	No.	%	No.	%	No.	%	No.	%
Membership in SHG/organization								
Yes	1	100	-	-	4	80	1	50
No	-	-	4	100	1	20	1	50
Role in SHG/organization								
Member	1	100	-	-	1	25	1	100
No response	-	-	-	-	3	75	-	-
Activities in SHG								
Education, awareness on agriculture and rural development	-	-	-	-	1	100	-	-
Provision of household necessities	1	100	-	-	-	-	1	100
Non-membership to organization								
No interest	-	-	4	100	1	100	1	100

2.3 Farming resources

Farm size and availability of irrigation. Farm size is from small to semi-medium with most having access to irrigation. In Kalahandi and Nuapada, a few of the participants have no access to irrigation. Only 6 of the 12 respondents relied on rainfall. All respondents from Bolangir relied on borewell, 2 (40%) in Nuapada on farm ponds, and 100% in Rayagada on canals and through water harvesting (Table 25).

Table 25. Farming system.

Particulars	Bolangir (n=1)		Kalahandi (n=4)		Nuapada (n=5)		Rayagada (n=2)	
	No.	%	No.	%	No.	%	No.	%
Farm size								
Small (1.01 - 2.00 ha)	1	100	1	25	4	80	-	-
Semi-medium (2.01 - 4.00 ha)	-	-	3	75	1	20	2	100
Irrigation								
Yes	1	100	2	50	2	40	2	100
No	-	-	2	50	3	60	-	-
Type of irrigation								
Borewell	1	100	1	25	-	-	-	-
Rainfed	-	-	3	75	3	60	-	-
Farm pond	-	-	-	-	2	40	-	-
Others (Canal, water harvesting, etc)	-	-	-	-	-	-	2	100

Sources of agri-information. There are diverse sources of agricultural information from among the farmer-respondents involved in FPVST. District-wise, different rankings were given. Media sources, specifically the television proves to be an important source. ICRISAT was also expressed as an important source and ranked 1 in Kalahandi, 2 in Rayagada and 4 in Nuapada (Table 26).

Table 26. Sources of agri-information.

Ranking	Bolangir (n=1)	Kalahandi (n=4)	Nuapada (n=5)	Rayagada (n=2)
Rank 1	Television (100%)	ICRISAT staff (50%)	NGO (60%)	DoA (100%)
Rank 2	Village workers (100%)	Farmer club (50%)	DoA (20%) Television (20%)	ICRISAT staff (50%)
Rank 3	Farmer's Club (100%)	DoA (20%) NGO (25%)	Television (40%)	Television (20%)
Rank 4	Friends (100%)	Friends (20%)	ICRISAT staff (40%)	Booklet (100%)
Rank 5	Poster (100%)	Television (25%)	Friends (20%) Radio (20%) VAW (20%)	-

Note: Rank accordingly from the most important to the least, with 1 as the most important
VAW: Village Agricultural Workers

Livestock resources. Respondents owned different types of livestock. Most have cows, bullocks, goats and chicken while others have duck and sheep. The first three livestock are important household assets because these are their sources of draught power, milk and cash (Table 27).

Table 27. Livestock resources (%).

Livestock	Bolangir (n=1)	Kalahandi (n=4)	Nuapada (n=5)	Rayagada (n=2)
Bullocks	100	-	60	50
Cow	100	100	60	50
Goat	100	100	40	-
Chicken	-	-	40	-
Others	-	25	-	-

2.4 Pigeonpea farming system

Gender participation. Respondents of FPVST reported that both men and women have shared responsibility in most of the farm operations across districts (Rayagada, 57%; Bolangir and Nuapada, 40% respectively; and Kalahandi, 8%) (Table 28). Specific farm operations where women do most are cleaning seeds, storing seed and preparing *dal*. Weeding is basically a women's activity in the districts of Bolangir, Kalahandi and Nuapada (Figure 10). Farmer-respondents were of the view that improved pigeonpea cultivation resulted in greater participation of women.

Table 28. Gender participation in farm operations.

	Gender participation (%)			
Location	Male	Female	Both	No response
Bolangir (n=1)	33	27	40	-
Kalahandi (n=4)	52	35	8	5
Nuapada (n=5)	33	27	40	-
Rayagada (n=2)	10	33	57	-

Cost of production (FPVST). Pigeonpea cultivation particularly for the varietal trial was conducted in marginal areas (less than 1.01 ha). The BCR ranged from 1:1.47 to 1.89. Rayagada and Nuapada registered the highest BCR of 1: 1.89 and 1.76, respectively. Bolangir is estimated at 1:1.57 and the lowest was in Kalahandi estimated at 1:1.41. This conforms with Deepak Mohanty et al. (2010) where an increase was seen in the NMR as well the BCR due to changes in the farming system and introduction of pigeonpea as part of it (Table 29).

Technologies adopted

Varietal adoption. Varietal adoption specifically ICPL 14001 and ICPL 14002 was well-received by farmer-respondents. All of them reported that the varieties newly introduced by ICRISAT-DoA Govt of Odisha are better than traditional seeds. Where hybrid commercial production was tested (ICPH 2671 and ICPH 2740) in Nuapada and Rayagada, only 40% assessed their performance as good in Nuapada while 100% considered them to be better than the local in Rayagada. According to them, hybrids were observed to have higher resistance to pests (Table 30).

Location	Land preparation			Planting / Sowing			Fertilizer application			Spraying			Weeding			Roughing			Harvesting			Threshing			Cleaning			Seed storage			Seed treatment			Dal preparation			Seed selection for planting			Irrigation			Others		
	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B
Bolangir (n= 1)	100	-	-	100	-	-	100	-	-	-	-	100	-	100	-	-	-	100	-	-	100	-	-	100	-	100	-	-	100	-	-	-	100	-	100	-	-	100	100	-	-	100	-	-
Kalahandi (n= 4)	75	-	25	75	25	-	100	-	-	50	-	50	-	100	-	100	-	-	25	25	50	25	75	-	-	100	-	-	100	-	-	100	-	-	100	-	100	-	-	100	-	-	25	-	-
Nuapada (n= 5)	40	-	60	-	20	80	20	20	60	80	-	20	-	60	40	40	20	40	-	-	100	40	20	40	-	80	20	-	60	40	40	20	40	20	60	20	60	20	20	80	20	-	80	-	20
Rayagada (n= 2)	100	-	-	-	-	100	-	-	100	-	-	100	-	-	100	-	-	100	-	100	-	-	100	-	-	100	-	-	100	-	-	100	-	-	100	-	-	100	-	-	100	50	-	50

○ Male △ Female ⬡ Both

Figure 10. Participation of women in pigeonpea cultivation (FPVST).

Table 29. Average area and cost of production of FPVST.

	Area	Quantity of seed	Yield	Price	Gross income	Cost of production (₹/ha)												Total production cost	Net income	
Location	Ha	Kg/ha	Kg/ha	₹/kg	₹/ha	Seed cost	Sowing	Cultivation	Fertilizer	Fertilizer labor	Pesticide	Pesticide labor	Weeding	Irrigation	Harvesting	Threshing	Others	₹/ha	₹/ha	BCR
Bolangir																				
Marginal (n=1)	0.40	9	640	45	28982	601	1513	1420	1402	648	834	226	988	206	1791	1070	597	11296	17686	1.57
Kalahandi																				
Marginal (n=4)	0.405	11	584	49	27729	124	1544	1544	778	679	618	309	988	618	1544	1235	1544	11523	16206	1.41
Nuapada																				
Marginal (n=5)	0.405	8	640	49	32555	1023	1828	939	1877	865	642	124	889	-	2371	1087	148	11792	20763	1.76
Rayagada																				
Marginal (n=2)	0.405	10	741	32	23712	494	556	1976	1173	247	1359	185	741	-	741	618	124	8213	15499	1.89

Marginal	-	< 1.01 ha
Small	-	1.01 - 2.00 ha
Semi-medium	-	2.01 - 4.00 ha
Medium	-	4.01 - 10.00 ha
Large	-	> 10.00 ha

Table 30. Specific technologies adopted in FPVST.

Technologies	Bolangir (n=1)	Kalahandi (n=4)	Nuapada (n=5)	Rayagada (n=2)
Varieties	**100%**	**100%**	**100%**	**100%**
Remarks	ICPL 14002, ICPL 14001 and ICP-7035 are good (100%)	Good variety (100%)	ICPL 14002, ICPL 14001 and ICP-7035 are good (100%)	New varieties are better than local (100%)
Hybrids	-	-	**40%**	**100%**
Remarks	-	-	ICPH-2671, ICPH-2740 are good (40%)	Hybrids are better than local (100%)
Fertilizer requirement	**100%**	**100%**	**100%**	**100%**
Remarks	Required dose of fertilizer applied for better yield (100%)	Adopted fertilizer application in pigeonpea to increase yield up to 2 times (100%)	Required dose of fertilizer applied for better yield (100%)	Required dose of fertilizer applied for better yield (100%)
Insecticide	**100%**	**100%**	**40%**	**100%**
Remarks	For disease control (100%)	Used pesticide to avoid insect attack (100%)	Provided own pesticide (20%) Provided pesticide (20%)	Controlled insects/pests effectively and saved the crop from damage (100%)
Line sowing	**100%**	**25%**	**100%**	**100%**
Remarks	Line sowing gave more yield than broadcasting and less seeds are required (100%)	Helped in better germination percentage (25%)	Line sowing gave more yield than broadcasting and less seeds are required (100%)	Line sowing gave more yield than broadcasting and less seeds are required (100%)
Weeding	**100%**	**100%**	**100%**	**100%**
Remarks	Good result (100%)	• Adopted weeding, for more yield with proper crop growth (25%) • We did not follow weeding previously (75%)	Two times weeding (100%)	Adopted weeding, for more yield with proper crop growth (100%)

Fertilizer and insecticide requirement. These are two inputs required to ensure good yield. Fertilizer application using the right dosage ensured doubling of the yield and proper application of insecticide prevented insect pests and saved crops from damage. In Nuapada, only 40% claimed to have adopted this technology.

Line sowing. This is a new technology learned by farmers of the districts. The traditional practice was broadcasting the seeds. This corresponds to a study by Dwivedi et al. (2011) in Uttar Pradesh where almost 90% of the respondents used to broadcast the seeds due to lack of knowledge and lack of raised-bed planter. Only 10% farmers used line sowing techniques.

The adoption rate for line sowing technology in the project sites was high at 100% in Bolangir, Nuapada and Rayagada. According to farmer-respondents, this resulted in better yield and less seeds are required.

Weeding. As a result of line sowing, weeding was facilitated. This is one operation that was not previously done among pigeonpea cultivators of the study sites. Its practice resulted in better yield. In a similar study by Dwivedi et al. (2011) in Uttar Pradesh, it was found that almost 40% of the respondents adopted the recommended weeding methods. The remaining either used manual method or did not use any method of weeding because of lack of knowledge about losses in productivity due to presence of weeds in pigeonpea cultivation.

Problems and constraints. High flower drop and insect pest attack were two of the major constraints of the farmer-respondents from Kalahandi. In Rayagada and Nuapada, market link is an expressed constraint. Inadequate training and exposure was also an issue among the respondents of Nuapada (Table 31).

Table 31. Problems and constraints of FPVST.

	Bolangir (n=1)		Kalahandi (n=4)		Nuapada (n=5)		Rayagada (n=2)	
Particulars	No.	%	No.	%	No.	%	No.	%
A. Cultural management								
1. High flower drop	-	-	3	75	-	-	-	-
2. High insect attack	-	-	2	50	-	-	-	-
3. Lack of labor	1	100	-	-	-	-	-	-
B. Marketing								
1. No market linkage	-	-	-	-	1	20	2	100
C. Others								
1. No training/awareness/ exposure	-	-	-	-	3	60	-	-

Involvement in pigeonpea project. Several questions were posed to farmer-respondents with the end view of identifying lessons that can serve as a springboard for improving the delivery of the project and future engagements either of ICRISAT or DoA Govt of Odisha.

Project inception. In the four sites where FPVST was conducted, the majority said that sufficient community participation happened during project inception. Farmer-respondents from Kalahandi claimed inadequate consultation. A similar response with that of IPPT was mentioned on very specific activities such as site selection, varietal and hybrid selection, conduct of demonstration, conduct of farmers' training, preparation of IEC materials, and purchase of farm requirements. However, on other items such as the conduct of experiments, conduct of specialized and SHG training were said to have been done without much community consultation (Annex 5).

Degree of satisfaction to capacity building activities. Almost 50% did not express their view on the various capacity building activities implemented. However, those who have responded in the affirmative, claimed either 'fully satisfied' or 'satisfied' (Table 32).

The high rate of no response for this query is a concern that needs to be verified since this can be one of the lessons learned for the project.

Table 32. Degree of satisfaction of participants' involvement in capacity building activities.

			Yes						No	
			Fully satisfied		Satisfied		Not satisfied			
Particulars (N=12)	No.	%	No.	%	No.	%	No.	%	No.	%
Project meeting and workshop	4	33	1	25	2	50	1	25	8	67
Project presentation meeting	4	33	2	50	2	50	-	-	8	67
Project orientation cum training	4	33	2	50	2	50	-	-	8	67
Project launching cum training workshop	4	33	1	25	3	75	-	-	8	67
Project orientation meeting seminar	4	33	1	25	3	75	-	-	8	67
Farmer's specialized training course	5	42	2	40	3	60	-	-	7	58
Farmer's field day demonstration	5	42	-	-	5	100	-	-	7	58
Others	7	58	1	14	6	86	-	-	5	42

Information, education and communication (IEC) strategies. Print materials such as the booklets 'Cultural Management Practices of Pigeonpea' and 'Integrated Pest Management and Integrated Disease Management of Pigeonpea' were the two most availed of IEC materials in all the districts (Annex 6). These were considered very useful because these served as their guide in their pigeonpea cultivation. Respondents claimed that the posters provided by the project were also very informative.

Degree of satisfaction on roles of key stakeholders. The respondents were found to be satisfied with the delivery of roles of all key stakeholders in the project; nevertheless full satisfaction was stated for ICRISAT, in Bolangir. On the other hand, a mixed response was gathered from respondents in Kalahandi and Nuapada. It ranged from "fully satisfied" to "satisfied". At the same time, 60% respondents expressed "not satisfied" with the Farmer Association and 20% expressed "not satisfied" for Deputy Director of Agriculture (DDA).

In Rayagada, respondents did not provide response of their assessment of the farmers' association while for the rest of the stakeholders, satisfaction was claimed (Table 33).

Table 33. Degree of satisfaction on roles of the stakeholders in the pigeonpea project.

Particulars	Degree of satisfaction	Bolangir (n=1)	Kalahandi (n=4)	Nuapada (n=5)	Rayagada (n=2)
Farmer Association	Fully satisfied	-	-	-	-
	Satisfied	100	100	40	-
	Not satisfied	-	-	60	-
	No response	-	-	-	100
DDA	Fully satisfied	-	25	-	-
	Satisfied	100	75	80	100
	Not satisfied	-	-	20	-
ICRISAT	Fully satisfied	100	75	40	100
	Satisfied	-	25	60	-
Others	Satisfied	100			100
	No response		100	100	

***Major factors/constraints in the delivery of pigeonpea technologies*.** Farmer-respondents from Bolangir and Kalahandi were pleased with the delivery of pigeonpea technologies and did not express any major constraints about it. A mixed opinion was found from the respondents of Nuapada. They found lack of storage facility (60%), lack of awareness (60%), lack of labor (20%) and lack of marketing facilities (100%) as the major constraints. On the other hand, 50% of the respondents found all particulars to be a constraint, ie, lack of storage facility, involvement of middlemen, lack of awareness, lack of labor and lack of marketing facilities (Table 34).

Table 34. Major factors/constraints in the delivery of pigeonpea technologies.

	Bolangir (n=1)		Kalahandi (n=4)		Nuapada (n=5)		Rayagada (n=2)	
Particulars	No.	%	No.	%	No.	%	No.	%
Lack of storage facility	-	-	-	-	3	60	1	50
Involvement of middlemen	-	-	-	-	-	-	1	50
Lack of awareness	-	-	-	-	3	60	1	50
Lack of labor	-	-	-	-	1	20	1	50
Lack of marketing facilities	-	-	-	-	3	100	1	50

Suggestions to sustain the achievements of pigeonpea project. Keeping in mind the importance of sustainability of a project, the farmer-respondents from Bolangir (100%) suggested that appropriate technologies like line sowing and support for some agri inputs such as fertilizers, sprayers and pesticides should be provided. In Kalahandi, 75% of the respondents expressed that appropriate technologies like line sowing should be provided while 25% stated that there should be an increase in the amount of training and exposure visits. Respondents from Nuapada suggested appropriate technologies like line sowing, support for some agri inputs such as fertilizers, sprayers and pesticides, and training and exposure visits to sustain the project. Support for some agri inputs such as fertilizers, sprayers and pesticides, and training and exposure visits were the suggestions from respondents of Rayagada (Table 35).

Table 35. Suggestions to sustain the achievements of pigeonpea project.

Particulars	Bolangir (n=1)		Kalahandi (n=4)		Nuapada (n=5)		Rayagada (n=2)	
	No.	%	No.	%	No.	%	No.	%
1. Appropriate technologies like line sowing	1	100	3	75	-	-	-	-
2. Support for some agri inputs like fertilizers, sprayers and pesticides	1	100	-	-	2	33	2	100
3. Training and exposure visits	-	-	1	25	3	50	2	100
4. Regular meetings for updates and feedback	-	-	-	-	1	17	-	-

3.0 Seed Production (SP)

The total number of respondents under the SP component is 161. The districts covered are Kalahandi, Nuapada and Rayagada (Figure 11).

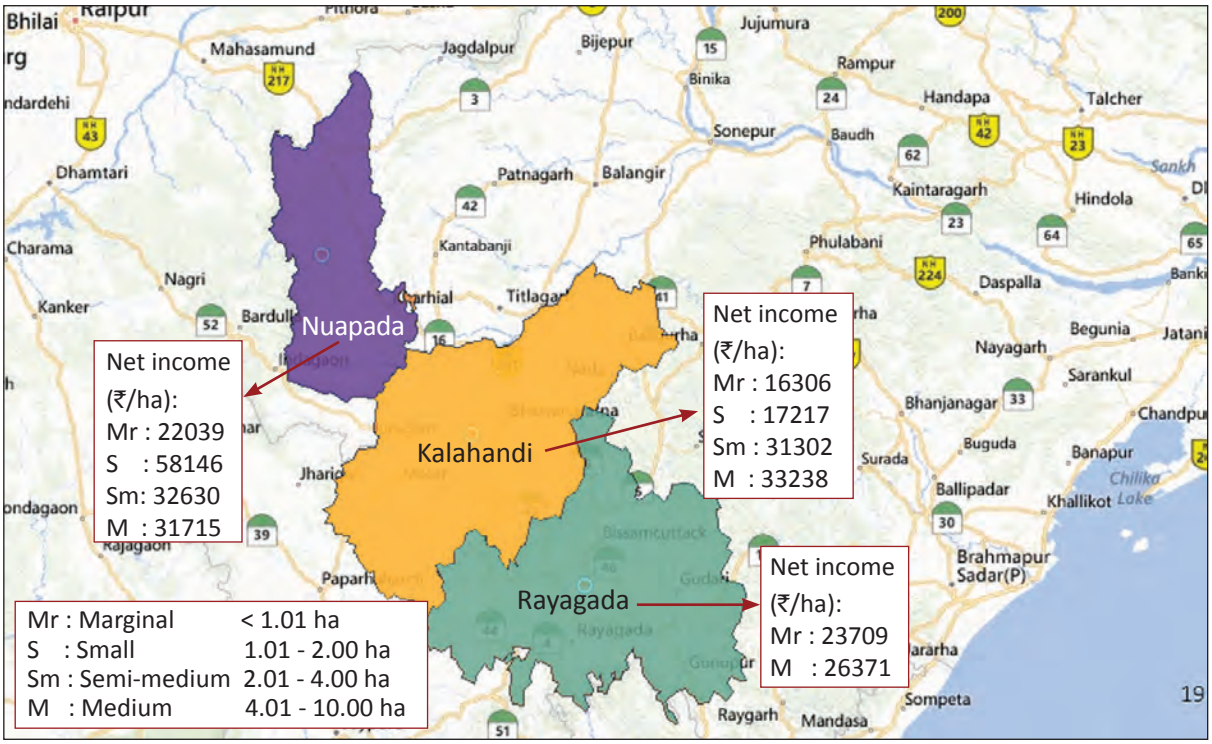


Figure 11. Map of the project sites for seed production showing net income per district.

3.1 Socio-demographic information

Farmer-respondents under this category belonged to the 25–44 years age range. Most of them are male (95% Kalahandi, 84% Nuapada, and 100% Rayagada) with a couple of women in the districts of Kalahandi (5%) and Nuapada (16%). Except for one, all are married and with certain degree of education mostly at Standard 6–10 (Table 36).

3.2 Membership to organizations

Non-members to any organization are more compared with those who answered in the affirmative under the SP component (Table 37). Among those who signified membership, most are mere members while a few hold an officer's position. The activities engaged in by their SHGs are on savings, informal education and provision of access to household needs. Non-members claimed not having interest, lack of awareness, resources, and also community issues like peace and order.

3.3 Farming resources

Farm size and availability of irrigation. Farm size of SP farmer-respondents in Kalahandi is semi-medium (43%) to medium (39%), Nuapada has mostly marginal (32%), small (42%), and semi-medium (23%) and in Rayagada, all the respondents have marginal farm size. Most of the SP respondents rely on rain for their irrigation (Kalahandi, 55% and Nuapada, 83%) while some rely on other types such as farm pond, borewell, river, etc (Table 38).

Table 36. Socio-demographic information.

	Kalahandi (n=44)		Nuapada (n=102)		Rayagada (n=15)	
Particulars	No.	%	No.	%	No.	%
Age group						
18 - 24 years	1	2	-	-	-	-
25 - 44 years	28	64	41	25	9	60
45 -64 years	11	25	56	35	5	33
65 -74 years	4	9	4	2	1	7
Above 75 years	-	-	1	1	-	-
Gender						
Male	42	95	86	84	15	100
Female	2	5	16	16	-	-
Marital status						
Married	44	100	101	99	15	100
Single	-	-	1	1	-	-
Educational qualification						
$1^{st} – 5^{th}$	6	14	14	14	8	53
$6^{th} – 10^{th}$	32	73	44	43	4	27
Above 10^{th}	6	14	13	13	1	7
Illiterate	-	-	29	28	2	13
No response	-	-	2	2	-	-

Table 37. Membership to organizations.

	Kalahandi (n=44)		Nuapada (n=102)		Rayagada (n=15)	
Particulars	No.	%	No.	%	No.	%
Membership in SHG/ organization						
Yes	10	23	48	47	4	27
No	34	77	54	53	11	73
Role in SHG/ organization						
Member	7	70	31	65	4	100
Officer	3	30	16	33	-	-
No response	-	-	1	2	-	-
Activities in SHG						
Saving	2	20	6	13	-	-
Education, awareness on agriculture and rural development	1	10	41	85	-	-
Provision of household necessities	2	20	1	2	-	-
Defunct	-	-	-	-	1	25
Non-membership to organizations						
Lack of interest	31	91	40	74	2	18
Lack of awareness	3	9	-	-	-	-
Lack of resources	-	-	9	17	-	-
Lack of community peace	-	-	5	9	2	18
No response	-	-	-	-	7	64

Table 38. Farming system.

Particulars	Kalahandi (n=44)		Nuapada (n=102)		Rayagada (n=15)	
	No.	%	No.	%	No.	%
Farm size						
Marginal	3	7	33	32	15	100
Small	4	9	43	42	-	-
Semi-medium	19	43	23	23	2	13
Medium	17	39	2	2	8	53
Large	-	-	1	1	-	-
No response	1	2	-	-	-	-
Irrigation						
Yes	20	45	18	18	15	100
No	24	55	84	82	-	-
Type of irrigation						
Borewell	5	11	3	3	1	7
Dug well	-	-	5	5	-	-
Rainfed	24	55	85	83	-	-
Farm pond	6	14	-	-	2	13
River	5	11	3	3	1	7
Lift	-	-	-	-	1	7
Others (canal, water harvesting, etc)	5	11	6	6	11	73

Marginal - < 1.01 ha
Small - 1.01 - 2.00 ha
Semi-medium - 2.01 - 4.00 ha
Medium - 4.01 - 10.00 ha
Large - > 10.00 ha

Sources of agri-information. In Kalahandi, ICRISAT staff was their most important source of information and for Nuapada and Rayagada, the agriculture department and its line department was ranked 1. Media sources including television, radio, and printed materials such as booklets and newspaper were also regarded important. In Nuapada, the Sahabhagi Vikash Abhiyan (SVA) non-government group working with this pigeonpea project was also regarded as one of the five most important sources of agricultural information (Table 39).

Table 39. Sources of agri-information.

Ranking	Kalahandi (n=44)	Nuapada (n=102)	Rayagada (n=15)
Rank 1	ICRISAT staff (64%)	DoA and line department (40%)	DoA (27%) ICRISAT staff (27%)
Rank 2	Farmer club (27%)	NGO (29%)	Line department (7%)
Rank 3	DoA (23%)	ICRISAT staff (19%)	ICRISAT staff (13%)
Rank 4	Television (14%)	Radio (15%) SVA (15%)	Television (33%) Radio (33%)
Rank 5	Newspaper (5%)	Television (16%)	Booklet (13%)

Note: Rank accordingly from the most important to the least, with 1 as the most important.

Livestock resources. Respondents owned different types of livestock; most have cows, bullocks, goats and chicken, while others have duck and sheep. These are equally important household assets as sources of food (milk) and cash (Table 40).

Table 40. Livestock resources (%).

Livestock	Kalahandi (n=44)	Nuapada (n=102)	Rayagada (n=15)
Bullocks	-	22	67
Cow	84	68	47
Goat	73	41	13
Chicken	5	13	-
Others	-	3	20

3.4 Pigeonpea farming system

Gender participation. Of the 44 SP respondents, the majority (56%) said that various farm operations are done by males (Table 41). In the districts of Nuapada and Rayagada, 61% and 60% respectively said that farm operations are shared work of both sexes. Women's involvement in farm operations are in weeding, harvesting, threshing and cleaning seeds (especially in Rayagada), storing seeds (especially in Kalahandi), and preparation of *dal* (especially in Kalahandi and Rayagada) (Figure 12).

Table 41. Gender participation in farm operations.

	Gender participation (%)			
Location	Male	Female	Both	No response
Kalahandi (n=44)	56	24	6	14
Nuapada (n=102)	27	12	61	-
Rayagada (n=15)	7	33	60	-

SP farmer-respondents were of the view that improved pigeonpea cultivation resulted in greater participation of women especially among tribal women (Rayagada, 100%) and their participation in various cultural management practices (Nuapada, 100%).

Types of seed production. Farmer-respondents under this component were mostly engaged in Foundation (Kalahandi, 52%; Nuapada, 75% and Rayagada, 13%) and Certified seeds production (Kalahandi, 45%; Nuapada, 19% and Rayagada, 18%). Very few (Nuapada, 6% and Kalahandi, 2%) are engaged in hybrid seed production. The full package of the SP protocol provided by ICRISAT-DoA Govt of Odisha project was adopted by the SP farmer-respondents (Table 42).

Table 42. Type of seed production.

	Kalahandi (n=44)		Nuapada (n=102)		Rayagada (n=15)	
Particulars	No.	%	No.	%	No.	%
Certified seed	20	45	19	19	13	87
Foundation seed	23	52	77	75	2	13
Hybrid seed	1	2	6	6	-	-

Location	Land preparation			Planting / Sowing			Fert application			Spraying			Weeding			Roughing			Harvesting			Threshing			Cleaning			Seed storage			Seed treatment			Dal preparation			Seed selection for planting			Irrigation			Others		
	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B	M	F	B
Kalahandi (n= 44)	93	2	5	75	20	5	100	-	-	91	7	2	39	61	-	80	14	5	73	18	9	75	25	-	30	59	11	18	61	20	75	11	11	16	68	9	39	2	-	27	2	2	16	2	9
Nuapada (n= 102)	35	-	65	3	7	90	17	1	82	53	1	46	1	24	75	35	-	65	13	1	86	7	14	79	7	38	55	23	25	52	32	14	54	5	46	49	25	9	66	76	-	24	72	-	28
Rayagada (n= 15)	100	-	-	-	-	100	-	-	100	-	-	100	-	-	100	-	-	100	-	100	-	-	100	-	-	100	-	-	100	-	-	100	-	-	100	-	-	100	-	-	100	-	-	100

○ Male △ Female ⬡ Both

Figure 12. Participation of women in seed production.

Production cost and benefit. Seed production in pigeonpea is a profitable enterprise as shown by BCR of 1: 1.45 to 3.38. As shown in Table 43, the highest BCR is from Rayagada with a value of 3.38 (farm size: medium), followed by Kalahandi (farm size: small) with a BCR of 1.70 and the lowest ones are in Kalahandi estimated at 1.45 (farm size: semi-medium) and Nuapada estimated at 1.45 (farm size: small).

Technologies adopted

Varietal and hybrid adoption. The introduction of ICPL 14001 and ICPL 14002 was well-received by the seed growers. In Kalahandi, 84% of the farmers that tried the ICRISAT varieties regarded their performance as good, Nuapada (77%) and Rayagada (80%) as better than the local (Table 44).

Hybrid seed production specifically ICPH 2740 was tested in Nuapada and Kalahandi and this was assessed as equally good. Among those who participated in hybrid production particularly in these two districts in 2012, the initial yield produced was quite remarkable.

Fertilizer application. The application of fertilizer helped growers in all the sites to obtain better yield. However, there were also first timers who have used fertilizers; Kalahandi, 23% and Nuapada, 14%.

Insecticide requirement. The judicious use of insecticide at the right time is another technology that contributed to improved yield of pigeonpea. In Rayagada (33%) growers remarked that the use of pesticide controlled pest attack and reduced crop loss. In Kalahandi, 34% implemented this technology and got more income in pigeonpea cultivation. In Nuapada, 25% said that the use of pesticide contributed to getting a good yield.

Line sowing. For the first time, farmers familiarized themselves with the technology of line sowing in ridges. Eighty seven percent (87%) of respondents from Rayagada adopted line sowing to increase yield and improve production. In Nuapada, 100% and in Kalahandi, 34% of the SP farmers adopted straight planting of pigeonpea in ridges, which facilitated other farm operations such as weeding and intercropping.

Weeding. After sowing, farmers practiced weeding to ensure crop growth. Seventy percent (70%) of the farmers in Kalahandi said that weeding is necessary especially after sowing (at least 30 days after) to ensure better yield. All respondents in Nuapada were of the same opinion about the importance of weeding.

Involvement in pigeonpea project. Several questions were posed to farmer-respondents with the end view of identifying lessons that can serve as a springboard for improving the delivery of the project and future engagements either of ICRISAT or DoA Govt of Odisha.

Project inception. During the project inception, Kalahandi and Nuapada SP-respondents claimed that there was partial consultation done whereas in Rayagada, sufficient consultation happened (Annex 7).

Specific activities such as site selection, varietal and hybrid selection, conduct of demonstration, conduct of farmers' training and specialized courses, and purchase of farm requirements were implemented with sufficient community consultation. The selection of hybrids was done by project implementers. On activities such as the conduct of baseline data, preparation of IEC materials, purchase of requirements, and construction of infra facilities some of the respondents said that sufficient consultation was done while others responded otherwise.

Table 43. Average area and cost of seed production.

	Area	Quantity of seed	Yield	Price	Gross income	Cost of production (₹/ha)												Total production cost	Net income	
Location	Ha	Kg/ha	Kg/ ha	₹/kg	₹/ha	Seed cost	Sowing	Cultivation	Fertilizer	Fertilizer labor	Pesticide	Pesticide labor	Weeding	Irrigation	Harvesting	Threshing	Others	₹/ha	₹/ha	BCR
Kalahandi																				
Marginal (n=5)	0.45	11	405	65	26330	2140	889	939	1591	543	692	395	543	543	889	840	593	10024	16306	1.61
Small (n=20)	1.02	12	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	12	682	65	44330	4800	906	851	1976	796	653	425	700	316	919	686	425	13028	31302	1.45
Medium (n=1)	4.05	12	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	10	1354	62	82354	2174	3088	3055	4899	906	1564	1153	3582	-	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	11	1372	65	89180	6000	4117	3086	5146	1235	2470	1235	14820	7410	12350	4940	-	62809	26371	3.38

Marginal	-	< 1.01 ha
Small	-	1.01 - 2.00 ha
Semi-medium	-	2.01 - 4.00 ha
Medium	-	4.01 - 10.00 ha
Large	-	> 10.00 ha

Table 44. Specific technologies adopted in seed production.

Particulars	Kalahandi (n=44)	Nuapada (n=102)	Rayagada (n=15)
Varieties	**99%**	**91%**	**80%**
Remarks	• Good yield (84%) • Needs intensive (11%) • ICPL 14002 is good (2%) • Adopted new technologies (2%)	• ICPL 14002 is good (77%) • ICPL 14001 is good (14%)	• Good yield and better than the local (80%)
Hybrids	**13%**	**8%**	
Remarks	• Good initial yield	• ICPH 2741 and ICPH 2671 are good (2%) • ICPL 14002 is good (5%) • ICPL 14001 is good (1%)	
Fertilizer requirement	**100%**	**100%**	**86%**
Remarks	• Fertilizer helped in getting good yield (68%) • Used fertilizer first time in *arhar* (23%) • No need of fertilizer to implement *arhar* (7%) • Provided fertilizer free of cost (2%)	• Fertilizer helped in getting good yield (73%) • Use own fertilizer (12%) • Less amount of fertilizer provided (1%) • Used fertilizer first time in *arhar* (14%)	• Fertilizer helped in getting good yield (73%) • Required dose of fertilizer applied for better yield (13%)
Insecticide	**68%**	**77%**	**35%**
Remarks	• Need pesticide for better yield (9%) • Got more income using pesticide (34%) • Not applied pesticide in *arhar* (18%) • Used pesticide for the first time in *arhar* (7%)	• Provided pesticide (33%) • Use own pesticide (22%) • Pesticide contributed to good yield (25%)	• Required dose of pesticide applied for better yield (2%) • Controlled pest attack and reduced crop loss (33%)
Line sowing	**36%**	**100%**	**100%**
Remarks	• Ease in weeding and intercropping (34%) • Followed line sowing in maize and *arhar* (2%)	• Ease in weeding and intercropping (100%)	• Adopted line sowing for better production (87%)
Weeding	**100%**	**100%**	**100%**
Remarks	• Weeding is necessary (70%) • Done once in 30 days after sowing (30%)	• Weeding helped in proper crop growth; hence good yield (100%)	• Labor problem (46%) • Weeding helped in proper crop growth (47%) • Hand weeding and tractor weeding (7%)

Problems and constraints. Key constraints of farmer-respondents involved in SP are varied across districts (Table 45). In Kalahandi, lack of inputs (16%), delayed seeds supply (92%) and isolation distance (3%) were expressed; Nuapada, irrigation problem (32%), lack of inputs (47%), and lack of training/awareness/exposure (21%); and Rayagada, lack of inputs (42%) and no fixed price (58%) were reported as constraints.

Table 45. Problems and constraints of seed production.

	Kalahandi (n=44)		Nuapada (n=102)		Rayagada (n=15)	
Particulars	No.	%	No.	%	No.	%
A. Cultural management						
1. Irrigation problem	-	-	68	32	-	-
2. Lack of inputs (fertilizer, pesticide and sprayer)	6	16	102	47	11	42
3. Delayed seeds supply	35	92	-	-	-	-
4. Isolation distance	1	3	-	-	-	-
B. Marketing						
1. No fixed price	-	-	-	-	15	58
C. Others						
1. No training/awareness/exposure	-	-	45	21	-	-

Degree of satisfaction to various capacity building activities. Farmer-respondents participated in different capacity building activities and gave their views regarding the activities they participated in. Most of the respondents expressed their satisfaction to project meeting, workshops and training programs conducted. Some also mentioned satisfaction on the awareness meeting they attended. Rarely did respondents claim no satisfaction. However, some declined to give their comments on major activities of the project (Table 46).

Table 46. Degree of satisfaction of participants' involvement in capacity building activities.

			Yes						No	
			Fully satisfied		Satisfied		Not satisfied			
Particulars (N=161)	No.	%	No.	%	No.	%	No.	%	No.	%
Project meeting and workshop	131	81	17	13	114	87	-	-	30	19
Project presentation meeting	113	70	2	2	111	98	-	-	48	30
Project orientation cum training	110	68	3	3	104	95	3	3	51	32
Project launching cum training workshop	112	70	1	1	111	99	-	-	49	30
Project orientation meeting seminar	127	79	1	1	126	99	-	-	34	21
Farmers' specialized training course	98	61	5	5	92	94	1	1	63	39
Farmers' field day demonstration	102	63	12	12	90	88	-	-	59	37
Others	45	28	1	2	43	96	1	2	116	72

Information, education and communication strategies (IEC). Awareness building regarding the project was done through intensive IEC activities using electronic media and print materials such as booklet on pigeonpea cultivation. The booklet provided by the project on cultural management practices had the best utilization (Kalahandi, 98%; Nuapada, 100%; and Rayagada,

100%) (Annex 8). Many were of the view that very useful information is contained in the material, learned about pigeonpea production practices such as insect control, proper use of pesticide and fertilizer application, and line sowing. A similar view was given about the booklet 'Integrated Disease and Pest Management'. Other materials availed of were radio, television and coverage of pigeonpea's production system, which provided additional agri-information.

Degree of satisfaction on roles of major stakeholders. Satisfaction on the roles of stakeholders is a basic condition for the success of a project. Information on the degree of satisfaction from the SP respondents' perspective revealed responses of 'fully satisfied' and just 'satisfied' on various key stakeholders of the project. In Kalahandi, almost everyone was satisfied with the different stakeholders. In Nuapada, SP respondents were satisfied with the farmers' association, DDA, and ICRISAT, with an equal number of respondents claiming no satisfaction. In Rayagada, respondents refused to provide response of their assessment of the farmers' association while for the rest of the stakeholders, satisfaction was claimed (Table 47).

Table 47. Degree of satisfaction on roles of stakeholders in pigeonpea project (%).

Particulars	Degree of satisfaction	Kalahandi (n=44)	Nuapada (n=102)	Rayagada (n=15)
Farmer Association	Fully satisfied	18	11	-
	Satisfied	59	76	-
	Not satisfied	-	13	-
	No response	23	-	100
DDA	Fully satisfied	2	6	-
	Satisfied	73	47	100
	Not satisfied	14	47	-
	No response	11	-	-
ICRISAT	Fully satisfied	82	6	-
	Satisfied	7	85	100
	Not satisfied	-	97	-
	No response	11	-	-
Others	Fully satisfied	-	-	-
	Satisfied	9	2	80
	Not satisfied	-	1	20
	No response	91	97	-

Major factors/constraints in the delivery of pigeonpea technologies. A major constraint in the delivery of the various pigeonpea technologies was the presence of pests and diseases. In Nuapada, 17% expressed unavailability of agricultural inputs such as fertilizer and pesticide. Another constraint in Kalahandi is slack labor for various farm operations such as weeding and ridging. In Rayagada, the control of pests and diseases is one of the technologies that should be looked into as part of the project (Table 48).

Table 48. Major factors/constraints in the delivery of pigeonpea technologies.

Particulars	Kalahandi (n=44)		Nuapada (n=102)		Rayagada (n=15)	
	No.	%	No.	%	No.	%
1. Pests and diseases	4	9	17	17	14	93
2. Labor availability for various operations (weeding and ridging)	4	9	-	-	-	-
3. Delayed provision of inputs	-	-	7	7	-	-
4. Inputs are not supplied (fertilizer, pesticide, etc)	-	-	17	17	-	-
5. Lack of awareness	1	2	-	-	-	-
6. Timely treatment of plant	-	-	-	-	1	7
7. No response	37	84	-	-	-	-

Suggestions to sustain the pigeonpea project. In order to make the project sustainable, SP farmer-respondents from Kalahandi (73%) suggested that support for agricultural inputs such as fertilizers, sprayers and pesticides should be provided. In the districts of Nuapada (50%) and Rayagada (73%), respondents expressed the need to conduct training and exposure visits to facilitate awareness. For the district of Rayagada (33%), better marketing facilities and linkages was mentioned as a suggestion for sustaining the project (Table 49).

Table 49. Suggestions to sustain the achievements of pigeonpea project.

Particulars	Kalahandi (n=44)		Nuapada (n=102)		Rayagada (n=15)	
	No.	%	No.	%	No.	%
Appropriate technologies like line sowing	-	-	1	1	-	-
Good seed system	6	14	8	8	4	27
Support for some agri inputs like fertilizers, sprayers and pesticides	32	73	18	18	-	-
Training and exposure visits	-	-	51	50	11	73
Better marketing facilities and linkages	2	5	12	12	5	33
Farmers who grow cotton could grow pigeonpea as intercrop to obtain best results	-	-	3	3	-	-
Irrigation facility	-	-	9	9	-	-

4.0 Godown and *Dal* Mill

The total number of respondents to the availability of godown facilities is 2; they belong to Kalahandi and Nuapada districts (Figure 13). The total number of respondents to the questionnaire on *dal* mill is 3; they belong to Kalahandi, Nuapada and Rayagada districts (Figure 14).

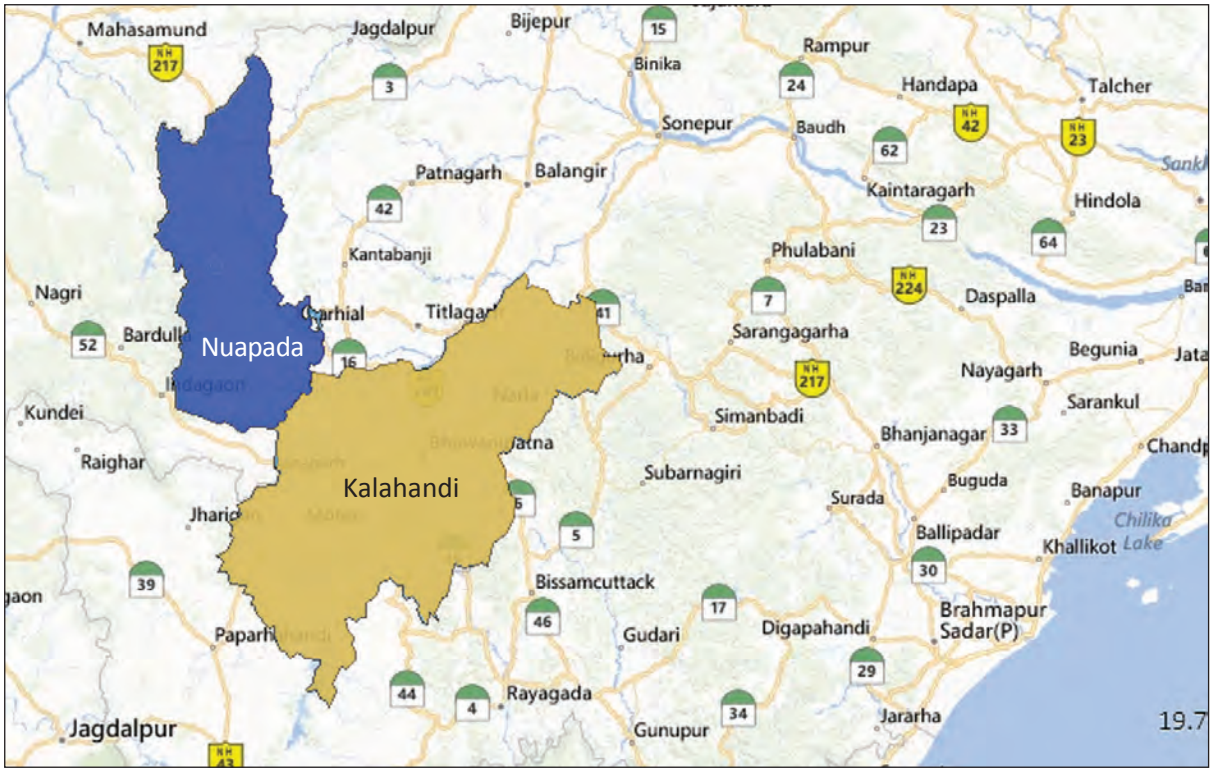


Figure 13. Map of project sites for godown structures.

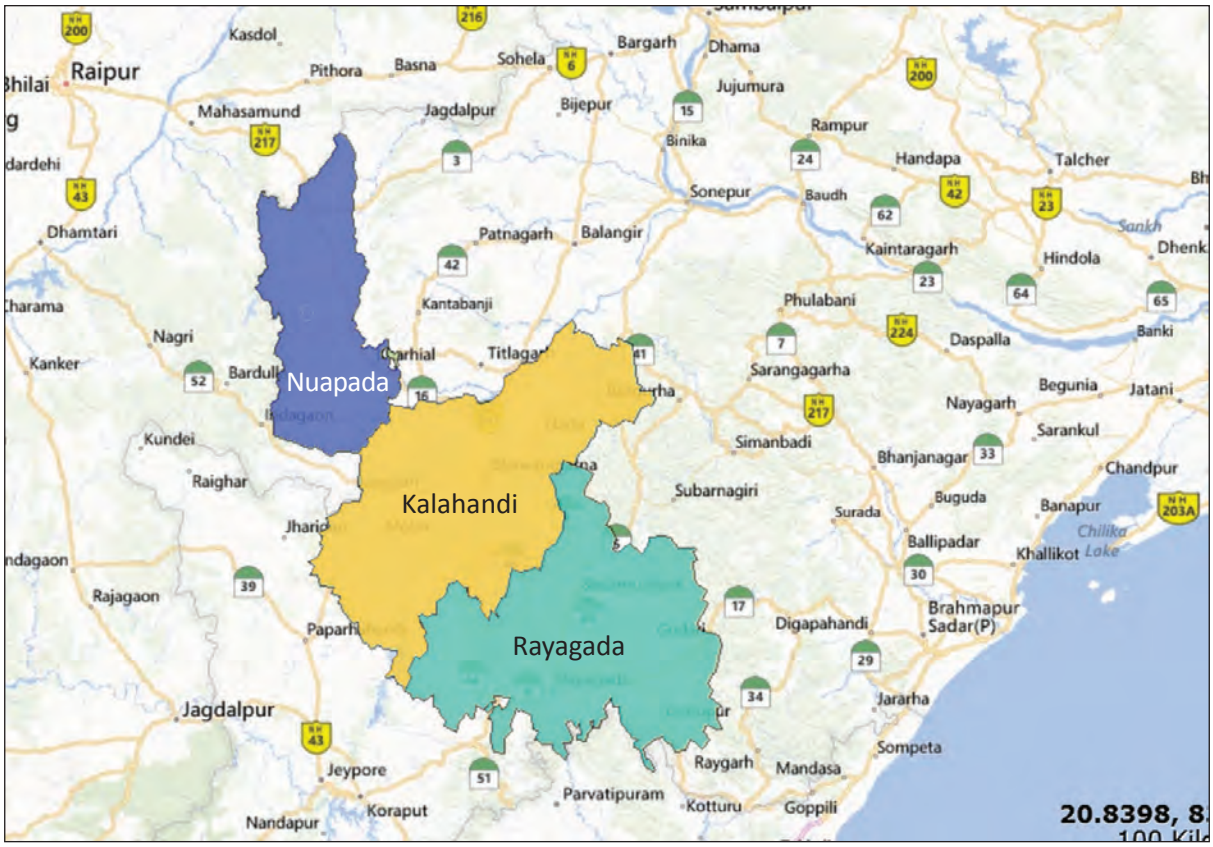


Figure 14. Map of project sites for dal *mill.*

4.1 Socio-demographic information

Age group for godown-respondents is in the range of 25-44 years. For *dal* mill-respondents, one in each category of age range (18-24, 25-44 and 45-64) was interviewed. All are male, majority of them are married, and with education above Standard 10 for godown respondents and between Standards 6-10 for *dal* mill-respondents. They are not members of any organization due to inadequate resources specifically cash to save.

4.2 Farming resources

Farm size. Farm size of farmer-respondents under this component are mostly marginal (less than 1.01 ha) to small (1.01-2.0 ha). Most rely on rainfall with a few having access to borewells.

Sources of agri-information. ICRISAT staff members are a major source of agri-information followed by the DoA and other media sources such as newspapers and television.

Livestock resources. A majority of them own livestock, specifically cow, which is their source of milk and draught power.

***Gender participation*.** According to godown respondents, female participation is mostly in planting/sowing, cleaning of seeds, threshing, weeding and *dal* preparation.

Among *dal* mill respondents, women participation is provided in oil and water mixing, drying the newly processed *dal*, and in packing.

Some of the most common activities of the female group are as follows: In Kalahandi, activities include cleaning harvested pigeonpea, *dal* conditioning by treating with oil and water, drying these under the sun, packing and storage. Men of this district are responsible for transport to storage room or to *dal* mills, and marketing.

In Rayagada, the activities involve making nutrition powder (*chatua*), vegetable cultivation, and assisting in the Anganwadi center. Men, on the other hand, do marketing and communication-related activities.

4.3 Benefits

Respondents appreciated that *dal* mills and godowns are part of the project. These have been found to be very helpful like the *dal* mill for processing their raw seeds into *dal*, which contributed to higher profit. They also expressed future expansion of this initiative.

The godown operators expressed the importance of this structure. However, maintenance is required and the need for assigning a watchman.

Technologies adopted

Among *dal* mill-respondents, they have been trained in different technologies for *dal* processing by the ICRISAT-DoA Govt of Odisha pigeonpea project. Table 50 shows the specific technologies adopted by them. In Nuapada, an important information learned (which is not a technology) is linking them to banks for financial support in the purchase of pigeonpea seeds and to local markets.

Table 50. Specific technologies adopted in *dal* processing.

District	Technologies
Kalahandi	Cleaning of raw pigeonpea seeds *Dal* processing Conditioning Grinding Polishing Bagging, stitching and storing
Rayagada	Spiral separator Drying and oiling *Dal* processing Grinding Polishing
Nuapada	Linkage to banks for financial support in the purchase of pigeonpea seeds and to local markets

Problems and constraints

Dal mill respondents have an array of constraints like operation, marketing, and on other issues as shown in Table 51. There is an expression of high cost of diesel for its operation and financial issue in Kalahandi for which they need ICRISAT support, and unavailability of machine parts and no market linkage in Rayagada.

Among godown respondents, maintenance is required and as mentioned earlier the need for a regular watchman.

Table 51. Problems and constraints of godown and *dal* mill.

		Kalahandi (n=1)		Nuapada (n=1)		Rayagada (n=1)	
Particulars		%	No.	%	No.	No.	%
Godown	1. Maintenance required	1	100	-	-		
	2. Need regular watchman	1	100	-	-	-	-
Dal mill	1. High cost of diesel	1	100	-	-	-	-
	2. Unavailability of machine parts	-	-	-	-	1	100
	3. No market linkage	-	-	-	-	1	100
	4. Financial issue	-	-	1	100	-	-
	5. No training/awareness	-	-	-	-	1	100
	6. Need ICRISAT support	-	-	1	100	-	-

Assessment to other project support

While many respondents said that community consultation was done during project inception and its various components such as project meetings, workshops and farmer training courses, there were also those who said this was not done. The various IEC strategies like printed materials, specifically the booklet on cultural management practices of pigeonpea and integrated disease and pest management availed of by most respondents were regarded important.

Suggestions to sustain the project

Among the suggestions made by godown operators are: the provision for marketing facility and small storage godown for storing raw materials safely, and some knowledge to improve their marketing skills.

For *dal* mill respondents, ICRISAT should introduce more number of high yielding varieties or hybrids of short and long duration types for more choices to suit their environment and especially the location of their farms and soil types.

5.0 Overall project benefit

The adoption of improved technologies like improved pigeonpea varieties (ICPL 14002 and ICPL 14001) and recommended technologies such as timely application of fertilizer and insecticide, line sowing in ridges, weeding, and intercropping led to significant improvement in yield and income. In addition to these technologies, support to enhance capacity of key stakeholders especially farmers has facilitated adoption of technologies. Table 52 shows that over a period of almost two years, approximately 6,683 individuals have been trained on various topics of pigeonpea cultivation. These include not only farmers but also technical staff directly involved in the project from DoA Govt of Odisha and NGO partners.

Another important aspect is the measure on investment gain of the project, which provides a snapshot of the project performance. Result on the calculation of investment in the project specifically for IPPT and SP showed a robust investment gain calculated at 308% from the ₹ 45 million investment of the project or about four times increased (Table 53).

Table 52. Training of key stakeholders (2011-2012).

Year	Particular	District (No.)	Participant (No.)	Women (No.)	Remarks
2011	Project meeting cum workshop		25	-	OUAT, DoA, NGOs, ICRISAT staff
	Project presentation meeting		60	5	DoA officers and technicians, and ICRISAT staff
	Project orientation cum training		50	3	NGOs, ICRISAT staff, and DoA officers
	Project launching cum training workshop	3	16	1	NGOs, ICRISAT staff, and DoA officers and technicians
	Project orientation meeting seminar	4	278	10	DoA officers and technicians, NGOs, farmers (Kalahandi, Rayagada and Nuapada)
	First international training course on pigeonpea seed production and management	3	11	-	ICRISAT staff, DoA officers and technicians
	Farmers' training program	3	195	11	IPM and IDM
	Farmers' field day	2	1,248	56	Farmers (Kalahandi & Nuapada)
Sub-total			1,883	86	
2012	Project orientation and planning workshop	5	65	1	NGOs, ICRISAT staff, and DoA officers and technicians
	Capacity building training cum-exposure visit of seed certification personnel and seed entrepreneurs of Odisha		13		OSSOPCA officers and private seed company
	Pigeonpea seed production and management training	3	90	10	Technicians of Kalahandi, Rayagada and Nuapada
	ICRISAT-ICAR international training course on high throughput phenotyping of chickpea and pigeonpea		3		ICRISAT staff and DoA officers
	Hybrid seed production and management training for farmer seed growers	2	35		Technicians of Kalahandi and Nuapada
	Training cum field exposure on pigeonpea seed production	5	19	1	Field assistants, DoA officers and ICRISAT staff
	Farmers' specialized training program	5	553	4	Pigeonpea awareness, IPM/IDM and cultural management
	Dal mill training	3	38	14	Rayagada, Nuapada and Kalahandi
	Farmers' awareness meetings	5	3,663	785	Farmer beneficiaries
	Farmers' field day	2	324	53	Farmers (Kalahandi and Nuapada)
Sub-total			4,800	868	
Total			6,683	954 (14%)	

OUAT - Orissa University of Agriculture and Technology; OSSOPCA - Orissa State Seed & Organic Product Certification Agency
ICAR - Indian Council for Agricultural Research; IPM - Integrated Pest Management; IDM - Integrated Disease Management

Table 53. Project investment gain.

Year	Proj invest'nt (₹)	Proj com	Area (ha) Target	Area (ha) Actual	No of farmers	Total yield (kg)	Avg price (₹/kg)	Total value of prod'n (₹)
2011	21,000,000	IPPT	2,000	2,102	5,718	572,000	45	25,740,000
		SP	1,000	1,000	1,667	318,000	70	22,260,000
2012	24,000,000	IPPT	4,000	4,070	6,353 (385 F)	2,102,000	45	94,590,000
		SP	1,262	1,300	1,437 (67 F)	590,000	70	41,300,000
Total	45,000,000		8,262	8,472	15,175 (452 F)	3,582,000		183,890,000 (308%)

6.0 Seed system model

The problem of poor quality seeds that has been highlighted by the farmer-respondents in the project's first year of operation led to the conceptualization of a seed system model by ICRISAT. The good amount of quality seeds produced, as claimed by farmers and implementers, show that stakeholders involved in the model have properly executed their roles and obligations. This has been a key factor in the success of the project in its succeeding year. As gleaned from Figure 15, engaging selected farmers within a village to do SP was beneficial in having a sustainable source of quality seeds. Seed growers have produced substantial amount of quality seeds. Under the watchful eye of Odisha State Seed & Organic Product Certification Agency (OSSOPCA), seeds produced have undergone certification. These have been the source of planting materials utilized in the succeeding years of the project till date, which have significantly contributed to better yield and income among farmers involved in and outside project sites (Refer to Tables 10, 11, 12, 20, 21, 22, 29 and 43).

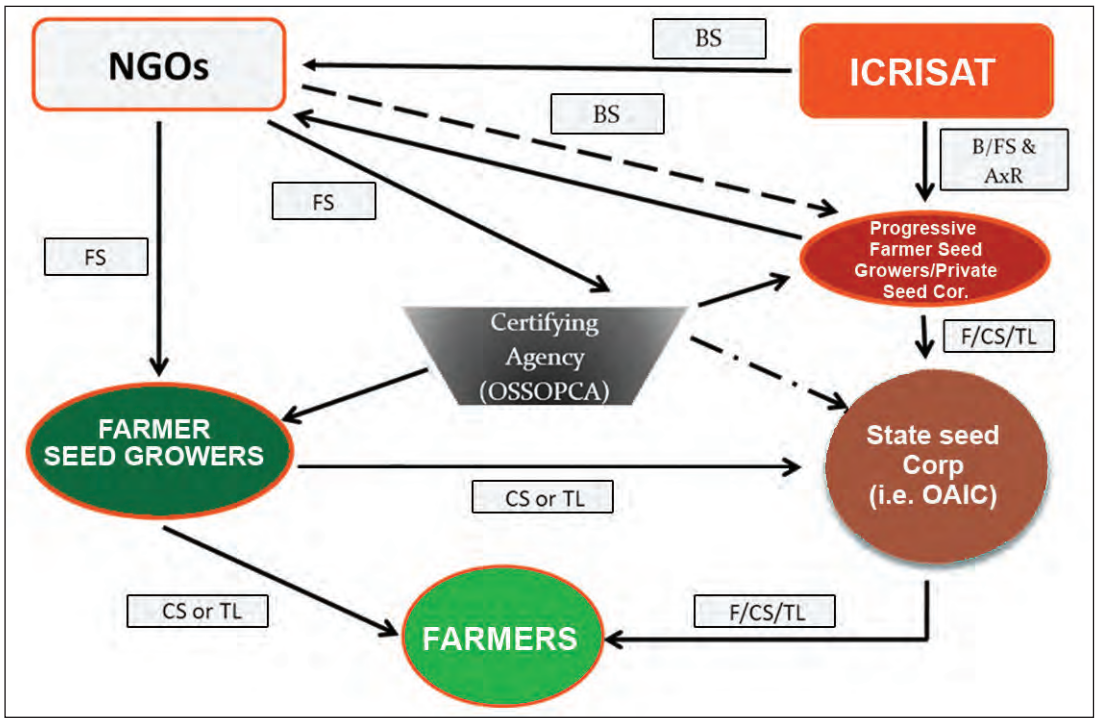


Figure 15. Seed system model.

The project has proven that local SP is possible and could be a lucrative enterprise for local farmers. However, the critical aspect of the entire value chain is a ready market to absorb the produce. The current situation on this is that the project can only purchase its seed requirement. Considering the volume of production, a program has to be in place to absorb the excess seeds produced for distribution to farmers within Odisha and even to adjoining states. The DoA Govt of Odisha should take this lead and be responsible for ensuring market availability. Personal interviews from farmer-respondents claim local seed traders coming from outside their districts and even outside Odisha, which implies the existence of demand and the need for an assured market in order for local seed producers to obtain a fair market price. This is a clear case of the need to consider not only pre-production essentials but also post-production, which determines the viability of any farming intervention.

7.0 Projection of pigeonpea area and production for year 2015 and 2020

The result of the assessment done on the current pigeonpea project in Odisha, specifically in the five districts, is very encouraging. There is a significant increase in net income as shown in the before and after estimation with the highest BCR of 1:4.12 in Rayagada (Tables 10 & 11) in the report. Even farmers who are not direct participants of the project, have shown significant BCR ranging from 1: 1.63 to 3.58 (Tables 20 & 21).

As an attempt to determine the future of pigeonpea production in the five districts, Table 54 shows the projections in area and yield for years 2015 and 2020. Projection for Boudh and Rayagada in terms of area and yield shows an increasing trend in both years (Figure 16). This is not surprising considering the sloping landscape of the areas and high dependency on rainfall. These explain the farmers' inability to diversify with other crops, hence, improving on their pigeonpea production system is their best bet option.

Table 54. Projected area and yield for pigeonpea for years 2015 and 2020.

Area (Thousand Hectares)

			Projection in:	
District	1990 - 2007 Area	CAGR*	2015	2020
Bolangir	9.19	-0.02	7.35	6.65
Boudh	4.80	0.05	6.51	8.17
Kalahandi	13.25	-0.03	11.01	9.39
Nuapada	5.87	-0.04	4.40	3.66
Rayagada	20.89	0.01	23.73	25.40

Production (Thousand Tons)

			Projection in:	
District	1990 – 2007 Prod'n	CAGR*	2015	2020
Bolangir	6.78	-0.01	6.43	6.03
Boudh	3.27	0.04	4.21	5.07
Kalahandi	13.18	-0.02	11.99	10.76
Nuapada	4.82	-0.01	3.82	3.60
Rayagada	19.34	0.01	19.58	20.70

*Compound Annual Growth Rate

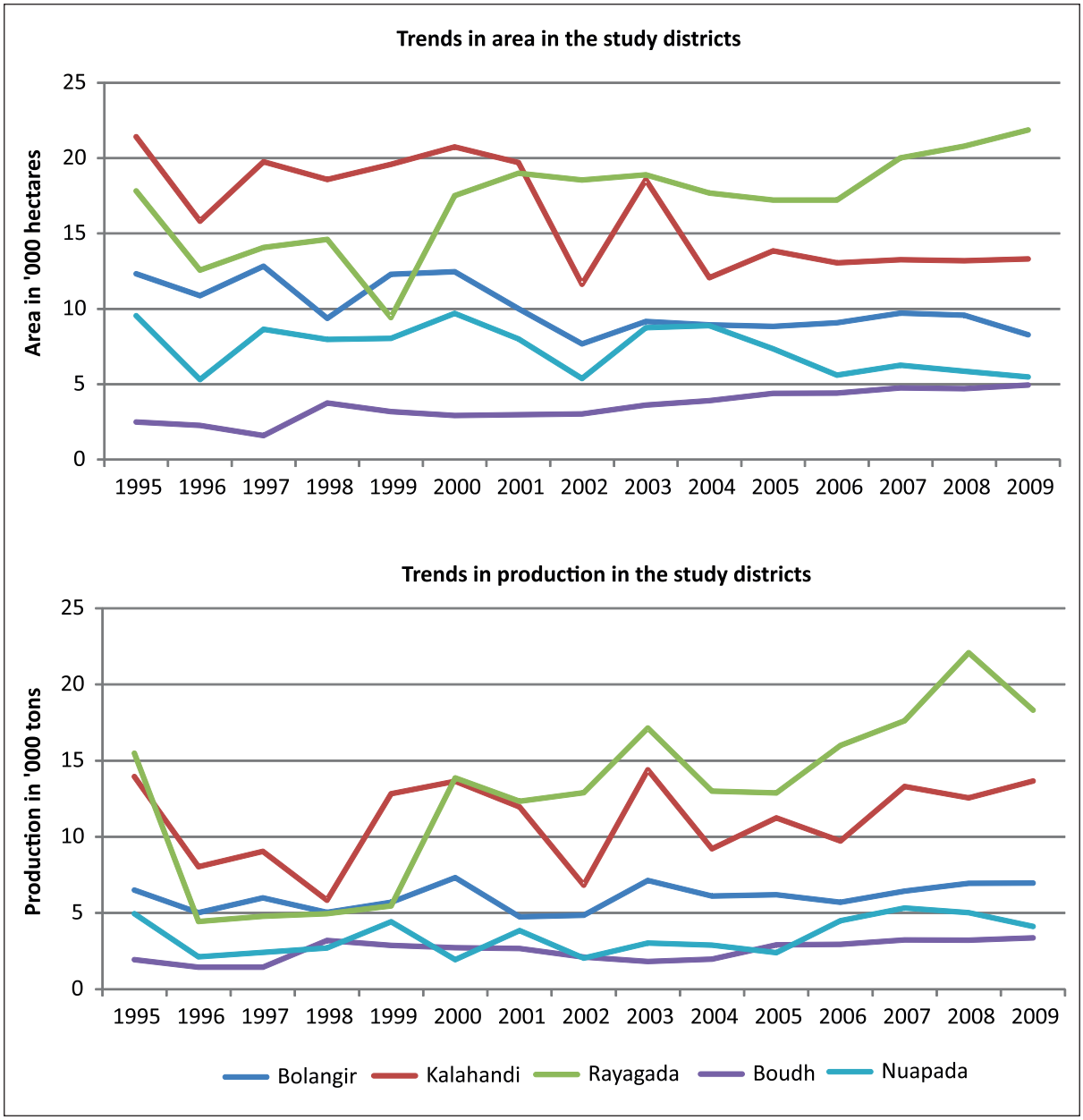


Figure 16. Area and production trends of pigeonpea in study districts.

For Bolangir, Kalahandi and Nuapada districts, area-wise pigeonpea cultivation will decrease. Several reasons may explain this scenario. One reason for projected decline in area of cultivation might be the availability of good rainfall, which will allow farmers to shift to other cash crops. Another might be the improved irrigation system in the region that may also contribute to a shift towards other crops. However, knowledge gained such as improved varieties and cultural management practices in the current ICRISAT-DoA Govt of Odisha pigeonpea project will be able to provide solutions for stable production in these districts.

Summary and Conclusion

The project 'Introduction and Expansion of Improved Pigeonpea (*Arhar*) Production Technology in Rainfed Upland Ecosystems of Odisha' was implemented in 2011 for a period of four years. To harness the potential of rainfed upland ecosystem, this calls for a science-led farmer centric approach. The project was farmer-driven, farmer-implemented, and farmer-owned and the researchers and extension agents played a catalytic and guiding role through the provision of technical options to farmers and helped them to make appropriate choices.

Summary

Research results reveal that the pigeonpea project was successful in achieving its initial goals, namely, to evaluate and identify newly developed high-yielding disease resistant varieties and hybrids of pigeonpea for further introduction and expansion; promote cultivation of high-yielding pigeonpea varieties and hybrids in the marginal soils; develop village-level seed delivery systems to achieve self-sufficiency in seed of farmer-preferred improved varieties and hybrids of pigeonpea; conduct capacity building of farmers, NGOs, and SHGs in sustainable pigeonpea production; enhance profitability by linking production with *dal* processing and marketing; and providing research backstopping. The detailed report provides in-depth information about the activities conducted, the results obtained as well as the lessons learnt in the form of constraints faced during project implementation. This information helps in targeting specific areas for improving the delivery of the project and future engagements either of ICRISAT or DoA Govt of Odisha.

Conclusion

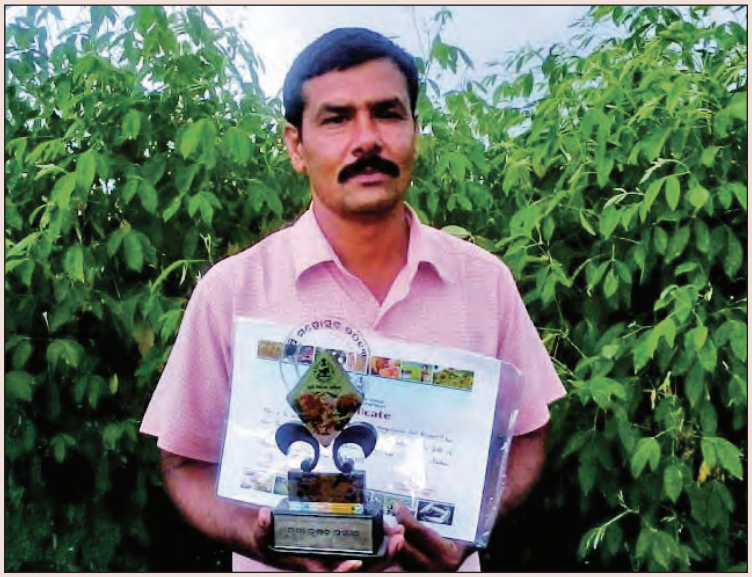
The study determined the extent of adoption of pigeonpea package of technologies by farmers of the five districts of Odisha. Technologies consisted of high yielding varieties (and partly hybrids) and cultural management practices. It also determined the gaps, constraints, and lessons for improving the delivery of interventions and activities including seed delivery system, capacity building, linking to production with *dal* processing and marketing and eliciting information on critical areas and suggestions for long term sustainability of the project outcomes/impacts.

In line with the above objectives, the following observations were made based on the two-year phase of the project life cycle. Below are the significant milestones of the assessment study for highlighting the importance of the pigeonpea project in the five districts and its scalability to other rainfed areas of Odisha.

The study was carried out in areas with a wide socio-demographic mixture with people ranging from all age groups, gender, marital status and educational qualifications. Increased women participation was noticed as part of the project activities. The women participants learned line sowing as well as improved seed storage practices and at the same time participated in various cultural management practices. The respondents were introduced to a number of technologies that were not practiced earlier, like introduction of new high yielding varieties (medium duration

ICPL 14002 and ICPL 14001and even some hybrids), seed rate, application of fertilizer (100 kg DAP/ha), application of insecticide, weeding, intercropping and line sowing. It was found that the respondents were benefitted with the introduction of these technologies and a positive result was obtained in their response. A distinct/noticeable increase was seen in the productivity by at least 70% and in net income by at least 170-190% (average IPPT, ₹11,549–28,422/ha; FPVST, ₹15,499–20,763/ha; SP, ₹17,428– 58,148/ha) of the respondents after the adoption of the aforementioned technologies in the management practices of pigeonpea. A case in point is Mr Pradeep Kumar Panda, who participated in the ICRISAT-Rashtriya Krishi Vikas Yojana (RKVY) Scheme, seed production program in 2012 and earned a net profit of ₹ 165,000 from cultivating ICPL 14001 of pigeonpea on 5 ha of land.

Pigeonpea enables best farmer award



Mr Pradeep Kumar Panda, a progressive farmer of Antamoda village, Kolnara block, District Rayagada in Odisha, lives with his wife and son in a joint family with 5 other members, and owns 17 hectares of land on which he cultivates paddy, cotton, pigeonpea and maize. In the year 2012, under the ICRISAT-Rashtriya Krishi Vikas Yojana (RKVY) Scheme, seed production program, Pradeep Kumar Panda cultivated pigeonpea of the ICPL 14001 on 5 ha of his land. He had sown seeds in a line with ridges and spacing of 90 cm × 75 cm. Using the prescribed methodology correctly, he applied fertilizers on time (100 kg DAP/ha). To control pest infestation, he had applied pesticides (Trizophus, Dimethyl Dichloro-Vinyl Phosphate (DDVP) and Confider) four times. Besides this, he followed all the other intercultural practices such as weeding, earthing up, thinning etc, properly and at the correct time.

From this land Panda harvested 6500 kg of seeds, approximately 1300 kg per hectare, more than double that of local varieties, where yield is hardly 500-600 kg/ha. He sold his produce at a cost of ₹5300 per 100 kg to the Odisha Agro Industries Corporation, earning ₹344,500, whereas the local variety would have fetched a market price of ₹3000-3500 per 100 kg. His total expenditure was ₹180,000, so he got a net profit of ₹165,000. In previous years, Panda had cultivated the local pigeonpea variety and cotton on this land. He recalls that he hardly ever earned more than ₹15,000/ha from both these crops, but from this new improved variety of pigeonpea, he made a profit of ₹30,000/ha. From this profit he bought a bike and deposited the rest in the bank.

For this result and achievement, Panda got the Best Farmer Award of the district in the month of January 2013, and received a prize of ₹5000. Besides this, he also got a prize of ₹15,000 in the state level agriculture fair in the month of March, with a certificate from the State Agriculture Department. Panda is proud and happy with his success, and for the following season he has planned to cultivate an area of 14 ha with the ICPL 14001 (Breeder). Learning of Panda's success, other farmers are also interested in cultivating around 16 ha of this crop in their fields.

To make the project stronger and to achieve better results in future the respondents were also asked to give a feedback on the major factors/constraints in the delivery of the various pigeonpea technologies. The respondents actively participated in this activity and pointed out the factors/ constraints they are faced with. Some of these are: pests and diseases, lack of inputs, lack of labor, no market linkage, lack of information, etc. A large number of capacity building activities like meetings, workshops, orientations cum training, farmers' specialized training courses and field demonstrations were conducted as part of project activities but still, some claim not being aware of these opportunities while others said they did not have the time to participate in the activities. IEC materials in the form of booklets, posters, coverage on local radio and television stations were made available to the farmers and according to the survey these proved to be very useful for the farmers.

In order to make the pigeonpea project sustainable, the respondents were asked to give suggestions on what improvements should be done to maintain its long term sustainability. The respondents participation was positive and responses received included the need for support required for some agri inputs like fertilizers, sprayers and pesticides; appropriate technologies like line sowing; more training and exposure visits; regular meetings for updates and feedback; better marketing facilities and linkages; and good seed system.

On the whole, the results obtained till date are very positive and the suggestions are under consideration and will be implemented accordingly with support from other stakeholders. The positive achievements of the project brings to light the need for continuous and increased support for the project not only because of the current investment gain but also due to projected increase in production especially in Rayagada and Boudh in the next year and even in year 2020.

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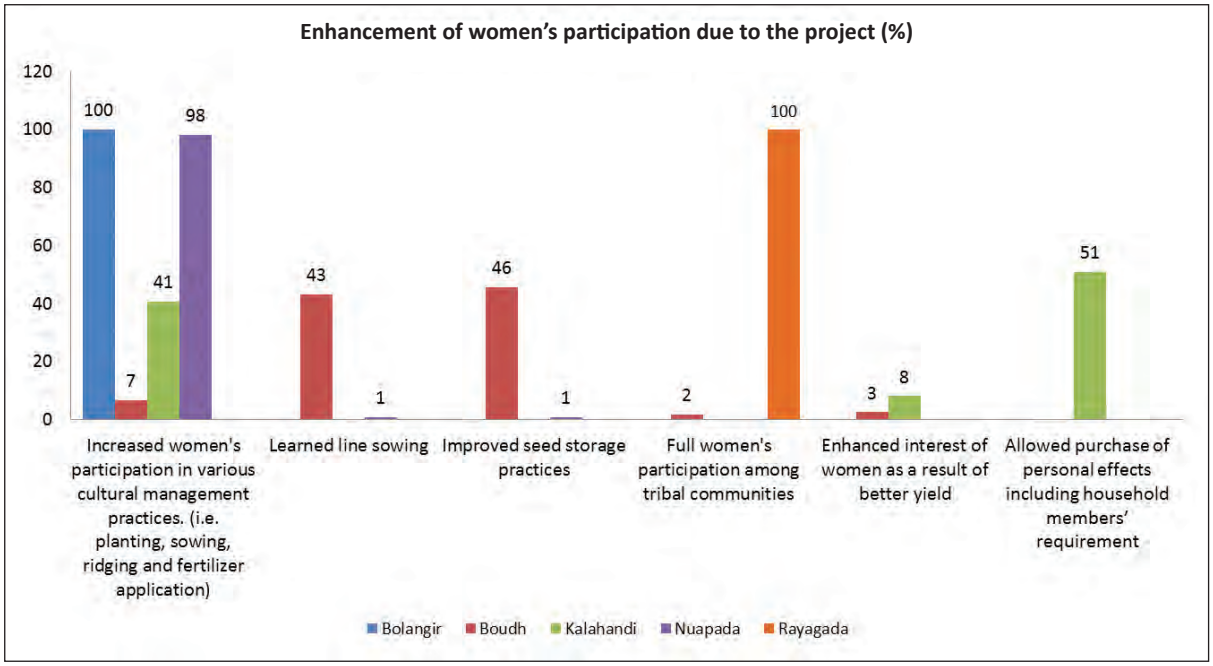
Annexure

Annex 1. Enhancement of women's participation due to the project (IPPT).



Annex 2. Sufficiency of community participation during project inception (IPPT).

	Bolangir (n=106)		Boudh (n=67)		Kalahandi (n=153)		Nuapada (n=216)		Rayagada (n=103)	
Particulars	No.	%	No.	%	No.	%	No.	%	No.	%
Sufficient community consultation										
Yes	71	67	50	75	17	11	69	32	99	96
Partial	3	3	2	3	113	74	106	49	-	-
Not at all	-	-	-	-	5	3	20	9	3	3
No response	32	30	15	22	18	12	21	10	1	1
1. Selection of sites										
Yes	106	100	67	100	152	99	205	95	102	99
No	-	-	-	-	1	1	11	5	-	-
No response	-	-	-	-	-	-	-	-	1	1
2. Selection of farmers										
Yes	106	100	67	100	148	97	203	94	102	99
No	-	-	-	-	4	3	11	5	-	-
No response	-	-	-	-	1	1	2	1	1	1
i. Selection of seeds - Varieties										
Yes	63	59	67	100	152	99	197	91	103	100
No	43	41	-	-	1	1	15	7	-	-
No response	-	-	-	-	-	-	4	2	-	-
ii. Selection of seeds- Hybrids										
Yes	-	-	-	-	-	-	16	7	4	4
No	32	30	-	-	151	99	39	18	-	-
No response	74	70	67	100	2	1	161	75	99	96

Continued

Annex 2. Sufficiency of community participation during project inception (IPPT) *continued*.

	Bolangir (n=106)		Boudh (n=67)		Kalahandi (n=153)		Nuapada (n=216)		Rayagada (n=103)	
Particulars	No.	%	No.	%	No.	%	No.	%	No.	%
3. Conduct of baseline of target districts										
Yes	105	99	15	22	21	14	66	31	90	87
No	1	1	-	-	132	86	139	64	-	-
No response	-	-	52	78	-	-	11	5	13	13
4. Demonstrations using locally available implements/materials										
Yes	56	53	15	22	121	79	186	86	89	86
No	50	47	-	-	29	19	25	12	-	-
No response	-	-	52	78	3	2	5	2	14	14
5. Conduct of experiments										
Yes	13	12	2	3	2	1	143	66	4	4
No	93	88	2	3	150	98	33	15	-	-
No response	-	-	63	94	1	1	40	19	99	96
6. Conduct of farmers training										
Yes	75	71	-	-	121	79	187	87	100	97
No	31	29	3	4	30	20	17	8	-	-
No response	-	-	64	96	2	1	12	6	3	3
7. Conduct of specialized courses										
Yes	13	12	-	-	71	46	96	44	16	16
No	93	88	3	4	71	46	99	46	-	-
No response	-	-	64	96	11	7	21	10	87	84
8. Conduct of SHG training										
Yes	6	6	-	-	49	32	82	38	4	4
No	99	93	-	-	95	62	89	41	-	-
No response	1	1	67	100	9	6	45	21	99	96
9. Preparation of IEC materials										
Yes	98	92	8	12	47	31	185	86	17	17
No	8	8	4	6	93	61	19	9	-	-
No response	-	-	55	82	13	8	12	6	86	83
10. Purchase of requirements										
Yes	19	18	5	7	2	1	98	45	15	15
No	87	82	-	-	133	87	90	42	1	1
No response	-	-	62	93	18	12	28	13	87	84
11. Construction of infra facilities (godown, seed storage, etc)										
Yes	16	15	1	1	-	-	161	75	4	4
No	88	83	5	7	143	93	40	19	-	-
No response	2	2	61	91	10	7	15	7	99	96
12. Others (self-storage of seed, etc)										
Yes	-	-	-	-	-	-	43	20	4	4
No	106	100	67	100	153	100	173	80	99	96

Annex 3. Information, education and communication (IEC) materials availed of by respondents (IPPT).

Location	Particulars	%	Remarks
Bolangir (n=106)	Booklet on cultural management practice of pigeonpea	100	• Learnt about pigeonpea cultivation and line sowing (48%) • Good initiative of the project especially with Oriya translation (52%)
	Integrated disease & pest management booklet	100	• Obtained information on pesticide application (51%) • Good for following technologies (49%)
	Coverage of local radio stations	6	• Provided good information in farming (6%)
	Coverage of local television stations	66	• Provided information in farming (4%) • Increased peoples' awareness (62%)
	Posters	97	• Benefited from pigeonpea cultivation specifically in line sowing (28%) • Provided information in farming (3%) • Increase peoples' awareness (66%)
Boudh (n=67)	Booklet on cultural management practice of pigeonpea	98	• Gained more knowledge on improved methods of cultivation and line sowing practices (15%) • Provided information on line sowing in pigeonpea cultivation and other related technologies (79%) • Good initiative of the project especially the Oriya translated materials (4%)
	Integrated disease & pest management booklet	98	• Gained more knowledge on effective methods of insect/pest control measures in pigeonpea (52%) • Suggested to provide the materials in local language, then it will be easy to understand the information (46%)
	Posters	72	• One good idea to provide the information to farmers especially for those who are unable to read (72%)
	Others		• In the rural area, people are illiterate so illustrated materials are important. Electronic media are not also appropriate. Village meetings and other face-to-face forms are important (73%)
Kalahandi (n=153)	Booklet on cultural management practice of pigeonpea	94	• Provided more knowledge on various technologies (94%)
	Integrated disease & pest management booklet	12	• Helped in effective control of pests/insects (12%)
	Local print	62	• Read about *arhar* seed production in local newspaper (62%)
	Coverage of local television stations	86	• Read about advanced *arhar* seed production in local newspaper (2%) • Seen a topic on improved production technology of *arhar* (21%) • Got visual information about the crop (63%)

Continued

Annex 3. Information, education and communication (IEC) materials availed of by respondents (IPPT) *continued*.

Location	Particulars	%	Remarks
Nuapada (n=216)	Booklet on cultural management practice of pigeonpea	65	• Provided information on line sowing (8%) • Gained more knowledge on improved methods of cultivation and line sowing practices for more success (32%) • Knew about *arhar* cultivation, disease and pest control (3%) • Learned about pesticide usage and fertilizer application provided by ICRISAT & SVA (22%)
	Integrated disease & pest management booklet	51	• Booklet is informative (13%) • Gained deep knowledge on effective insect/pest management (33%) • Learned about the disease in pigeonpea cultivation and growing technique of line sowing (1%) • Received copies from ICRISAT and SVA (2%) • Knew about *arhar* cultivation, disease and pest control (2%)
	Coverage of local radio stations	4	• Good Information about farming (3%) • Line sowing (1%)
	Coverage of local television stations	22	• Not provided (19%) • Provided important information on pigeonpea production system (3%)
	Posters		• *Hardara Chasara Lava Aneka* poster (1%) • Learned about pesticide use (30%) • Learned line sowing and use of fertilizer through poster by ICRISAT and SVA (13%) • Provided by ICRISAT and SVA (2%)
Rayagada (n=103)	Booklet on cultural management practice of pigeonpea	98	• Provided information on line sowing in pigeonpea cultivation (96%) • Learnt about usage of pesticide and fertilizer application (2%)
	Integrated disease & pest management booklet	98	• Gained deep knowledge on effective insect/pest management (98%)
	Local print & electronic media	100	• Visible impact of various methods i.e line sowing, pest management, seed treatment (100%)
	Coverage of local television stations	3	• Got visual information about the crop (3%)
	Others	82	• Rayagada is a backward district in the state of Odisha. Only 25% of people are educated. In the rural area, they suggested that village meeting to create awareness is important (82%)

Annex 4. Sufficiency of community participation during project inception (FPVST).

	Bolangir (n=1)		Kalahandi (n=4)		Nuapada (n=5)		Rayagada (n=2)	
Particulars	No.	%	No.	%	No.	%	No.	%
Sufficient community consultation								
Yes	1	100	-	-	4	80	2	100
Partial	-	-	2	50	1	20	-	-
Not at all	-	-	1	25	-	-	-	-
No response	-	-	1	25	-	-	-	-
1. Selection of sites								
Yes	1	100	4	100	5	100	2	100
2. Selection of farmers								
Yes	1	100	4	100	5	100	2	100
i. Selection of seeds - Varieties								
Yes	1	100	4	100	5	100	2	100
ii. Selection of seeds - Hybrids								
Yes	-	-	2	50	3	60	2	100
No	-	-	2	50	2	40	-	-
No response	1	100	-	-	-	-	-	-
3. Conduct of baseline of target districts								
Yes	1	100	2	50	4	80	-	-
No	-	-	2	50	1	20	-	-
No response	-	-	-	-	-	-	2	100
4. Demonstrations using locally available implements/materials								
Yes	1	100	1	25	5	100	-	-
No	-	-	3	75	-	-	-	-
No response	-	-	-	-	-	-	2	100
5. Conduct of experiments								
Yes	-	-	-	-	4	80	-	-
No	1	100	4	100	1	20	-	-
No response	-	-	-	-	-	-	2	100
6. Conduct of farmers training								
Yes	1	100	4	100	5	100	1	50
No	-	-	-	-	-	-	-	-
No response	-	-	-	-	-	-	1	50
7. Conduct of specialized courses								
Yes	-	-	-	-	1	20	1	50
No	1	100	4	100	4	80	-	-
No response	-	-	-	-	-	-	1	50
8. Conduct of SHG training								
Yes	-	-	-	-	-	-	-	-
No	1	100	4	100	5	100	-	-
No response	-	-	-	-	-	-	2	100

Continued

Annex 4. Sufficiency of community participation during project inception (FPVST) *continued*.

	Bolangir (n=1)		Kalahandi (n=4)		Nuapada (n=5)		Rayagada (n=2)	
Particulars	No.	%	No.	%	No.	%	No.	%
9. Preparation of IEC materials								
Yes	1	100	4	100	5	100	-	-
No	-	-	-	-	-	-	-	-
No response	-	-	-	-	-	-	2	100
10. Purchase of requirements								
Yes	1	100	2	50	3	60	-	-
No	-	-	2	50	2	40	-	-
No response	-	-	-	-	-	-	2	100
11. Construction of infra facilities (godown, seed storage, etc)								
Yes	1	100	1	25	3	60	-	-
No	-	-	3	75	2	40	-	-
No response	-	-	-	-	-	-	2	100
12. Others (Self seed storage, etc)								
Yes	-	-	-	-	-	-	-	-
No	1	100	4	100	5	100	-	-
No response	-	-	-	-	-	-	2	100

Annex 5. Information, education and communication (IEC) materials availed of by respondents (FPVST).

Location	Particulars	%	Remarks
Bolangir (n=1)	Booklet on cultural management practice of pigeonpea	100	• Helped farmer in proper cultivation practices of pigeonpea (100%)
	Integrated disease & pest management booklet	100	• Helped in effective pest control in pigeonpea (100%)
	Coverage of local TV stations	100	• Learnt important program about pigeonpea cultivation (100%)
	Posters	100	• Read the poster (*Harada Chashare Labha Aneka*) and got information on pigeonpea (100%)
Kalahandi (n=4)	Booklet on cultural management practice of pigeonpea	75	• Very useful (75%)
	Integrated disease & pest management booklet	100	• Very useful (25%) • No response (75%)
Nuapada (n=5)	Booklet on cultural management practice of pigeonpea	100	• It helped farmer in proper cultivation practices of pigeonpea (20%) • Got information on line sowing, harvesting, etc (60%) • Helped in proper cultivation practices in pigeonpea (20%)
	Integrated disease & pest management booklet	100	• Helped in effective pest control in pigeonpea (100%)
	Posters	100	• Farmer know about pigeonpea cultivation through poster (100%)
Rayagada (n=2)	Booklet on cultural management practice of pigeonpea	100	• Helped in proper cultivation practices in pigeonpea (100%)
	Integrated disease & pest management booklet	100	• Helped in effective pest control in pigeonpea (100%)

Annex 6. Sufficiency of community participation during project inception (SP).

	Kalahandi (n=44)		Nuapada (n=102)		Rayagada (n=15)	
Particulars	No.	%	No.	%	No.	%
Sufficient community consultation						
Yes	1	2	48	47	15	100
Partial	32	73	52	51	-	-
Not at all	2	5	1	1	-	-
No response	9	20	1	1	-	-
1. Selection of sites						
Yes	44	100	102	100	15	100
2. Selection of farmers						
Yes	44	100	102	100	15	100
i. Selection of seeds - Varieties						
Yes	43	98	98	96	14	93
No	-	-	4	4	-	-
No response	1	2	-	-	1	7
ii. Selection of seeds - Hybrids						
Yes	1	2	5	5	-	-
No	43	98	94	92	1	7
No response	-	-	3	3	14	93
3. Conduct of baseline of target districts						
Yes	3	7	65	64	-	-
No	41	93	37	36	-	-
No response	-	-	-	-	15	100
4. Demonstrations using locally available implements/materials						
Yes	36	82	102	100	-	-
No	8	18	-	-	-	-
No response	-	-	-	-	15	100
5. Conduct of experiments						
Yes	1	2	57	56	-	-
No	43	98	44	43	-	-
No response	-	-	1	1	15	100
6. Conduct of farmers training						
Yes	32	73	101	99	15	100
No	12	27	1	1	-	-
7. Conduct of specialized courses						
Yes	28	64	66	65	15	100
No	16	36	36	35	-	-
8. Conduct of SHG training						
Yes	10	23	48	47	-	-
No	34	77	52	51	-	-
No response	-	-	2	2	15	100

Continued

Annex 6. Sufficiency of community participation during project inception (SP) *continued*.

	Kalahandi (n=44)		Nuapada (n=102)		Rayagada (n=15)	
Particulars	No.	%	No.	%	No.	%
9. Preparation of Information, education & communication (IEC) materials						
Yes	9	20	92	90	-	-
No	34	77	10	10	-	-
No response	1	2	-	-	15	100
10. Purchase of requirements						
Yes	12	27	63	62	-	-
No	30	68	39	38	-	-
No response	2	5	-	-	15	100
11. Construction of infra facilities (godown, seed storage, etc)						
Yes	-	-	85	83	-	-
No	43	98	17	17	-	-
No response	1	2	-	-	15	100
12. Others (self storage of seed, etc)						
Yes	-	-	8	8	-	-
No	43	98	94	92	-	-
No response	1	2	-	-	15	100

Annex 7. Information, education and communication (IEC) materials availed of by respondents (SP).

Location	Particulars	%	Remarks
Kalahandi (n=44)	Booklet on cultural management practice of pigeonpea	98	Very useful information (98%)
	Integrated disease & pest management booklet	13	Followed the guidelines to avoid insects attack (13%)
	Local print & electronic media	86	Read about improved *arhar* seed production in local newspaper (86%)
	Coverage of local radio stations	5	Listened to agri radio program sometimes (5%)
	Coverage of local television stations	86	Seen improved production technology of *arhar* (86%)
Nuapada (n=102)	Booklet on cultural management practice of pigeonpea	100	Received information on how to use pesticide and fertilizer and line sowing in pigeonpea cultivation (100%)
	Integrated disease & pest management booklet	94	Learned more about insect and pest management (85%) Helped in effective pest control & layout in pigeonpea (9%)
	Local print & electronic media	8	Technologies read worked effectively (8%)
	Coverage of local radio stations	7	Heard from the radio advertisement about pigeonpea cultivation (7%)
	Coverage of local television stations	4	Seen a program on pigeonpea (4%)
	Posters	98	*Harada Chasara Lava Aneka* (6%) Obtained more information about process and technologies of pigeonpea cultivation (92%)
Rayagada (n=15)	Booklet on cultural management practice of pigeonpea	100	Gained deep knowledge on improved methods of cultivation practices in pigeonpea for more yield (100%)
	Integrated disease & pest management booklet	100	Gained deep knowledge on effective methods of pest control in pigeonpea compared before (100%)
	Local print & electronic media	10	Obtained knowledge on new methodologies of pigeonpea production (10%)

Photo Documentation

(Photos: ICRISAT)

Seed distribution of pigeonpea seeds.

Land preparation for pigeonpea planting.

Intercropping of groundnut with pigeonpea.

Harvested pigeonpea transported by a woman farmer-respondent.

Drying of pigeonpea seeds.

Bagging of pigeonpea dried seeds.

Local trader buying seeds from farmers.

Meeting of ICRISAT implementers and DoA Govt of Odisha officials.

ICRISAT and DoA Govt of Odisha participants during the presentation of pigeonpea project accomplishment.

Farmers' meeting in one of the villages.

Focus group discussion with women in a village.

RP Mula of ICRISAT doing focus group interviews with local women.

Interview of local farmers by ICRISAT researchers.

ICRISAT team Drs CV Sameer Kumar, Myer G Mula and Rosana P Mula presenting update of the pigeonpea project and new proposals to Dr RS Gopalan, Director of DoA Govt of Odisha.

About ICRISAT

ICRISAT
Science with a human face

International Crops Research Institute for the Semi-Arid Tropics

CGIAR

ICRISAT is a member of the CGIAR Consortium

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, of whom 644 million are the poorest of the poor. ICRISAT innovations help the dryland poor move from poverty to prosperity by harnessing markets while managing risks – a strategy called Inclusive Market-Oriented Development (IMOD).

ICRISAT is headquartered in Patancheru near Hyderabad, Telangana, India, with two regional hubs and six country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

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