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Pigeonpea Baseline and Early Adoption Surveys in South Asia

Insights from TL-II (Phase 1) Project in India

D Kumara Charyulu, Cynthia Bantilan, GP Sunandini, RG Deshmukh, CV Sameer Kumar, MW Marawar, GD Nageswara Rao, A Rajalaxmi, D Moses Shyam and KB Saxena

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Abstract

Pigeonpea is an important pulse crop particularly in the semi-arid tropics of India contributing towards the nutritional security and also generates significant income to small and marginal farmers. Its share in India's pulse production is around 16%. India is the largest pigeonpea producing country in the world accounting for nearly 67% of the total production. Being a major pigeonpea consumer in the world, India imports around 0.6 million tons of pigeonpea per year to meet the domestic needs from Africa, Nepal and Myanmar. Area and production of pigeonpea in India showed a steady growth until recently. However, the productivity in the country has stagnated between 700 and 800 kg ha^{-1}. Recent initiatives like National Food Security Mission (NFSM), Accelerated Pulse Production Programme (A3P) and enhancement of minimum support price created more interest in pigeonpea growers in the country. Pigeonpea is one of the mandate crops of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and this premier international institute has been contributing significantly to the genetic improvement and crop management in India and Africa during the last four decades. The generous support received from the Bill and Melinda Gates Foundation (BMGF) has provided ICRISAT an opportunity to work more intensively with its research and development partners to demonstrate the potential of new technologies to enhance the yields, raise the profitability and revive the interest of the farmers in pigeonpea crop in India and the strategy chosen is farmer participatory varietal selection (FPVS). This report synthesizes the efforts made under the Tropical Legumes-II Project during the short period of three years (2007-10) in the states of Andhra Pradesh and Maharashtra for pigeonpea crop improvement in India. Overall, the FPVS results established that the new improved varieties outyielded the respective check varieties in the two states. The diffusion and adoption of these varieties increased significantly in the targeted districts. From the past lessons learnt, the report re-focuses on further efforts needed during the second phase of the project to achieve greater success and impact.

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Synthesis Report

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1. Introduction

Background

Global agriculture has increasingly become vulnerable and sensitive to many factors such as land degradation, climate change effects and spiraling prices of agricultural commodities in recent times. However, increasing population and rising per capita income are fuelling growth in demand for food and feed. In the process of becoming self-sufficient in food grain production following the Green Revolution**,** pulse crops have been displaced to marginal lands from the fertile soils and considered less remunerative crops in India. This resulted in lower yield levels and steady decline in per capita consumption of pulses from 69 g day^{-1} in 1960s to 37 g day^{-1} in 2009. At this juncture, diversification of production portfolio is an alternative option that needs to be explored. Among pulses, pigeonpea (*Cajanus cajan*) is a crop with great potential that makes a significant contribution to the food and nutritional security of people. Harnessing the potential of pigeonpea technology is crucial for increasing pulse production and ensuring income and nutritional security of small and marginal farmers. The Tropical Legumes-II (TL-II) Project supported by Bill & Melinda Gates Foundation (BMGF) is an excellent opportunity to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and its partners to demonstrate the potential of new cultivars and production technologies of pigeonpea to the farmers in a considerable way and contribute to the national goals by reducing the poverty and malnutrition at national level besides serving its own mandate of benefitting the poorest of the poor in the semi-arid tropics of India.

Pigeonpea is generally cultivated as a *kharif* (rainy season) crop in diverse cropping systems. It is a traditional food crop and consumed in different forms such as decorticated grain, raw, roasted, boiled, green vegetable and further as processed flour. It is also used as fuel, fodder, forage and medicine and to enrich soil fertility and soil conservation. It is a major income generator in many households and plays a key role in subsistence agriculture because it produces protein rich food with minimum inputs per unit of land (Areke 2004). Pigeonpea is an excellent source of protein (17.9 to 24.3 g per 100 g of whole grain), carbohydrates (57.3 to 58.7%), 1.2 to 8.1% of crude fiber, 0.6 to 3.8% lipids (Sinha 1977), vitamins A and C, and minerals.

Among legumes, pigeonpea has been revolutionized by hybrid technology using cytoplasmic genetic male sterility (CGMS) system in recent years. It is a drought tolerant, versatile food grain legume crop of the tropical and subtropical regions, especially in South Asia, Eastern Africa, the Caribbean region and South and Central America. Pigeonpea can be grown in a wide range of soils from black clay to sandy soil, but is very sensitive to calcareous, saline, alkaline (Chauhan 1987) or waterlogged conditions. Soils with depth exceeding 45 cm and pH between 5 and 7 are ideal. Generally it is cultivated on marginal soils and has an inherent ability to withstand environmental stress, specifically short periods of drought, waterlogging and frost conditions. Traditional varieties of pigeonpea are highly sensitive to photoperiod (McPherson et al. 1985) and they take about 160 to 210 days to reach maturity. Fusarium wilt and sterility mosaic are highly endemic and devastate the pigeonpea crop, particularly in India. Efforts at ICRISAT have led to development and release of resistant varieties like Maruti and Asha, which are most popular across the country and stabilized the crop production in several states. Due to exchange of germplasm and improved lines, the national agricultural research system (NARS) has subsequently developed and released many varieties in the country for cultivation by farmers. Though there are efforts made in varietal development, the crop productivity has been stagnant over the past decades. To address this issue, ICRISAT has used CGMS system and developed new pigeonpea hybrids.

Pigeonpea is a staple pulse crop particularly in the semi-arid tropics and generates significant income to marginal and small farmers. Its share in India's pulse production is 16%. India is the largest pigeonpea producing country in the world accounting for nearly 67% of the total production. During 1950-2010, area under pigeonpea in India increased by 102% (from 2.18 to 4.42 million ha) and production

increased by 68.02% (from 1.72 to 2.89 million tons). Development of short-duration varieties was originally targeted for pigeonpea-wheat rotation in northern states of India while the development of medium-duration, wilt and sterility mosaic resistant varieties like Maruti, Asha, BSMR 736 and BSMR 853 has helped in further expansion of the area under pigeonpea in southern states, especially in Karnataka, Maharashtra and Andhra Pradesh. These varieties have certain other advantages over the prevalent medium- to long-duration cultivars such as ability to escape drought and suitability in the existing cropping systems resulting in higher production levels. The increasing demand for consumption by the burgeoning population and adoption of improved short-duration cultivars which are resistant to biotic and abiotic stresses (Fusarium wilt, sterility mosaic and drought) are the major influencing factors in expanding the area under pigeonpea which resulted in increase in production over a period of time despite the productivity levels being stabilized. The total area under the crop across the country has increased significantly during the past sixty years. The cropped area reached its peak at 4.42 million ha in 2010/11 and production surged to 2.89 million tons with productivity of 655 kg ha^{-1}. In India majority of pigeonpea produced was marketed internally and consumed within the country. Being a major pigeonpea consumer in the world, India imports around 0.6 million tons per year from Africa, Nepal and Myanmar to meet the domestic needs. Area of pigeonpea under irrigation has increased from about 0.5% in 1950/51 to 4.5% in 2008/09, which also might have contributed to growth in production.

Recent trends of pigeonpea in India and major states

The performance of pigeonpea in India during the past three decades is summarized in Table 1.1. During the period 1981-90, area under pigeonpea increased at a compound growth rate of 2.31% per annum. The production and productivity of pigeonpea also registered positive growth. In case of total pulses, the area marginally declined during the same period. Despite fall in area, growth in production remained positive during the 1980s due to a significant increase in productivity. But during the next decade (1991-2000), area under pigeonpea and total pulses showed a negative trend due to conspicuous damage caused by Fusarium wilt. However, production increased marginally due to growth in productivity levels in both the cases because of adoption of niche specific improved technology to some extent. During the last decade (2001-10), total pulses performed much better than pigeonpea, with a significant growth rate of 1.16% in area, 2.71% in production and 1.53% in yield due to innovations in research and development and national policy support (National Food Security Mission scheme). Relatively the growth

Table 1.1. Performance of pigeonpea and total pulses in India, 1980-2010[1].

		Annual compound growth rate (%)[2]		
Crop	Period	Area	Production	Productivity
Pigeonpea	1980-81 to 1989-90	2.31	2.86	0.54
	1990-91 to 1999-2000	-0.65	0.95	1.60
	2000-01 to 2009-10	0.16	1.62	1.47
	1980-81 to 2009-10	0.50	0.29	-0.21
Total pulses	1980-81 to 1989-90	-0.09	1.49	1.59
	1990-91 to 1999-2000	-0.60	0.67	1.27
	2000-01 to 2009-10	1.16	2.71	1.53
	1980-81 to 2009-10	-0.13	0.64	0.77

1. Source: Department of Agriculture and Cooperation, Government of India.
2. Base triennium ending 1981-82 = 100

in area of pigeonpea was much slower while the production and productivity levels exhibited consistent growth.

The trends in area and productivity of pigeonpea in the major growing states of India are summarized in Table 1.2 by computing triennium averages at decadal intervals during the period 1970 to 2010. In India, all the major states registered a positive growth trend in area and productivity of pigeonpea except in the northern states of Uttar Pradesh and Madhya Pradesh. In Maharashtra, area under pigeonpea increased twofold, while the productivity also approximately went up by 1.6 times to 787 kg ha^{-1} from 496 kg ha^{-1}. The crop expansion was quite rapid after the 1990s. During the study period, ie, from 1971-73 to 2008-10, mean pigeonpea area in Maharashtra increased from 0.5 to 1.1 million ha while the production rose from 270,000 to 871,000 tons by registering a growth of 222%. The remarkable production in the state was achieved because of increase in both area as well as yield. The adoption of improved varieties of pigeonpea on a fairly large scale might have also added largely to the enhancement of productivity.

In Andhra Pradesh, both area and productivity have increased more than twofold due to adoption of medium-duration, wilt resistant cultivars. During the study period, the cropped area in the state increased by 45% from 192,000 ha in 1971-73 to 454,000 ha by 2008-10. Growth in area and productivity has significantly increased the production of pigeonpea in the state. Adoption of improved varieties of pigeonpea namely, Abhaya, Asha, Maruti, Lakshmi, Durga, LRG 30, LRG 41 and PRG 158 contributed immensely to the enhancement of productivity in the state.

Table 1.2. Performance of pigeonpea in major producing states of India[1].

	AP		Gujarat		Karnataka		Maharashtra		MP		UP		India	
Time period	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y
Average of triennium ending[2]														
1973	192	207	89	451	271	456	539	496	517	768	520	1136	2470	681
1983	251	236	263	740	376	462	706	619	513	861	504	1258	3050	742
1993	321	281	412	774	445	325	1022	554	449	867	527	1046	3580	667
2003	457	405	314	687	509	383	1046	715	308	750	374	1071	3400	666
2010	454	515	268	1001	627	569	1092	787	335	775	333	822	3520	736
Instability index (CV%)														
Raw data														
1981-2010	27	37	19	25	24	26	16	21	19	21	16	18	8	10
1981-1990	16	23	20	25	12	16	14	17	7	20	4	11	8	7
1991-2000	19	26	9	25	18	29	3	28	15	16	10	10	3	13
2001-2010	14	20	9	21	19	26	8	13	16	21	9	16	9	9
Detrended														
1981-2010	12	23	19	23	15	24	7	19	12	19	7	12	6	8
1981-1990	5	19	21	22	4	16	7	16	5	24	5	12	6	6
1991-2000	14	24	8	26	17	28	4	26	11	15	6	14	4	10
2001-2010	16	27	9	21	18	27	7	14	17	18	6	10	8	7

1. Source of data: Directorate of Economics and Statistics, Government of India.
2. A = Area in '000 ha; Y = Yield in kg ha^{-1}

The other major pigeonpea producing states are Karnataka and Gujarat; cropped area has increased nearly threefold. The productivity in Gujarat took a greater leap from 451 to 1000 kg ha^{-1} on adoption of improved cultivars and better management practices. In Karnataka, the productivity level increased only marginally at a slow pace from 456 to 569 kg ha^{-1} during the study period. In the northern states, the share of pigeonpea is slowly declining due to the shift to cereal and oilseed based cropping systems. The pigeonpea cropped area in India increased by 42% (from 2.5 to 3.5 million ha) whereas the productivity increased marginally by 8% during the study period. However, there is a huge scope for pigeonpea to reach the potential yield levels in the country. The linear trend line computed for productivity for the period 1950-51 to 2010-11 indicated that the productivity did not increase over the period of time (Fig. 1.1).

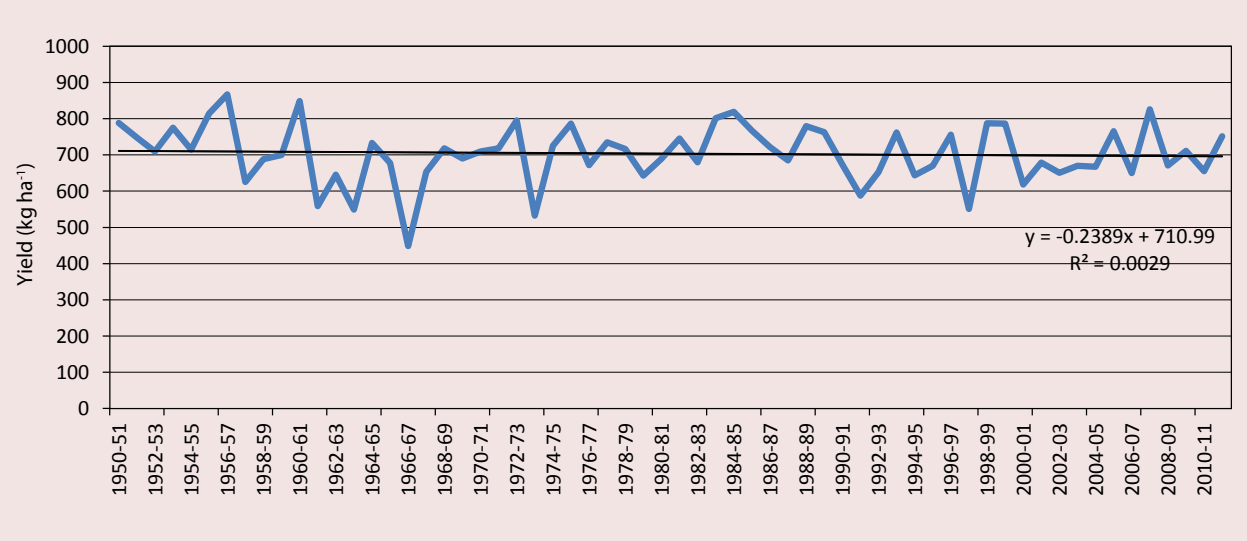

Figure 1.1. Productivity of pigeonpea in India, 1950-51 to 2010-11.

Yet, the instability in area and productivity of pigeonpea remains high in individual states, while it gets moderated at the all India level (Table 1.2). In general, high levels of instability were observed in productivity when compared with area of pigeonpea. The area instability indices were relatively lower in the pigeonpea growing states of Maharashtra and Uttar Pradesh. Higher levels of instability in pigeonpea area were observed in Andhra Pradesh followed by Karnataka and Gujarat. When the trend was removed, the instability indices for the total period of analysis, 1981-2010, across states were lower when compared with the same computed for raw data.

Scope of the study

This report focuses on how the interventions made under TL-II Project during Phase 1 (2007-10) through farmers' participatory varietal selection (FPVS) have generated interest among the farmers to grow some of the new varieties. TL-II also gave scope for establishment of proper seed systems in the target states which provided a channel to the smallholder farmers for accessing seed of improved varieties. When backed up by sustained production of seeds of improved varieties and distribution of the same in small quantities to the farmers in adopted villages, there was a change in the composition of the pigeonpea varieties in the study area between the base year in 2007/08 and the year of early adoption study in 2009/10. The impact in terms of increased yields and higher net returns is assessed to quantify increased farm incomes of the sample farmers. The lessons learnt from the experience in the first phase are used for improving the planning during the second phase of the project. During the three years

of implementation in the first phase, the TL-II Project had a target of achieving a 5% increase in the productivity of legumes by achieving 10% coverage of area under the crop in the study area with new and high-yielding varieties. Globally, the project aimed to accomplish net benefits to the tune of US$300 million. The TL-II Project entitled "Enhancing grain legumes productivity, production and incomes of poor farmers in drought-prone areas of Sub-Saharan Africa and South Asia" targeted six grain legumes, viz, chickpea, pigeonpea, groundnut, common bean, cowpea and soybean. In South Asia, the intervention is limited to the first three crops under the mandate of ICRISAT. The intervention strategy of the TL-II Project is presented in Figure 1.2.

As the first step, baseline surveys were planned to be conducted to document the areas allocated by farmers to pigeonpea, the varieties grown, and productivity and profitability. Then some promising high-yielding varieties had to be tested on farmers' fields to provide farmers the opportunity to select varieties with which they are impressed in terms of productivity, pod characteristics and market acceptance. The varieties selected by the farmers had to be multiplied on selected farmers' fields and seed produced to be distributed among the farmers with the expectation that the farmers would gradually multiply them on their farms and benefit from the adoption of improved cultivars. Implementation of this strategy was expected to create an impact on the farmers by way of higher yields, reduced unit cost of production and higher profitability. The project aimed at reducing the time lag between the development of variety and its popularization with the farmers. High potential states like Andhra Pradesh and Maharashtra in India were chosen for implementing the project strategy in pigeonpea. Although Karnataka, Uttar Pradesh and Madhya Pradesh are the other important states for pigeonpea production in the country, Andhra Pradesh and Maharashtra were chosen because of the availability of suitable varieties and better cooperation expected from the research and development partners in these states.

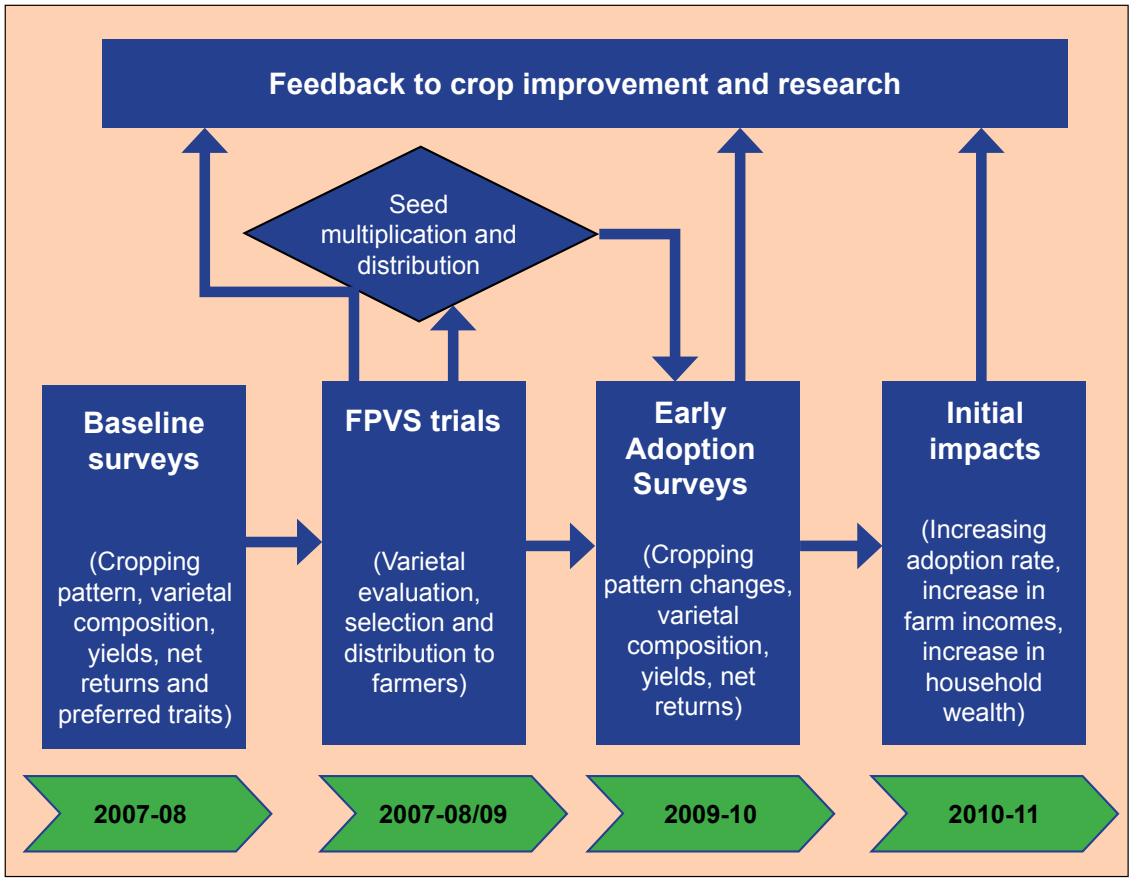

Figure 1.2. TL-II Project (Phase 1) and interventions.

Plan of the report

The introductory section provided the importance and historical performance of pigeonpea crop in terms of area, production and productivity in the major states of India and the country as a whole during the last three decades. The paradigm shift in pigeonpea area from northern states with long growing season to southern states with warmer medium growing season was discussed. The measures of instability both in area and productivity remain high due to the rainfed nature of the crop, biotic stresses like Fusarium wilt, *Maruca*, *Helicoverpa* and limited input utilization; these were discussed. The scope of the study was highlighted by focusing on the strategy of TL-II Project and how it was implemented in the study states.

Section 2 is devoted to the description of the study locations and listing of the adopted or treated villages and control villages in the three study districts of two states in India. The simple tools and techniques used in the study to achieve the objectives are described. Section 3 furnishes the full details of the baseline studies conducted in the two states during 2007-08. Section 4 presents the FPVS trials conducted in the selected villages of Rangareddy and Mahabubnagar districts of Andhra Pradesh and Akola district of Maharashtra. The performance of new improved cultivars tested in the mother-baby trials is discussed. Farmers' varietal selections and their trait preferences are documented. Section 5 presents the results of early adoption surveys conducted in Andhra Pradesh and Maharashtra in 2009/10. Finally, the synthesis of the studies in the two states and the lessons learnt are summarized in Section 6. The appendices at the end of the report contain the questionnaires used in baseline and early adoption studies.

2. Sampling and methodology

Sample details and survey methods

Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh and Uttar Pradesh are the top five major pigeonpea growing states in India (see Table 1.2). Even though there are high pigeonpea area concentrations in Maharashtra, Karnataka and Andhra Pradesh, the productivity levels were much lower than or similar to all India average. The main reason may be due to prevailing abiotic and biotic stresses or low adoption of improved technologies. However, these three states have shown a significant increase in area under pigeonpea since 1990s and still have a lot of potential for further improvement. Observing the huge potential for pigeonpea in these states, the TL-II Project supported by BMGF has selected Andhra Pradesh and Maharashtra for its interventions.

The top two pigeonpea growing districts, Rangareddy and Mahabubnagar were chosen in Andhra Pradesh for the introduction of new varieties and crop technologies. Similarly, Akola district in Maharashtra was chosen for implementation of the project. In each of the selected states, three villages were selected for intervention (called 'adopted' villages) and three other villages which were similar to the intervention villages were selected as control villages for comparison. Thirty pigeonpea growers were randomly chosen from each of the adopted villages, while 15 pigeonpea growers were randomly chosen from each of the control villages. Thus, 180 sample farmers were selected for conducting the baseline survey from the intervention villages of the two states, while 90 farmers from the control villages were chosen for the same purpose. Besides the sample farmers, data relating to marketing aspects were also collected from traders, processors, retailers and consumers. The reference period for data collection was 2006/07 season, as the data were collected in 2007-08. The relevant secondary data were collected from the Directorates of Economics and Statistics of Andhra Pradesh and Maharashtra and analyzed for better understanding of performance of pigeonpea in these states over a period of time.

Farmers' Participatory Varietal Selection (FPVS) trials were conducted during the rainy season of 2008/09 in the so-called adopted villages. Some new varieties were tested vis-à-vis the ruling varieties in the region to assess their comparative performance. Farmers were asked to rank the varieties based on the traits preferred by them. The varieties selected by the farmers were taken up for seed multiplication. The farmers were supplied with small quantities of seed so that they multiply the seeds and bulk the supply and gradually switch over to the preferred varieties. In 2009-10, an early adoption survey was commissioned to assess the impact that the new varieties were making and whether this adoption has caused any improvement in their yields and incomes of the farmers.

Table 2.1 presents the trends in area, production and productivity of pigeonpea in the study districts and the instability from 1980 to 2010. Rapid growth was witnessed in pigeonpea area, production and productivity between 1970 and 2010 in the districts chosen for introduction of pigeonpea technology through the TL-II Project. The area under pigeonpea in Rangareddy district increased from 26800 to 33200 ha during the period 1991-93 to 2008-10. The production increased nearly 2.89 times while the productivity also increased 2.29 times during the same period. The productivity levels in the district were similar to the national average. Mahabubnagar is considered as rain-shadow area of Andhra Pradesh with a normal rainfall of 604 mm (approximately 74% from SW and 20% from NE monsoons). The area under pigeonpea in Mahabubnagar district increased nearly three times from 1970-71 to 2008-10. There was a significant improvement in pigeonpea production during the study period. The productivity was much stable up to 1990s but increased significantly from early 21st century. In Akola, pigeonpea area increased tremendously up to 1990s but later decreased significantly. The production in the district also exhibited similar pattern over time. But the productivity levels were much higher in Akola district when compared with Andhra Pradesh.

Table 2.1. Trends in area, production and productivity of pigeonpea in the study districts and measures of instability[1].

	Rangareddy			Mahabubnagar			Akola		
Time period	A	P	Y	A	P	Y	A	P	Y
Average of triennium ending									
1973	NA	NA	NA	24.0	3.7	150	35.7	18.3	509
1983	NA	NA	NA	35.3	5.2	148	53.3	39.2	733
1993	26.8	7.3	280	39.5	6.5	166	75.9	50.4	667
2003	34.0	19.9	583	58.6	21.4	365	48.0	42.4	882
2010	33.2	21.1	642	80.6	30.8	405	52.8	46.4	863
Instability index (CV%)									
Raw data									
1981-2010	13[2]	53[2]	47[2]	34	84	61	21	32	30
1981-1990	NA	NA	NA	17	41	46	17	31	20
1991-2000	16	51	44	29	69	41	23	30	34
2001-2010	4	26	27	19	48	49	8	35	33
Detrended									
1981-2010	9[2]	33[2]	34[2]	19	57	48	20	33	24
1981-1990	NA	NA	NA	7	21	30	20	31	12
1991-2000	11	31	34	26	52	30	21	30	27
2001-2010	7	36	35	18	77	70	8	36	29

1. A = Area ('000 ha); P = Production ('000 tons); Y = Yield (kg ha-1); NA = Data not available.
2. For period 1990-2010 only.

The secondary data before 1990s were not available for Rangareddy district as it was formed during 1990 (see Table 2.1). The instability in area, production and productivity was much higher during the first period (1991-2000) when compared with later decade (2001-10). The production and productivity showed higher levels of instability than area. This may be because pigeonpea is a rainfed crop and due to vagaries of monsoon. Similarly, the instability in production and productivity was higher in Mahabubnagar district when compared with Rangareddy district. Over time, the de-trended instabilities in pigeonpea area, production and productivity increased and exhibited more risk in pigeonpea cultivation. In Akola, except in pigeonpea area, instabilities in both production and productivity were much similar over time. Overall, the de-trended data exhibited slightly lower instabilities only for long-term period, ie, 1981-2010.

Both the districts were selected purposively for project interventions and similarly for baseline surveys in Andhra Pradesh. Relatively Mahabubnagar district is more rainfed dependent and falls under typical semi-arid tropical climate with normal rainfall of around 500-600 mm. Rangareddy district is close to Hyderabad city and receives normal rainfall of 700-800 mm. However, both the districts are major pigeonpea producing districts of the state. During 2007-08 farmers grew pigeonpea on nearly 32000 ha in Rangareddy and around 69000 ha in Mahabubnagar district. Because of high dependency on rainfall during rainy season, farmers in these districts have limited choice in crops subjected to uncertainties in onset of monsoon, prolonged dry spells and moisture stress during the critical stages of crop growth. Tandur and Basheerabad mandals from Rangareddy and Kodangal mandal from Mahabubnagar district were purposively chosen for the study because of highest proportion of pigeonpea in these mandals.

The details of villages selected for intervention (adopted and control) and their corresponding sample units chosen for the study are presented in Table 2.2. In Rangareddy district, Old Tandur and

Table 2.2. Sample villages selected for baseline survey in Andhra Pradesh.

District	Mandal	Adopted village	No. of farmers	Control village	No. of farmers
Rangareddy	Tandur	Old Tandur	30	Mittabasupally	15
	Basheerabad	Parvathapally	30	Damarched	15
Mahabubnagar	Kodangal	Kodangal	30	Huanabad	15
Total			90		45

Parvathapally villages were chosen for intervention, while Mittabasupally and Damarched were selected as control villages. In Mahabubnagar district, Kodangal was selected as adopted village, while Huanabad was selected as the control village. Thirty pigeonpea growers were randomly selected from each adopted/intervention village whereas 15 pigeonpea growers were also identified from control villages. Thus, a total of 135 sample farmers were chosen from six villages of Andhra Pradesh.

The post-stratification of the Andhra Pradesh baseline sample among different size groups is summarized in Table 2.3. Of the total sample of 135 households, 90 farmers were from the adopted villages and 45 were from the control villages. In the adopted villages, around 41% of the sample farmers were large followed by small (33%), medium (19%) and 7% were marginal farmers while in control villages, 33% of the sample were large farmers followed by 31% medium farmers, 29% small farmers and 7% marginal farmers. In both the categories of villages, large farmers constituted the bulk of the sample farmers. The distribution pattern of sample farmers was much similar in both the adopted and control villages. Overall, the proportion of sample farmers increased practically with increase in the farm size in both categories of villages.

Table 2.3. Distribution of sample farmers among different farm size groups in Andhra Pradesh.

	Adopted villages		Control villages	
Farm size	No.	%	No.	%
Marginal	6	6.67	3	6.67
Small	30	33.33	13	28.89
Medium	17	18.89	14	31.11
Large	37	41.11	15	33.33
Total	90	100.00	45	100.00

In Maharashtra, pigeonpea is mainly grown as an intercrop with cotton, soybean, sorghum, mung bean and black gram. Akola district was purposively selected as it is situated in Vidarbha region and represents typical semi-arid tropical climate in the state (see Table 2.4). After Yavatmal, Akola is also one of the major pigeonpea growing districts in Maharashtra. Two mandals, namely, Akola and Murtizapur were purposively selected for the study. Agar village was selected for introduction of pigeonpea technology whereas Ugwa village was identified as a control in Akola mandal. Similarly, two villages Kanzara and Sirso were chosen for intervention in Murtizapur mandal. Correspondingly, Kinkheda and Jitapur were chosen as control villages for comparison in Murtizapur mandal. A total of 135 households were surveyed from three adopted and three control villages in the district.

In Maharashtra, marginal and small farmers together formed the major group in the sample in both adopted and control villages (Table 2.5). In the pooled sample, small farmers constituted 33% followed by medium and marginal farmers with 21% and 28% respectively. Relatively, the share of large farmers

Table 2.4. Sample villages selected for baseline survey in Maharashtra.

District	Mandal	Adopted village	No. of farmers	Control village	No. of farmers
Akola	Akola	Agar	30	Ugwa	15
	Murtizapur	Kanzara	30	Kinkheda	15
		Sirso	30	Jitapur	15
Total			90		45

Table 2.5. Distribution of sample farmers among different farm size groups in Maharashtra.

	Adopted villages		Control villages	
Farm size	No.	%	No.	%
Marginal	21	23.33	17	37.78
Small	31	34.44	14	31.11
Medium	21	23.33	8	17.78
Large	17	18.90	6	13.33
Total	90	100.00	45	100.00

was slightly higher in adopted villages when compared with control villages. The presence of marginal farmers was predominant in control villages while the group of small farmers was conspicuous in adopted villages. On the whole, the sample landholdings were relatively smaller in Maharashtra compared to those in Andhra Pradesh.

Tools and analytical techniques

Tabular analysis

Tabular analysis was adopted to compile the general characteristics of the sample farmers, the resource structure, cost structure, returns, profits and opinions of farmers regarding the problems in production and marketing. Simple statistics like averages and percentages were used to compare, contrast and interpret results in an appropriate way.

Growth rate analysis

For assessing the trends in area, production and productivity of pigeonpea in different states and the study districts of Andhra Pradesh and Maharashtra, the following growth rate formula was employed:

$$Y^t = ab^t u^t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where,

Y^t = Area/production/productivity in the year 't'
a = Intercept indicating Y in the base period (t = 0)
b = Regression coefficient
^{t} = Time period in years
u^t = Disturbance term for the year 't'

Equation 1 was converted into the logarithmic form to facilitate the use of linear regression. By taking logarithm on both sides of equation 1, we get equation 2.

$$\ln Y = \ln a + t \ln b + \ln ut \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

This is of the linear form.

$$Yt = A + Bt + et \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where,

Yt = lnYt

A = lna

B = lnb

et = lnut

The linear regression of the above form (equation 3) was fitted separately for area, production and productivity of pigeonpea. The values of 'a' and 'b' were estimated by using ordinary least squares technique.

Later, the original 'a' and 'b' parameters in equation 1 were obtained by taking antilogarithms of 'a' and 'b' values as:

a = Antilog A

b = Antilog B

Average annual compound rate was calculated as:

b = 1 + g

g = b – 1

To obtain percentage compound growth rate, the value of g was multiplied by 100.

Garrett's ranking technique

The reasons were prioritized by using Garrett's ranking technique in the following manner. The preferences considered important by majority of respondents were first listed. Each of 135 respondents selected in each state were asked to rank the preferences based on their priorities using ranks from 1 to 10. In this analysis, rank 1 means most important problem and rank 10 means least important problem. In the next stage rank assigned to each reason by each individual was converted into per cent position using the following formula:

Per cent position = 100 (Rij – 0.5) / Nj

where,

Rij stands for rank given for the i^{th} factor (i = 1, 2 ... 5) by the j^{th} individual (j = 1, 2 … 60).

Nj stands for number of factors ranked by j^{th} individual.

Once the per cent positions were found, scores were determined for each per cent position by referring Garrett's table. Then, the scores for each problem were summed over the number of respondents who ranked that factor. In this way, total scores were arrived at for each of the factors and mean scores were calculated by dividing the total score by the number of respondents who gave ranks. Final overall ranking of the factors was carried out by assigning rank 1, 2, 3 … etc, in the descending order of the mean scores.

Coefficient of variation

Coefficient of variation (CV) explains the deviation in the observation over a period around its mean value.

CV (%) = (Standard deviation/mean) X 100

3. Insights from baseline survey

The baseline survey was conducted in 2007-08 with the sample farmers in Andhra Pradesh and Maharashtra as described in Section 2. The baseline survey primarily focused on socioeconomic profile of the farmers to understand their standard of living, financial position, assets and liabilities, sources of income and details of consumption expenditure, cropping pattern, varietal composition, yield levels and economics of pigeonpea vis-à-vis other competing crops, sources of information about technology, trait preferences, gender issues, etc in the selected villages.

Andhra Pradesh

Socioeconomic and demographic characteristics of sample

The details of the socioeconomic profile of Andhra Pradesh sample farmers are presented in Table 3.1. The land ownership, in general, was vested with the men of sample households. Relatively, the male-headed households were more in adopted villages (100%) than in the control villages (97.48%) of Andhra Pradesh. The household head is slightly older in the control villages (42.7 years) than in the adopted villages (41 years). Dependency ratio is calculated at 1.04 and 0.71 in adopted and control villages respectively. The average education level of the household heads is six years of schooling in both the adopted and control villages. A slightly higher percentage of household heads participated in the local bodies in adopted villages than in control villages. A larger proportion of sample farmers had agriculture as the main occupation in both the control (95.67%) and adopted villages (86.66%) of Andhra Pradesh. Business or service as secondary source of income was prevalent more in control villages (62%) than in the adopted villages (57%). In adopted villages, 69% of households owned a two-wheeler or bicycle while only about half of the households possessed these in control villages. About 75% of the households in both the adopted and control villages of the state owned television sets. The ownership of radios/tape recorders was restricted to 9% of households in both categories of sample villages.

Table 3.1. Socioeconomic profile of sample farmers in Andhra Pradesh, 2007-08.

Parameter	Adopted villages	Control villages
Male-headed households (%)	100.00	97.48
Household size (no.)	6.71	5.94
Male workers (no.)	2.01	2.21
Female workers (no.)	1.27	1.25
Dependency ratio[1]	1.04	0.71
Age of household head (years)	41.04	42.70
Education level of household head (no. of years)	6.16	6.00
Participation in local bodies (%)	10.00	8.89
Proportion with agriculture as the main occupation (%)	86.67	95.66
Proportion with business/service as secondary occupation (%)	56.66	62.22
Ownership of two-wheelers/bicycles (%)	68.89	53.33
Ownership of television sets (%)	77.78	73.33
Ownership of radio/tape recorder (%)	8.89	8.89

1. Dependency ratio = (Family size – No. of workers)/No. of workers

Resource endowments of sample households

The average size of landholding per household was similar in both the adopted and control villages of Andhra Pradesh (Table 3.2). Irrigation coverage was higher in control villages than in the adopted villages. Area of rainfed land was higher compared to irrigated and fallow lands in both adopted and control villages. The extent of land possessed per household was slightly higher in adopted villages than in control villages. Per unit irrigated land values were lower in control villages when compared with adopted villages. However, in case of rainfed land, the differences in unit land values were marginal. Overall, values of land owned per farm were similar in adopted and control villages. Because of the close proximity of the two districts to Hyderabad city and influence of real estate market, the per unit land values were relatively higher in the study locations.

Table 3.2. Value of land (per household) owned by sample farmers in Andhra Pradesh, 2007-08.

	Adopted villages		Control villages	
Land type	Area (ha)	Value (₹)	Area (ha)	Value (₹)
Irrigated land	0.14	82222	0.65	194510
Rainfed land	3.68	850485	3.23	747120
Fallow land	0.21	49506	0.14	33308
Total land	4.03	982213	4.02	974938

The sample farmers in the adopted villages owned slightly more number of livestock than their counterparts in the control villages in Andhra Pradesh (Table 3.3). But the average value of livestock per household in control villages was more than that in the adopted villages. Of the total livestock owned by the sample farmers, draft animals contributed highest value in both adopted and control villages followed by cows/buffaloes and poultry/goat and sheep.

Table 3.3. Livestock owned by sample farmers in Andhra Pradesh, 2007-08.

	Adopted villages		Control villages	
Livestock	No. per household	Value (₹)	No. per household	Value (₹)
Draft animals	2.07	31187	2.07	31683
Cows/buffaloes	2.46	13194	2.93	16700
Poultry/goat and sheep	3.77	3502	3.15	1604
Total livestock	8.30	47883	8.15	49987

Ownership of tractors and accessories was relatively more prevalent in adopted villages than in control villages (Table 3.4). The number of electric pump sets, tractors and accessories was slightly higher in adopted villages whereas bullock-drawn implements and other tools were majorly used in control villages. The total value of farm implements owned per household was slightly higher in control villages than that in adopted villages.

Table 3.4. Farm implements owned by sample farmers in Andhra Pradesh, 2007-08.

	Adopted villages		Control villages	
Implements	No. per household	Value (₹)	No. per household	Value (₹)
Tractor and accessories	0.16	27111	0.08	24444
Electrical pump sets	0.90	9400	0.87	8842
Bullock-drawn implements	0.11	1488	0.47	4977
Other tools	4.62	8105	5.0	8817
Total farm implements	-	46104	-	47080

The value of consumer durables owned by sample farmers in Andhra Pradesh is summarized in Table 3.5. Relatively, the average number of consumer durables per farm was higher in adopted villages when compared with control villages. All the sample farmers in control and adopted villages possessed residential house whereas other durables like cattle shed and two-wheelers were possessed by only few sample farmers. The contribution of residential house value in the total consumer durables was higher in adopted villages than in control villages.

Table 3.5. Consumer durables owned by sample farmers in Andhra Pradesh, 2007-08.

	Adopted villages		Control villages	
Type of durables	No. per household	Value (₹)	No. per household	Value (₹)
Residential house	1.00	119166	1.00	82955
Cattle shed	0.36	5136	0.51	2358
Cycle/two-wheelers	0.69	8925	0.53	6695
Others	2.59	5159	1.82	4161
Total consumer durables	4.64	138386	3.86	96169

Table 3.6 gives an account of the financial assets and liabilities of the sample farmers in Andhra Pradesh. Although institutional credit constitutes the major source of finance, private moneylenders also had lent almost an equal sum of money. Friends and relatives formed an important source of finance, lending fairly substantial sum of money in both adopted and control villages. In general, most of the savings were in the form of LIC policies and bank deposits. The sample farmers in control villages had the highest borrowing of ₹47,934 per household compared to ₹38,633 per household in adopted villages. In contrast, despite higher borrowing, farmers in control villages lent more money and had more savings per household compared to those in adopted villages.

Table 3.6. Financial liabilities (₹ per household) of sample farmers in Andhra Pradesh, 2007-08.

Financial liabilities	Adopted villages	Control villages
Borrowing (-)	38633	47934
Lending (+)	1667	6311
Savings (+)	36563	52014
Net liabilities	-403	+10391

The sample households in adopted villages turned out to be wealthier than those in control villages (Table 3.7). The value of land alone contributed nearly 80-85% share in the total net worth value of a household in both adopted and control villages. It was followed by value of consumer durables with a share of around 8-11%. The results clearly indicate the strong net worthiness of the sample households in both the study districts.

Table 3.7. Net worth (₹ per household) of sample farmers in Andhra Pradesh, 2007-08.

Assets and liabilities	Adopted villages	Control villages
Value of land	982213	974938
Value of livestock	47883	49987
Value of farm implements	46104	47080
Value of consumer durables	138386	96169
Total assets	1214586	1168174
Net liabilities	-403	+10391
Net worth	1214183	1178565

Place of pigeonpea in cropping pattern and productivity levels

The area under pigeonpea constituted about 80% of the rainy season cropped area in adopted villages while it occupied almost 72% of the rainy season cropped area in control villages (Table 3.8). It clearly reveals the great importance of pigeonpea crop in farmers' livelihood in the study districts. Correspondingly, the relative share in the total gross cropped area was 78% in adopted villages and 68% in control villages. Due to the limited access to irrigation sources, the cropped area during *rabi* (postrainy season) was negligible in both the categories of villages. Such an excessive dependence on a single crop during rainy season may not be desirable because of erratic rainfall and lack of suitable crop rotations. The main reasons expressed by the respondents for the cultivation of pigeonpea were that it fetches high income and is best suited to their marginal lands. Pigeonpea requires low-input costs and restores the soil fertility as a bonus. Black gram, sorghum, paddy and castor were other major crops competing with pigeonpea during the rainy season in both adopted and control villages. Sorghum, paddy, chickpea and onion were some of the major postrainy season crops grown in the study villages.

Table 3.8. Relative importance of pigeonpea in sample households in Andhra Pradesh, 2007-08.

Indicator	Adopted villages	Control villages
Rainy season cropped area (ha)	413.8	173.6
Postrainy season cropped area (ha)	10.5	10.1
Total cropped area (ha)	424.3	183.7
Area under pigeonpea (ha)	331.7	125.3
Proportion of pigeonpea area in rainy season cropped area (%)	80.12	72.18
Proportion of pigeonpea area in total cropped area (%)	78.16	68.20

During the baseline survey, sample farmers were asked to give their perceptions about pigeonpea yields under different weather situations experienced by them. In all the selected study villages, pigeonpea is primarily cultivated under rainfed situation. In general, the yields were perceived to be high in good rainy season while low yields indicated bad season for pigeonpea cultivation (Table 3.9). The highest yields observed by the farmers in their lifetime were considered as 'best yields'. On the whole, the perceived yield levels were slightly higher in all the weather situations in treated (adopted) villages when compared

Table 3.9. Productivity (kg ha^{-1}) of pigeonpea perceived by sample farmers in Andhra Pradesh, 2007-08.

Perceived yield	Adopted villages	Control villages
Rainfed		
Good	1440.83	1375.30
Bad	709.92	624.95
Best	1529.20	1395.85
Irrigated		
Good	-	-
Bad	-	-
Best	-	-

with control villages. None of the pigeonpea plots were grown under irrigated conditions in the baseline survey sample villages.

Technology adoption and source of information

The total cropped area under pigeonpea during rainy season was 331.7 ha in the three adopted villages. Around 62% of pigeonpea area is occupied by the variety Asha followed by Abhaya (11.1%), local variety Nallakandi (11.1%), Maruti (7.5%), Lakshmi (4.8%), Durga (1.9%), LRG 30 (0.7%), LRG 41 (0.6%) and white pigeonpea (0.4%) (Table 3.10). Asha was observed as the single dominant variety in the adopted villages during 2007-08. Overall, nearly 90% of the cropped area in adopted villages was under improved varieties whereas the remaining 10% was occupied by the local variety Nallakandi. In control villages, the cropped area under pigeonpea was estimated at 125.3 ha. Nearly 77% of pigeonpea area was covered by the variety Asha followed by local cultivars (7.1%), Lakshmi (6.1%), Abhaya (5.8%), Durga (2.3%) and white pigeonpea (1.8%). The spread of improved varieties (Asha and Maruti) released in early 1990s was dominant during baseline surveys in both the adopted and control villages. Relatively, the diffusion of Asha was much higher in the control villages than in the adopted villages. Other improved varieties released in early 2000s occupied less area both in adopted and control villages.

Table 3.10. Distribution of pigeonpea varieties in Andhra Pradesh, 2007-08.

	Adopted villages		Control villages	
Variety	Area (ha)	% of total pigeonpea area	Area (ha)	% of total pigeonpea area
Asha	204.57	61.7	96.32	76.9
Abhaya	36.83	11.1	7.28	5.8
Local	37.11	11.1	9.71	7.1
Durga	6.48	1.9	2.02	2.3
Lakshmi	16.19	4.8	7.69	6.1
LRG 30	2.43	0.7	0	0.0
LRG 41	2.02	0.6	0	0.0
Maruti	24.89	7.5	0	0.0
White pigeonpea	1.21	0.4	2.23	1.8
Total	331.7	100.0	125.3	100.0

Table 3.11. Sources of information on technology to sample farmers in Andhra Pradesh, 2007-08.

Source of information	Farmers (%) getting information from the source[1]	
	Adopted villages	Control villages
TV	26 (4)	27 (4)
Radio	12 (9)	10 (7)
Newspaper	12 (7)	15 (5)
Agriculture magazine diary/newsletter	18 (5)	9 (8)
Fellow farmers	53 (1)	60 (1)
Friends/relatives	39 (2)	40 (2)
Input supplier	28 (3)	29 (3)
Research institute	12 (8)	8 (9)
NGOs	2 (10)	4 (10)
Others	16 (6)	13 (6)

1. Figures in parentheses indicate rank of importance as source of information.

The sample households in adopted villages largely depended on fellow farmers for obtaining information on technology inputs, like improved seeds, plant protection chemicals, etc (see Table 3.11). After fellow farmers, friends and relatives were the next important source of information about new technology. Input suppliers, television and agricultural magazines/newsletters were the other important sources of information. Similarly, in the control villages also fellow farmers emerged as the most important source of information followed by friends/relatives, input suppliers and television.

Viability of pigeonpea in the study area

Among the three rainy season crops, the gross income per ha was the highest for pigeonpea followed by black gram and sorghum (Table 3.12). This clearly lends support for pigeonpea crop being dominated in all the six study villages. The relative profitability levels per ha were marginally higher in pigeonpea cultivation in adopted villages when compared to control villages. In general, crops like paddy and onion were grown during the *rabi* season by very few farmers because of their access to irrigation facilities. Crops like paddy and chickpea obtained better gross income per ha than pigeonpea in the study area.

Table 3.12. Gross returns (₹ per ha) from different crops grown by sample farmers in Andhra Pradesh, 2007-08.

Crop	Adopted villages	Control villages
Pigeonpea (*Kharif*)	22000	19000
Black gram (*Kharif*)	17000	18000
Sorghum (*Kharif*)	14000	9000
Paddy (*Rabi*)	52000	49000
Chickpea (*Rabi*)	30000	29000
Safflower (*Rabi*)	15000	-

Table 3.13. Economics of local and improved varieties of pigeonpea on sample farms in Andhra Pradesh, 2007-08.

Cost/returns	Adopted villages	Control villages
Check (Local cultivar)		
Yield (kg ha^{-1})	863	830
Cost of cultivation (₹ ha^{-1})	15534	14849
Gross returns (₹ ha^{-1})	17828	17073
Net returns (₹ ha^{-1})	2294	2224
Benefit-cost ratio	1.15	1.15
Improved variety (Asha)		
Yield (kg ha^{-1})	1200	1100
Cost of cultivation (₹ ha^{-1})	16811	16001
Gross returns(₹ ha^{-1})	25200	23100
Net returns (₹ ha^{-1})	8389	7099
Benefit-cost ratio	1.50	1.44

The most preferred local cultivar grown in the adopted and control villages was Nallakandi while Asha was the predominant improved pigeonpea variety adopted by farmers. The performance of the improved variety was much superior to the local cultivar in both the categories of villages (Table 3.13). Correspondingly, the gross and net returns per ha were marginally higher with Asha than the local cultivar. However, the relative performance of these varieties was much superior in adopted villages than the control villages. This may be because of best management practices or availability of better soils. Overall, the benefit-cost ratio was better in improved variety.

Income and expenditure

Of the total annual net household income earned, nearly 60% was contributed by agriculture alone in adopted villages (Table 3.14). Income from livestock sources (including sale of milk and milk products, sheep/goat/chicken and hiring out bullocks) together contributed around 11% of the total income. By hiring out labor (farm and non-farm), a household, on an average, earned 6.7% of total income. Subsidiary sources like salaried jobs, pension and business, selling handicrafts, etc together contributed 6.3% of the net household income. Income from renting out assets contributed about 3% of household income. The remaining household income was from cash and kind gifts, remittances, government welfare programs, etc.

The contribution of agriculture income was low at 45% in sample households in control villages. Livestock sources accounted for 7.5% of total household income, while the farmers earned 24.8% income by participating in the labor market. Salaried jobs provided 1.83% of the total income per household. The balance income was generated from cash and kind gifts and through participation in the government welfare programs. Overall, average net income per household per annum was much higher (48%) in control villages than in the adopted villages. Relatively, items like wages from labor market participation and dowry contributed significantly to the total household income in control villages.

The annual household consumption expenditure pattern of sample farmers in Andhra Pradesh is furnished in Table 3.15. Since rice is the main staple food for the farmers, it occupied nearly 75% of the share in the total cost on cereals in both control and adopted villages. Among the pulses group, the expenditure on pigeonpea had the lion share (nearly 65%) in all the six villages. Overall, the average

Table 3.14. Average annual net income (per household) of sample farmers in Andhra Pradesh, 2007-08.

Sources of income	Adopted villages		Control villages	
	Amount (₹)	Share (%)	Amount (₹)	Share (%)
Crops	55671	60.66	60719	44.68
Farm work (labor earnings)	5039	5.49	4478	3.29
Non-farm work (labor earnings)	1106	1.21	1244	0.92
Regular farm servant	0	0.00	28000	20.60
Livestock (sale of milk and milk products)	6503	7.09	7409	5.45
Hiring out bullocks	2363	2.57	2407	1.77
Sale of sheep, goat, chicken, meat, eggs, etc	1293	1.41	362	0.27
Rental income (tractor, auto, sprayer, truck, etc)	2767	3.01	2667	1.96
Regular salaried jobs (Government/private)	2061	2.25	2489	1.83
Out-migration	133	0.14	0	0.00
Remittances	7276	7.93	2287	1.68
Interest on savings and from moneylending	1238	1.35	3491	2.57
Cash and kind gifts including dowry received	2585	2.82	19822	14.58
Pension from employer	2267	2.47	0	0.00
Government welfare/development programs	0	0.00	533	0.39
Total	91779	100.00	135908	100.00

Table 3.15. Annual consumption expenditure (₹ per household) of sample farmers in Andhra Pradesh, 2007-08.

Item	Adopted villages	Control villages
Food		
Cereals	12830	10539
Pulses	4589	4627
Oils and oilseeds	2553	2436
Non-veg foods	2945	2824
Milk and milk products	4296	3791
Fruits and vegetables	4887	4447
Other food items	3471	3069
Total	35571	31733
Non-food		
Health	2113	1928
Education	7110	4055
Clothing/shoes	4263	3334
Toddy, alcohol, *bidi* and cigarettes	3185	2923
Entertainment and travel	2635	2494
Other non-food items including ceremonies	5035	4573
Total	24341	19307
Grand total expenditure	59912	51040

consumption expenditure per household per year is slightly higher in adopted villages (₹59912) when compared with controlled villages (₹51040).This trend is in contrast to the earlier pattern observed in household income of the sample farmers in the adopted and control villages. In both adopted and control villages, the expenditure incurred on cereals was around 20% of the total expenditure. Yet, the expenditures on food and non-food items were higher in sample households in adopted villages when compared with control villages. The food expense was around 60-62% whereas non-food expense was about 38-41% across two categories of sample farmers. Expenditure on education was the single largest component among non-food items in adopted villages than in control villages.

Pigeonpea traits preferred by farmers and markets

The agronomic traits of pigeonpea which farmers prefer the most is high yield followed by biotic resistance (see Table 3.16) in both the control and adopted villages of Andhra Pradesh. Ability to fit into the existing cropping systems and more recovery percentage of dal are the other important traits considered by farmers while choosing a variety. Short-duration of crops was next in order of preference for producer farmers in the study districts.

Table 3.16. Farmer-preferred traits of pigeonpea in Andhra Pradesh, 2007-08 [1].

Trait	Adopted villages	Control villages
High yield	45 (1)	48 (1)
Short duration	19 (6)	18 (7)
Disease resistance	37 (3)	39 (3)
Pest resistance	41 (2)	45 (2)
Suitability in existing cropping system	28 (4)	31 (4)
More recovery percentage of dal	22 (5)	25 (5)
Improves soil fertility	15 (7)	21 (6)
Drought tolerance	12 (8)	15 (8)

1. Garrett scores; figures in parentheses represent ranks in descending order of importance.

The traits preferred in the market are high market demand followed by medium seed size, white seed and better market price (see Table 3.17). Slight deviation was observed in the order of preferred traits between adopted and control village sample households.

Table 3.17. Market-preferred traits of pigeonpea in Andhra Pradesh, 2007-08[1].

Trait	Adopted villages	Control villages
High demand	47 (1)	56 (1)
Seed size (medium)	32 (2)	31 (2)
Seed color (white)	20 (3)	9 (4)
Fetches high price	8 (4)	10 (3)

1. Garrett scores; figures in parentheses represent ranks in descending order of importance.

When farmers were asked how much they are willing to pay more for the seeds by incorporating the desired traits, they responded positively. The responses were averaged among adopted and control villages and are presented in Table 3.18. High yield is the most desired trait for which the farmers are willing to pay around 20-25% more price per kg of seed. Next, they expressed willingness to pay 20% and 18% more for seeds with better taste and disease and pest resistance characteristics respectively. The variety with large seed size will be bought at 16% higher price. Market preference and short-duration traits would also influence the farmers' willingness to pay more over base price of seed.

Table 3.18. Price premium which farmers are willing to pay for pigeonpea traits in Andhra Pradesh, 2007-08.

	Price of seed[1]	
Trait	Adopted villages	Control villages
High yield	25	19
Disease and pest resistance	20	17
Seed size (medium)	18	15
Better taste	22	18
Short duration	14	12
Market preference	16	16

1. Percentage over base price.

Gender issues

In agriculture sector in India, women play a predominant role along with the men but they have very little command on the ownership rights and decision-making. In both the adopted and control villages, the ownership of assets was mostly entitled towards men. Only one woman member owned the land out of a total sample of 135 (see Table 3.19). Ownership of livestock also is mainly with the men. Again, the ownership of a capital item like machinery was also heavily skewed towards men. Only one woman member owned some of the assets in the entire study population. In general, ownership by women is largely confined to women-headed households in the study.

Table 3.19. Ownership of assets by gender in sample households in Andhra Pradesh, 2007-08.

		No. of persons	
Resource	Gender	Adopted villages	Control villages
Land	Female	1	0
	Male	86	38
	Jointly	3	7
Livestock	Female	2	0
	Male	84	39
	Jointly	4	6
Machinery	Female	1	0
	Male	86	41
	Jointly	3	4

As discussed earlier, due to lack of ownership and cultural belief, opinion of women was not considered much in decision-making in day-to-day activities (see Table 3.20). Decisions relating to land, machinery and labor use are largely taken by men. Women have some say only in decisions relating to livestock. But a majority of decisions relating to household maintenance, education of children and marriages of children are jointly taken by both men and women. Women also emerge as decision-makers in some of the households in the study villages.

Table 3.20. Decision-making by gender in sample households in Andhra Pradesh, 2007-08.

		No. of persons	
Resource	Gender	Adopted villages	Control villages
Land	Female	2	0
	Male	58	38
	Both	30	7
Livestock	Female	1	0
	Male	59	35
	Both	30	10
Machinery	Female	1	0
	Male	69	36
	Both	20	9
Labor use	Female	2	0
	Male	54	31
	Both	34	14
Children's marriage	Female	0	0
	Male	14	7
	Both	76	38
Education of children	Female	1	0
	Male	13	5
	Both	76	40
Household maintenance	Female	0	0
	Male	11	7
	Both	79	38

Due to their preoccupation with household work, women take part in less intensive agricultural activities when compared to men (see Table 3.21). The selection of pigeonpea and its variety was the prerogative of the men folk. The women folk had generally little say in this regard. However, hand weeding was the major responsibility of women during the crop season. Apart from that, women participate significantly in farm operations like field cleaning, sowing, harvesting of main crop and fodder, etc.

Maharashtra

Socioeconomic and demographic characteristics of sample

The details of socioeconomic characteristics of Maharashtra sample farmers are summarized in Table 3.22. Nearly, 94% of the households were male-headed in adopted villages whereas the proportion was around 91% in control villages. The average age of household head (51 years) and levels of education

Table 3.21. Performance of farm operations by gender in sample households in Andhra Pradesh, 2007-08.

		Persons (%)	
Operation	Gender	Adopted villages	Control villages
Field cleaning	Female	37.78	53.33
	Male	27.78	15.56
	Jointly	32.22	31.11
Land preparation	Female	2.22	4.44
	Male	95.56	88.89
	Jointly	2.22	6.67
Sowing seed	Female	46.67	53.33
	Male	10	6.67
	Jointly	37.78	40
Hand weeding	Female	84.44	91.11
	Male	8.89	4.44
	Jointly	5.56	4.44
Fertilizer application	Female	4.44	6.67
	Male	76.67	66.67
	Jointly	17.78	24.44
Plant protection measures	Female	4.44	6.67
	Male	87.78	84.44
	Jointly	7.78	6.67
Harvesting main crop	Female	4.44	8.89
	Male	28.89	28.89
	Jointly	66.67	62.22
Harvesting fodder	Female	30	33.33
	Male	10	0
	Jointly	60	66.67

Table 3.22. Socioeconomic profile of sample farmers in Maharashtra, 2007-08.

Parameter	Adopted villages	Control villages
Male-headed households (%)	94.5	91.1
Household size (No.)	6	5
Male workers (No.)	2	3
Female workers (No.)	2	1
Dependency ratio[1]	0.5	0.3
Age of household head (years)	51	52
Education level of household head (No. of years)	7	7
Participation in local bodies (%)	2.2	0.0
Proportion with agriculture as the main occupation (%)	87	97.8
Proportion with business/service as secondary occupation (%)	17.8	33.3
Ownership of two-wheelers/bicycles (%)	28	29
Ownership of television sets (%)	38	29
Ownership of radio/tape recorder (%)	33	23

1. Dependency ratio = (Family size – No. of workers)/No. of workers

(7 completed years) were almost similar in both adopted and control villages. But the dependency ratio was higher in adopted sample households (0.5) than that of control sample (0.3). The level of education increased with increase in farm size in control sample households. Relatively, the education status of sample farmers was slightly better in Maharashtra than in Andhra Pradesh. Only 2% of the farmers in the sample participated in local bodies in adopted villages whereas their participation was completely absent in control villages of Maharashtra. The major source of income of sample households was agriculture. Nearly 87% of the adopted sample households depended on agriculture while the proportion was much higher at 98% in control villages. Business/service as main/secondary occupation was observed in nearly 18% sample households in adopted villages while it was higher at 33% in control villages. Around one-third of the sample households under the two categories possessed two-wheelers/bicycles. A slightly higher proportion of them also had television sets in their households in Akola district.

Resource endowments of sample households

The details of land owned by sample farmers are summarized in Table 3.23. The average size of landholding was slightly higher in the adopted villages of Maharashtra than in control villages. Rainfed land contributed a major part of the total landholding in both the categories of sample households. Access to irrigation was slightly higher in adopted villages when compared with control villages. The portion of irrigated land increased with increase in the size of farm. Relatively, per unit mean land value of both irrigated and rainfed areas was higher in adopted villages than in control villages. Overall, an average household in adopted villages possessed land having 41% higher value than in control villages.

Table 3.23. Value of land (per household) owned by sample farmers in Maharashtra, 2007-08.

	Adopted villages		Control villages	
Land	Area (ha)	Value (₹)	Area (ha)	Value (₹)
Irrigated land	0.50	194061	0.40	98162
Rainfed land	2.54	608218	2.24	381493
Fallow land	0.00	0	0.00	0
Total land	3.04	802279	2.64	479655

The livestock owned by sample farmers in Maharashtra are furnished in Table 3.24. The number of livestock owned by an average household was slightly higher in control villages than in adopted villages. The relative number of draft animals and cows/buffaloes per household was also high in control villages. The data clearly indicates that the farmers in both categories of villages had more dependency on both draft and milch animals for agriculture and their livelihood. However, total value of owned livestock per household was 27% higher in adopted villages than in control villages.

Table 3.24. Livestock owned by sample farmers in Maharashtra, 2007-08.

	Adopted villages		Control villages	
Livestock	No. per household	Value (₹)	No. per household	Value (₹)
Draft animals	1.09	30556	1.18	20422
Cows and buffaloes	1.93	12518	2.40	13680
Goats and sheep	0.61	944	0.27	433
Total livestock	3.63	44018	3.85	34535

The value of farm implements owned by sample farmers in Maharashtra is tabulated in Table 3.25. The presence of tractor and accessories per household was more prevalent in control villages while their ownership was lower in adopted villages. The value of tractor and accessories holds the lion share in total value of farm implements in both categories of villages. The total value of farm implements owned in control villages was much higher at ₹66695 per household than in adopted villages with ₹25352 per household. The marginal and small farmers in Maharashtra owned a fairly large number of farm implements under the custom hiring scheme. They were also earning a substantial income by hiring out their farm implements.

Table 3.25. Farm implements owned by sample farmers in Maharashtra, 2007-08.

	Adopted villages		Control villages	
Implement	No. per household	Value (₹)	No. per household	Value (₹)
Tractor and accessories	0.03	12222	0.13	57778
Bullock-drawn tools	0.42	3894	0.42	4556
Manual/power sprayers	0.46	469	0.38	694
Sprinkler sets	0.07	656	0.00	0
Electrical pump sets	0.39	3944	0.00	0
Others	0.07	4167	0.04	3667
Total farm implements	1.43	25352	0.98	66695

The value of consumer durables owned by sample farmers in Maharashtra is presented in Table 3.26. The value of consumer durables per household was higher (nearly 30%) in control villages than in adopted villages. In general, the total value of consumer durables increased with increase in farm size in Maharashtra.

Table 3.26. Value (₹ per household) of consumer durables owned by sample farmers in Maharashtra, 2007-08.

Type of consumer durables	Adopted villages	Control villages
Residential house	164722	206156
Cattle shed	9911	22000
Cycle/two-wheelers	9342	9634
Others	6927	8264
Total consumer durables	190902	246054

Table 3.27 gives an account of the financial assets and liabilities of the sample farmers in Maharashtra. The sample farmers in adopted villages had the highest borrowing per household compared to control villages in the study area. Institutional source of credit constituted the maximum share in the total borrowing of both adopted and control villages. Village moneylenders have fewer shares in Maharashtra when compared to Andhra Pradesh villages. In general, most of the savings per household were in the form of bank deposits, followed by LIC policies and Postal Saving Schemes in the study district. Despite less savings in the control villages, the net liabilities were lower in control villages compared to adopted villages. The prevailing interest rates were around 7% in cooperatives, 6.5% in nationalized banks and 10% with private moneylenders in the villages. However, the interest rates were quite rational and moderate in Maharashtra compared to Andhra Pradesh.

Table 3.27. Financial liabilities (₹ per household) of sample farmers in Maharashtra, 2007-08.

Financial liabilities	Adopted villages	Control villages
Borrowing (-)	22256	18933
Lending (+)	-	-
Savings (+)	4252	3127
Net liabilities	-18003.3	-15806.7

Comparatively, the sample households in adopted villages were more wealthy despite higher net liabilities than those in control villages (Table 3.28). The control villages had lower asset values than those of the adopted villages which finally resulted in lower net worth per household.

Table 3.28. Net worth (₹ per household) of sample farmers in Maharashtra, 2007-08.

Assets and liabilities	Adopted villages	Control villages
Value of land	802279	479655
Value of livestock	44018	34535
Value of farm implements	25352	66695
Value of consumer durables	190902	246054
Total assets	1062551	826939
Net liabilities	-18003	-15807
Net worth	1044548	811132

Place of pigeonpea in cropping pattern and productivity levels

In Maharashtra, the total rainy season cropped area was around 211.22 ha in adopted villages while it was around 96.77 ha in control villages (Table 3.29). Since most of the cropped area is rainfed dependent, crops were cultivated only during the rainy season. The lands were left fallow during the postrainy season in both adopted and control villages. In general, farmers in the study area prefer to grow pigeonpea as intercrop (preferably with cotton, soybean and green gram or mung bean) than sole crop. They practice these cropping systems to minimize the risk in rainfed agriculture and maximize the income per ha. The major advantage for farmers in cultivating intercrops was maximum assurance of certain income either from the main crop or intercrop. Pigeonpea area constituted around 93.5% and 96.2% of the total cropped area respectively in adopted and control villages. This clearly demonstrates the preference of pigeonpea in the study area.

Table 3.29. Relative importance of pigeonpea in sample farms in Maharashtra, 2007-08.

Cropped area	Adopted villages	Control villages
Rainy season cropped area (ha)	211.22	96.77
Postrainy season cropped area (ha)	0.00	0.00
Total cropped area (ha)	211.22	96.77
Area under pigeonpea (as intercrop) during *kharif* (ha)	197.46	93.09
Proportion of pigeonpea area in total cropped area (%)	93.49	96.20

During the baseline survey, sample farmers were asked to give their perceptions of possible pigeonpea yields under different weather situations. In a good season, pigeonpea yields were perceived to be quite high even under rainfed situation and were slightly higher in the best season (Table 3.30). In a bad season, the yields dwindled to 1/5 of the good year yields in both adopted and control villages. This

Table 3.30. Productivity level (kg ha^{-1}) of pigeonpea perceived by sample farmers in Maharashtra, 2007-08.

Perceived yield	Adopted villages	Control villages
Rainfed		
Good	756	743
Bad	225	198
Best	934	845
Irrigated		
Good	1482	1359
Bad	296	247
Best	1510	1375

may be because of high sensitivity of pigeonpea to moisture stress and weather aberrations. In general, the crop yields are expected to go up by another 10-20% with the support of supplement irrigation when compared with rainfed condition. Overall, the average productivity level was slightly higher in adopted villages than that in control villages. This may be possible because of availability of good soil and adoption of better management practices.

Technology adoption and source of information

Maruti was the first improved variety of pigeonpea introduced in Maharashtra in 1999-2000 and it occupied the peak area of its adoption within a short period. Based on the baseline survey conducted in 2007-08, Maruti occupied 177 ha with a major share of 89% of the total pigeonpea area in adopted villages followed by Asha (8%) and Vipula (1.9%) (Table 3.31). Similarly, 95% of the pigeonpea cropped area in control villages was dominated by Maruti followed by Asha (3.5%) and Vipula (1.7%). The awareness and spread of these improved varieties was impressive in both adopted and control villages during the survey year. It was possible largely because of the prior contacts the sample farmers had with the research stations and scientists and subsequent efforts of Agricultural Universities and Department of Agriculture and Extension.

Table 3.31. Distribution of pigeonpea varieties in Maharashtra, 2007-08.

	Adopted villages		Control villages	
Variety	Area (ha)	% of total pigeonpea area	Area (ha)	% of total pigeonpea area
Maruti	176.76	89.52	88.24	94.78
Durga	1.22	0.62	0.00	0.00
Vipula	3.76	1.91	1.62	1.74
Asha	15.72	7.96	3.24	3.48
Total	197.46	100.00	93.1	100.00

Different sources of information about new technologies for sample farmers of Maharashtra are summarized in Table 3.32. Newspaper was the major source of technology transfer in the adopted villages. It was followed by mass media communication devices like television and radio which played an important role in information dissemination. Fellow farmers, newsletters and input-dealers always have significant impact in transfer of technology. Research institutes and NGOs were least important sources.

Table 3.32. Sources of information on technology to sample farmers in Maharashtra, 2007-08[1].

Sources of information	Farmers (%) getting information from the source	
	Adopted villages	Control villages
TV	36.42 (2)	22.00 (3)
Radio	25.78 (3)	33.69 (1)
Newspaper	38.90 (1)	26.67 (2)
Agriculture magazine/newsletter	12.13 (5)	20.13 (5)
Farmers	19.78 (4)	20.84 (4)
Friends/relatives	9.21 (7)	12.44 (6)
Input supplier	9.43 (6)	11.04 (7)
Research institute	0.34 (8)	2.07 (8)
NGOs	-	-
Others	-	-

1. Figures in parentheses indicate rank of importance as source of information.

Radio and newspaper were major sources of new agricultural technology in control villages as well. Television sets and fellow farmers were in the next priority order of list.

Viability of pigeonpea in the study area

The relative gross returns from different pigeonpea-based cropping systems are presented in Table 3.33. In general, pigeonpea in Maharashtra was mostly grown as intercrop with cotton, green gram, soybean and sorghum. It was rarely grown as a sole crop in the study area. Intercropping of pigeonpea was the major practice in *kharif* and was observed in both adopted and control villages of Maharashtra. Among all the combinations, cotton + green gram + pigeonpea gave the highest income per ha in both categories of sample villages.

Table 3.33. Gross returns (₹ per ha) from different crops grown by sample farmers in Maharashtra, 2007-08.

Cropping systems	Adopted villages (Rainfed/Irrigated)	Control villages (Rainfed)
Cotton + pigeonpea[1]	33000/62000	29000
Cotton + green gram + pigeonpea	45000/69000	41000
Cotton + sorghum + pigeonpea	36000/66000	32000
Sorghum + pigeonpea	29000	26000
Soybean + pigeonpea[1]	34000	35000

1. Predominant intercropping systems.

The cost and returns of major improved varieties of pigeonpea, namely, Asha, Maruti and Durga under rainfed cultivation were calculated with baseline information. The cost of cultivation per ha for Asha was slightly higher in control villages than in adopted villages while it was vice-versa for Durga (Table 3.34). A similar trend was observed in gross returns for Asha and Durga. The highest productivity and profitability per ha was noticed in Asha followed by Maruti and Durga. The lowest yield levels and benefit-cost ratios were observed in Durga. Overall, the benefit-cost ratio of cultivation was better in Asha followed by Maruti and Durga. These differences were due to high-yielding ability of Asha over Maruti and Durga.

Table 3.34. Economics of three improved varieties of pigeonpea in Maharashtra, 2007-08.

Cost/returns	Adopted villages	Control villages
Asha		
Yield (kg ha^{-1})	980	1050
Cost of cultivation (₹ ha^{-1})	17464	18134
Gross returns (₹ ha^{-1})	25279	26927
Net returns (₹ ha^{-1})	7815	9793
Benefit-cost ratio	1.44	1.48
Maruti		
Yield (kg ha^{-1})	921	NA[1]
Cost of cultivation (₹ ha^{-1})	17318	NA
Gross returns (₹ ha^{-1})	20341	NA
Net returns (₹ ha^{-1})	3033	NA
Benefit-cost ratio	1.17	NA
Durga		
Yield (kg ha^{-1})	843	752
Cost of cultivation (₹ ha^{-1})	18745	17103
Gross returns (₹ ha^{-1})	19546	17544
Net returns (₹ ha^{-1})	801	441
Benefit-cost ratio	1.04	1.02

1. NA = Data not available.

Income and expenditure

The major sources of annual net income of sample farmers in Maharashtra are presented in Table 3.35. The income from cultivation of crops had the highest share constituting around 65% in the total income of both adopted and control village samples. The other major sources of income were obtained from salaried jobs (6.24%) followed by farm labor (5.85%) and business (5.43%) in adopted villages. Rental income obtained from hiring out farm implements, etc constituted a significant (5%) source of income in adopted villages. Mechanization of agriculture is widely practiced in Maharashtra due to the non-availability of adequate labor for timely agricultural operations. Income from livestock contributed nearly 10% share of total household income in control villages. Hiring out farm implements and machinery also generated 9% of the total income. Overall, the net income per household was comparatively higher (8%) in control sample than that of adopted sample.

Table 3.36 presents the pattern of household consumption expenditure in the sample villages of Maharashtra. The total expenditure of control villages is marginally higher by 15% compared to that of the adopted villages. Control villages incur higher expenditure on both food and non-food items compared to the adopted villages. The farmers in the study area of Maharashtra were mainly wheat consumers, which constituted about 70% of the total expenditure of cereals and millets consumption. Among pulses, pigeonpea had the highest share of expenditure. The amount incurred on cereals, pulses, edible oils and non-vegetarian foods was similar in both categories of villages. But significant variations erupted only in non-food expenditures such as health, education, toddy and alcohol consumption.

Pigeonpea traits preferred by farmers and markets

Among the different production traits, farmers prefer high yield the most, followed by medium duration and drought resistance (see Table 3.37). Pest and disease resistance, suitability in existing cropping

Table 3.35. Average annual net income (per household) of sample farmers in Maharashtra, 2007-08.

Sources of income	Adopted villages		Control villages	
	Amount (₹)	Share (%)	Amount (₹)	Share (%)
Crops	76133	67.90	79295	65.33
Farm work (labor earnings)	6563	5.85	2022	1.67
Non-farm work (labor earnings)	0	0.00	0	0.00
Regular farm servant	0	0.00	0	0.00
Livestock (sale of milk and milk products)	3278	2.92	12644	10.42
Hiring out bullocks	733	0.65	0	0.00
Sale of sheep, goat, chicken, meat, eggs, etc	444	0.40	0	0.00
Rental income (tractor, auto, sprayer, truck, etc)	4689	4.18	11111	9.15
Rent from land, building, machinery, etc.	0	0.00	0	0.00
Caste occupations	3667	3.27	0	0.00
Business	6089	5.43	8578	7.07
Regular salaried jobs (Government/private)	7000	6.24	3467	2.86
Out-migration	0	0.00	0	0.00
Cash and kind gifts including dowry received	0	0.00	4267	3.52
Total	112130	100.00	121383	100.00

Table 3.36. Annual consumption expenditure (₹ per household) of sample farmers in Maharashtra, 2007-08.

Item	Adopted villages	Control villages
Food		
Cereals	5132.5	5471.7
Pulses	3495.6	3438.5
Oils and oilseeds	4418.5	4816.0
Non-veg foods	2228.1	1533.3
Milk and milk products	6954.6	6652.8
Fruits and vegetables	4847.3	9249.6
Other food items	5043.6	4410.9
Total	32120.3	35572.9
Non-food		
Health	1445.6	1093.3
Education	1624.4	3776.0
Clothing/shoes	1879.1	2125.8
Toddy, alcohol, *bidi* and cigarettes	770.9	1140.4
Entertainment and travel	1405.6	1343.7
Other non-food items	4002.3	4698.8
Total	11127.9	14178.1
Grand total	43248.2	49751.1

Table 3.37. Farmer-preferred traits of pigeonpea in Maharashtra, 2007-08[1].

Trait	Adopted villages	Control villages
High yield	62.18 (1)	66.66 (1)
Short duration	30.99 (2)	38.73 (2)
Drought resistance	30.62 (3)	17.05 (3)
Pest resistance	17.91 (4)	8.55 (5)
Disease resistance	7.87 (5)	5.39 (6)
Suitability in existing cropping system	3.01 (6)	16.91 (4)
Improves soil fertility	2.88 (7)	1.32 (8)
More recovery percentage of dal	0.61 (8)	1.39 (7)

1. Garrett scores; figures in parentheses represent ranks in descending order of importance.

system and high recovery of dal were the other preferred traits by the sample farmers. The preferences for different traits were more or less in the same priority order in both the adopted and control villages.

High demand, medium seed size and dark brown seed were the major traits preferred by various stakeholders in the marketing process (Table 3.38). Higher price per unit and higher demand were the major interests of traders in control villages.

Table 3.38. Market-preferred traits of pigeonpea in Maharashtra, 2007-08[1].

Trait	Adopted villages	Control villages
High demand	55.30 (1)	51.67 (2)
Fetches high price	22.28 (4)	56.82 (1)
Seed color (dark brown)	31.67 (3)	35.77 (3)
Seed size (medium)	39.44 (2)	5.74 (4)

1. Garrett scores; figures in parentheses represent ranks in descending order of importance.

During the survey, farmers were asked to indicate the premium price they would like to pay for seeds incorporating the desired traits. Sample farmers from adopted village were willing to pay 37.5% over base price for seeds having better taste (see Table 3.39). They also expressed willingness to pay 36.36% more for drought resistant trait and around 35% more for bigger seed size. Short duration (26%) and dark brown seed (24%) were other pigeonpea traits preferred by farmers in adopted villages.

Table 3.39. Price premium which farmers are willing to pay for pigeonpea traits in Maharashtra, 2007-08.

	Price of seed[1]	
Traits	Adopted villages	Control villages
High yield	23.76	-
Disease and pest resistance	-	50.00
Seed size (medium)	34.65	23.10
Drought resistance	36.36	45.45
Better taste	37.50	30.50
Short duration	25.62	36.36
Seed color (dark brown)	24.48	21.99

1. Percentage over base price.

While the sample farmers in control villages were prepared to pay 50% more for pest and disease resistance traits, they were also interested to pay 45% higher price for traits like drought tolerance followed by 36.4% for short duration, 30.5% for better taste and 23.1% for bigger seed size. The traits prioritized by the sample farmers must be incorporated in the research agenda of crop improvement in pigeonpea.

Gender issues

The ownership of assets was majorly by men in male-headed households in both adopted and control villages of the study area (see Table 3.40). The ownership of the land assets by women is very limited; 8 in adopted villages and only 3 in control villages. In case of livestock ownership, only 4 and 2 female members were holding ownership in adopted and control villages respectively. The ownership of non-land assets like machinery by women is completely absent. So the ownership of resources and their utilization, in general, were mostly with the men, and the women had little say in this.

Table 3.40. Ownership of assets by gender in sample households in Maharashtra, 2007-08.

		No. of persons	
Resource	Gender	Adopted villages	Control villages
Land	Female	8	3
	Male	82	42
	Jointly	0	0
Livestock	Female	4	2
	Male	67	32
	Jointly	19	11
Machinery	Female	0	0
	Male	5	4
	Jointly	0	0

In general, the male-headed households were maintained either by men or jointly by men and women. The assets such as land, livestock and farm implements were majorly owned by men (Table 3.41). Men had a significant role in input management such as credit, seeds, fertilizers and pesticides, while the extent of usage of labor, both own and hired labors were jointly decided by men and women. Women had a role only in the household maintenance, children's education and children's marriage.

In general, the participation of women alone in field operations is limited for pigeonpea in Maharashtra (see Table 3.42). Almost all the operations are either jointly performed by men and women or exclusively by men. Due to their preoccupation with household work, women take less part in agricultural activities when compared to men. The selection of pigeonpea and its variety was the prerogative of the men folk only. The women folk had generally little choice in this regard. However, the hand weeding operation was the major responsibility of women. Women had a minor role in other operations like field cleaning, seed sowing and plant protection measures.

Table 3.41. Decision-making by gender in sample households in Maharashtra, 2007-08.

Resource	Gender	No. of persons	
		Adopted villages	Control villages
Land	Female	4	1
	Male	83	44
	Both	2	0
Livestock	Female	4	0
	Male	69	34
	Both	1	0
Machinery	Female	0	0
	Male	5	4
	Both	0	0
Children's marriage	Female	20	17
	Male	1	4
	Both	19	5
Education of children	Female	45	28
	Male	0	0
	Both	2	0
Household maintenance	Female	86	44
	Male	1	0
	Both	3	1

Table 3.42. Performance of operations by gender in sample households in Maharashtra, 2007-08.

Operation	Gender	Persons (%)	
		Adopted villages	Control villages
Field cleaning	Female	6.66	0
	Male	87.78	100
	Jointly	5.56	0
Land preparation	Female	5.56	6.67
	Male	92.22	93.33
	Jointly	2.22	0.00
Sowing seed	Female	5.56	4.44
	Male	85.56	95.56
	Jointly	8.89	0.00
Hand weeding	Female	90.00	97.78
	Male	6.67	2.22
	Jointly	3.33	0.00
Fertilizer application	Female	7.78	2.22
	Male	86.67	91.11
	Jointly	5.56	6.67
Plant protection measures	Female	5.56	0.00
	Male	82.22	95.56
	Jointly	12.22	4.44
Harvesting main crop	Female	2.22	0.00
	Male	82.22	95.56
	Jointly	15.56	0.00
Irrigation	Female	1.11	2.22
	Male	24.44	11.11
	Jointly	1.11	8.89

4. Farmers' Participatory Varietal trials

As part of the TL-II Project strategy, FPVS trials were conducted in the adopted villages of Rangareddy and Mahabubnagar districts of Andhra Pradesh and Akola district of Maharashtra to introduce new varieties in farmers' fields so that farmers could select the varieties with the traits preferred by them. Besides recording the data on yield in the FPVS trials, farmers who visited the trials were also asked to rank the varieties based on their trait preferences. The results of FPVS trials and farmers' selection feedback for Andhra Pradesh and Maharashtra are discussed.

A 'mother' trial tests all the promising varieties at the same location and when it is conducted on several farmers' fields in a village, these locations serve as replications. By observing the relative performance of the varieties in all the trials in a village, farmers in the village and visitors will be in a position to assess the average performance of these varieties in the village. They can also assess the seed characteristics like size, color and dal recovery percentage. Since plant breeders and social scientists jointly record the preferences of the farmers for different varieties with respect to production and market traits, they will be in a position to accord scores to the varieties by trait. 'Baby' trials test only two or three varieties with a particular farmer. While all the varieties figure in baby trials with at least some farmers, it is possible that the soil fertility status and management ability of the farmers may influence the performance of some varieties. Therefore, the analysis is restricted to only mother trials so that the results will not be clouded by the uncontrollable factors like soil fertility and management ability.

Andhra Pradesh

Trial locations and details of mother and baby experiments

Considering the importance of pigeonpea in low rainfall areas of the state, the project has targeted to conduct FPVS trials in Rangareddy and Mahabubnagar districts of Andhra Pradesh to demonstrate the comparative performance of selected improved varieties. Mother and baby trials were conducted successfully in both the selected districts during 2008/09 *kharif* season (see Table 4.1). The varieties Asha, Maruti and Lakshmi developed by ICRISAT, LRG 41 and PRG 158 developed by ANGRAU (Acharya NG Ranga Agricultural University), one pigeonpea hybrid ICPH 2671 developed by ICRISAT and one local cultivar Nallakandi were used as experimental material to conduct FPVS trials. Data from both mother and baby trials were collected and analyzed systematically. The mother trial consisted of full set of varieties including control and these were sown at one location in each mandal (a total of 4 mother trials in 2 districts). Baby trials were conducted at random with 2 or 3 varieties in a farmer's plot in a village. The heterogeneity in location, soil type and irrigation support is very wide in the baby trials. The baby trials were sown with two test varieties and a local check for evaluation in the villages.

Profile characteristics of farmers

An innovative attempt was made by both the breeders and economists to collect the data on responses of farmers regarding the performance of improved varieties in the mother trials. A short survey instrument was prepared and data were collected from 20 farmers to elicit information on preferred traits, which were subsequently used in the Garrett score calculations and ranked accordingly. It was also observed that the farmers may get confused in ranking the varieties, as the number of varieties in the trial increases. Further, to judge the adoption and technology diffusion process, information on different socioeconomic indicators like age, education and association with groups was collected and analyzed.

Table 4.1. Details of pigeonpea mother trials conducted in Andhra Pradesh, 2008-09.

Location	Variety	Disease incidence (%)			Insect incidence		Yield (kg ha^{-1})
		Phytopthora blight	Fusarium wilt	Sterility mosaic	*Heliothis*	*Maruca*	
Kodangal (Mahabubnagar)	Asha[1]	Nil	Nil	Nil	Negligible	Negligible	960
	Maruti	Nil	Nil	25	Negligible	Negligible	800
	Lakshmi	Nil	20	30	Negligible	Negligible	700
	PRG 158	Nil	10	40	Negligible	Negligible	720
	LRG 41	Nil	20	25	Negligible	Negligible	820
	ICPH 2671[1]	Nil	Nil	Nil	Negligible	Negligible	970
	Local	Nil	20	25	Negligible	Negligible	600
Naacharam (Mahabubnagar)	Asha[1]	Nil	Nil	Nil	Negligible	Negligible	1120
	Maruti[1]	Nil	Nil	Nil	Negligible	Negligible	1100
	Lakshmi	Nil	10	Nil	Negligible	Negligible	950
	PRG 158[1]	Nil	Nil	Nil	Negligible	Negligible	1120
	LRG 41	Nil	Nil	Nil	Negligible	Negligible	1070
	ICPH 2671	80	Nil	Nil	Negligible	Negligible	550
	Local	Nil	20	Nil	Negligible	Negligible	500
Parvathapally (Rangareddy)	Asha[1]	Nil	Nil	Nil	Negligible	Negligible	1230
	Maruti	Nil	Nil	Nil	Negligible	Negligible	1050
	Lakshmi	Nil	10	25	Negligible	Negligible	970
	PRG 158	Nil	Nil	35	Negligible	Negligible	1160
	LRG 41	Nil	40	25	Negligible	Negligible	1010
	ICPH 2671[1]	Nil	5	10	Negligible	Negligible	1245
	Local	Nil	60	60	Negligible	Negligible	780
Tandur (Rangareddy)	Asha[1]	Nil	Nil	Nil	Negligible	Negligible	1350
	Maruti	Nil	Nil	25	Negligible	Negligible	875
	Lakshmi	Nil	10	30	Negligible	Negligible	920
	PRG 158	Nil	Nil	40	Negligible	Negligible	960
	LRG 41	Nil	40	25	Negligible	Negligible	870
	ICPH 2671	50	Nil	Nil	Negligible	Negligible	800
	Local	Nil	60	60	Negligible	Negligible	600

1. Preferred varieties.

Socioeconomic profile of the respondents

Of the 20 farmer respondents, half of the sample belonged to Rangareddy while the remaining belonged to Mahabubnagar district. Of the 20 respondents, 14 belonged to the age group of 35 to 55 years. The remaining six respondents belonged to young category (25 to 35 years). All the respondents were men except one. About 60% of the respondents belonged to farmers' organization or had affiliation to other groups such as Rythumitra. About 45% of the farmer respondents had education levels between 5 and 10 years while another 25% had education up to 12 years. The respondents visited the trials during the flowering, maturity and harvesting stages indicating random distribution of farmers at different stages of crop growth. Nearly 75% of the FPVS trial plots had pigeonpea crop during the previous season.

Pigeonpea varieties and traits preferred by farmers

The preferences for different traits and varieties given by the farmers in Rangareddy district are summarized in Table 4.2. Asha scored the highest rank of 9 over the other varieties in terms of plant

Table 4.2. Crop growth characters of pigeonpea varieties in Rangareddy district, 2008-09.

Crop growth trait	Asha (ICPL 87119)	Maruti (ICP 8863)	Lakshmi (ICPL 85063)	PRG 158	LRG 41	ICPH 2671	Local
Plant vigor (rank)	4	4	3	4	4	4	3
Leaf color	Green	Green	Green	Green	Green	Green	Green
Resistance to drought	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant
Resistance to wilt	Resistant	Resistant	Tolerant	Resistant	Susceptible	Resistant	Susceptible
Resistance to sterility mosaic	Resistant	Susceptible	Susceptible	Susceptible	Susceptible	Resistant	Susceptible
No. of pods per plant	190	175	172	185	187	190	136
Seed size	Medium	Medium	Medium	Medium	Medium	Bold	Small
No. of seeds per pod	4	4	4	4	4	4	3
Pod filling	Good	Good	Good	Good	Good	Good	Good
Healthy pods per plant	177	150	150	159	163	173	98
Maturity (days)	180	165	170	160	180	170	165
Expected grain yield	1250	950	975	1050	1050	1125	650
Overall rank	9	7	7	7.5	7.5	8	5

vigor, biomass for fodder, pods per plant, healthy pods per plant and expected grain yield. ICRISAT pigeonpea hybrid ICPH 2671 scored 8 and was preferred by the farmers for bold seed, number of pods per plant, number of healthy pods per plant and biomass fodder yield. The varieties PRG 158 and LRG 41 were preferred mainly because of their tolerance to drought and high expected grain yield. However, Maruti was liked by farmers due to its resistance to wilt and moderately high-yielding nature. The local cultivar has small seed size, lower expected yield levels, relatively lower number of pods per plant and three seeds per pod compared to improved varieties. Overall, the clear message from farmers was high preference for improved varieties Asha, ICPH 2671 and PRG 158 in Rangareddy district. The project team has to follow a strategy for mass seed production campaign to meet the growing demand for seed of these varieties in the study area.

The traits and varieties preferred by the farmers in Mahabubnagar district are furnished in Table 4.3. The Garrett scores computed indicated that farmers preferred Asha, PRG 158 and LRG 41 in Mahabubnagar district. These varieties were scored highest with respect to plant vigor and growth, pods per plant, healthy pods per plant and expected grain yield. Maruti and ICPH 2671 were placed in second rank as they were preferred for good size of pod and expected grain yield. Lakshmi was ranked third followed by the local check. The performance of Lakshmi was relatively better than the check in terms of yield and tolerance to wilt.

The overall rating of economically desirable traits of pigeonpea in Andhra Pradesh is summarized in Table 4.4. ICPH 2671 and Asha stood top in the list when compared with other improved varieties used in FPVS trials. These were closely followed by Maruti, PRG 158 and Lakshmi. ICPH 2671 was recommended for bulk seed production and distribution of free seed samples in the study locations.

Table 4.3. Crop growth characters of pigeonpea varieties in Mahabubnagar district, 2008-09.

Crop growth trait	Asha	Maruti	Lakshmi	PRG 158	LRG 41	ICPH 2671	Local
Plant vigor (rank)	4	4	4	4	4	4	2
Leaf color	Green	Green	Green	Green	Green	Green	Green
Resistance to drought	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant
Resistance to wilt	Resistant	Resistant	Tolerant	Resistant	Susceptible	Resistant	Susceptible
Resistance to sterility mosaic	Resistant	Susceptible	Susceptible	Susceptible	Susceptible	Resistant	Susceptible
No. of pods per plant	177	177	169	186	176	173	158
Seed size	Medium	Medium	Medium	Medium	Medium	Bold	Small
No. of seeds per pod	4	4	4	4	4	4	3
Pod filling	Good	Good	Good	Good	Good	Good	Good
Healthy pods per plant	163	165	155	165	165	155	129
Maturity (days)	180	165	170	160	180	170	165
Expected grain yield	1050	940	880	1090	1010	930	700
Overall rank	9	8	7	9	9	8	6

Table 4.4. Rating of improved pigeonpea varieties as per economically desirable traits in Andhra Pradesh.

Crop trait	Asha	Maruti	Lakshmi	PRG 158	LRG 41	ICPH 2671	Local
Cooking quality and taste	4	4	4	4	4	5	2
Yield	5	4	4	4	4	5	2
Resistance to pests and diseases	5	4	4	4	3	5	2
Expected farm price per kg seed	5	5	5	5	5	5	3
Dal recovery percentage	5	5	5	5	5	5	3
Preference for bold seed	5	4	4	4	4	5	3
Overall rank (farmer and trader)	5	4	4	4	4	5	2

Performance of varieties in the trials

Results of FPVS trials in Rangareddy district

Six improved varieties were tested along with the local check (Nallakandi) in the mother trials which were conducted in the villages of Parvathapally and Old Tandur of Rangareddy district. All the six improved varieties performed better than the check cultivar in the mother trials (Table 4.5). The margin of yield increase was highest with ICPH 2671 (59.62%) over the check in Parvathapally. It was followed by Asha, PRG 158, Maruti, LRG 41 and Lakshmi. In Old Tandur, the performance of Asha was better than other improved varieties. Relatively, the performance of ICPH 2671, PRG 158, Lakshmi, Maruti and LRG 41 was better in Parvathapally than in Old Tandur. Overall, the new improved varieties used in the FPVS trials created interest and enthusiasm among the farmers in Rangareddy district.

Table 4.5. Performance of pigeonpea varieties in mother trials in Rangareddy district of Andhra Pradesh, 2008-09.

	Average yield (kg ha^{-1})		Yield increase (%) over check	
Variety	Parvathapally	Old Tandur	Parvathapally	Old Tandur
ICPH 2671	1245	800	59.62	33.33
Asha	1230	1350	57.69	125.00
Maruti	1050	875	34.62	45.83
LRG 41	1010	870	29.49	45.00
PRG 158	1160	960	48.72	60.00
Lakshmi	970	920	24.36	53.33
Local check (Nallakandi)	780	600	-	-

Results of FPVS trials in Mahabubnagar district

As in Rangareddy, six improved varieties along with one local check were tested in mother trials conducted in Mahabubnagar district during 2008-09. All the six improved varieties gave higher yields than the check. ICPH 2671 gave the highest yield increase of 61.67% over the check (Tabe 4.6). It was followed by Asha with a margin of advantage around 60%. LRG 41 and Maruti performed moderately. Among the six varieties, the lowest performance was noticed in Lakshmi. On the whole, the results of mother trials have demonstrated the potentiality of improved technology in Mahabubnagar district of Andhra Pradesh.

Table 4.6. Performance of pigeonpea varieties in mother trials in Mahabubnagar district of Andhra Pradesh, 2008-09.

Variety	Average yield (kg ha^{-1})	Yield increase (%) over check
Asha	960	60.00
Maruti	800	33.33
Lakshmi	700	16.67
PRG 158	720	20.00
LRG 41	820	36.67
ICPH 2671	970	61.67
Local check (Nallakandi)	600	-

Feedback and selection of varieties by farmers

Four mother trials with seven varieties and 16 baby trials with three varieties including local check were conducted in eight villages each in Rangareddy and Mahabubnagar districts. The maximum yield registered was 1350 kg ha^{-1} in Asha in Old Tandur village of Tandur mandal and in Manthati village in Basheerbad mandal. The least yield of 760 kg ha^{-1} was observed in Maruti in Rampur in Tandur mandal. All the six varieties (Asha, ICPH 2671, Maruti, PRG 158, Lakshmi and LRG 41) performed better when compared with the check Nallakandi (see Table 4.7). According to the breeder's view, farmers preferred Asha and ICPH 2671 in Rangareddy district while in Mahabubnagar district they preferred Asha, PRG 158, LRG 41, ICPH 2671 and Maruti due to high yield and resistance to diseases and pests.

Table 4.7. Pigeonpea varieties and traits preferred by farmers as noted by breeders in Andhra Pradesh.

District	Varieties preferred by farmers	Preferred traits
Rangareddy	Asha	1. Disease resistance 2. High yield
	ICPH 2671	1. High yield 2. Disease resistance
Mahabubnagar	Asha	1. Disease resistance 2. High yield
	ICPH 2671	1. High yield 2. Disease resistance
	PRG 158	1. Disease resistance 2. High yield
	Maruti	1. Disease resistance 2. High yield
	LRG 41	1. High yield 2. Pest resistance

Maharashtra

Trial locations and details of mother and baby experiments

FPVS trials of pigeonpea intercropping system were conducted in Akola and Washim districts of Maharashtra under rainfed conditions with the active participation of the Krishi Vignan Kendra (KVK) and Agricultural Research Station (ARS). Progressive farmers from selected villages were identified for the conduct of mother and baby trials using FPVS approach. The most preferred traits of pigeonpea were selected with emphasis on wilt resistance, medium size, bold, red seed and suitability for intercropping with crops like soybean, cotton, green gram and black gram. The preference of the improved varieties varied from village to village depending on soil type, cropping system and the existing disease problems. During 2008/09, in total six mother trials were implemented in six villages and 91 baby trials in 15 villages of Akola and Washim districts of Maharashtra (see Table 4.8). The varieties tested in FPVS mother trials were Asha, PKV Tara, AKT 8811, ICPH 2671, BSMR 853, BSMR 736, BDN 708 and Vipula along with Maruti as a check variety. The demand for PKV Tara, BSMR 736, BDN 708 and Vipula was more as compared to other varieties. Although ICPH 2671 produced high yield, it was not preferred by farmers due to the dark color of the seed. Of six mother trials, data of only five mother trials was used for analysis due to scanty rainfall and crop failure in one location.

Table 4.8. Mother trial locations in Maharashtra, 2008-09.

Village	District
Kanzara	Akola
Durgapur	Akola
Nipana	Akola
Shelu Khadase	Washim
Shelgaon Ingole	Washim
Karda	Washim

Pigeonpea varieties and traits preferred by farmers

Among all the improved varieties, farmers still prefer Maruti even though the potential yield is lower than Asha, BSMR 736 and BSMR 853 (Table 4.9). Maruti was released in 1986 and its genetic purity might have gone down due to cross-pollination. When compared with new improved varieties, Maruti is susceptible to sterility mosaic but resistant to wilt. Because of its early maturity, medium seed and resistance to Fusarium wilt, it is highly preferred by farmers in the study region.

Table 4.9. Crop growth characters of pigeonpea varieties in Maharashtra, 2008-09.

Crop growth trait	Asha (ICPL 87119)	Maruti (ICP 8863)	BSMR 853	BSMR 736	BDN 708	ICPH 2671	Vipula
Plant vigor (rank)	4	4	4	4	4	4	2
Leaf color	Green	Green	Green	Green	Green	Green	Green
Resistance to drought	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant
Resistance to wilt	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Susceptible
Resistance to sterility mosaic	Resistant	Susceptible	Resistant	Resistant	Resistant	Resistant	Susceptible
No. of pods per plant	190	175	172	185	187	190	136
Seed size	Medium	Medium	Medium	Medium	Medium	Bold	Small
No. of seeds per pod	4	4	4	4	4	4	3
Pod filling	Good	Good	Good	Good	Good	Good	Good
Healthy pods per plant	197	160	180	179	168	183	120
Maturity (days)	180	165	180	180	180	160	125
Expected grain yield	1250	950	975	1050	1050	1125	550
Overall rank	7	9	7	7	7	8	5

The details of economically preferred traits identified by respondent farmers in the improved varieties are summarized in Table 4.10. Asha, ICPH 2671 and Maruti were ranked as top three varieties because of high yield and resistance to pests and diseases. BSMR 736, BSMR 853 and BDN 708 were rated as the next best varieties in the study locations of Maharashtra. Of the five mother trial locations, Maruti stood first in four villages as preference was given by the farmers during field days/on-farm training. PKV Tara was only preferred in one out of five villages.

Performance of pigeonpea varieties in the trials

The average yields recorded in the mother trials conducted in Maharashtra reveals that Asha gave the highest average yield, followed by Vipula and PKV Tara (see Table 4.11). These three varieties performed better than the check variety Maruti whereas performance of the varieties AKT 8811, BSMR 853, BSMR 736, BDN 708 and ICPH 2671 was lower than the check variety.

Table 4.10. Ranking of economically preferred traits in pigeonpea varieties in Maharashtra.

Trait	Asha	Maruti	BSMR 853	BSMR 736	BDN708	ICPH 2671	Vipula
Cooking quality and taste	4	4	4	4	4	5	3
Yield	5	4	4	4	4	5	3
Resistance to pests and diseases	5	4	5	5	3	5	2
Expected farm price per kg	5	5	5	5	5	5	3
Dal recovery percentage	5	5	5	5	5	5	3
Bold seed	5	4	4	4	4	5	3
Overall rank (farmer and trader)	5	5	4	4	4	5	2

Table 4.11. Average yields of pigeonpea in mother trials conducted in Maharashtra, 2008-09.

Variety	Average yield (kg ha^{-1})	Yield increase (%) over check
Maruti (check)	660	-
Asha	680	3.03
PKV Tara	672	1.82
AKT 8811	584	-11.52
BSMR 853	610	-7.58
BSMR 736	648	-1.82
BDN 708	528	-20.00
Vipula	674	2.12
ICPH 2671	654	-0.91

Feedback and selection of pigeonpea varieties by farmers

The details of breeders' opinion on FPVS trials during 2008-09 are summarized. The location-wise preference of pigeonpea varieties indicated by sample farmers is furnished in Table 4.12. The results clearly indicate that Maruti is the most preferred variety in the study locations followed by PKV Tara, BSMR 736, Vipula and ICPH 2671.

Table 4.12. Pigeonpea varieties and traits preferred by farmers as noted by breeders in Maharashtra.

Location	Varieties preferred in the order of importance	Preferred traits
Kanzara	Maruti, BSMR 736, ICPH 2671	Medium duration, high yield and fetches good market price
Durgapur	Maruti, Vipula, PKV Tara	High yield, minimum attack of pod borer and highly suitable for intercropping
Shelu Khadse	Maruti, BSMR 736, Vipula	Resistance to wilt or sterility mosaic
Shelgaon Ingole	PKV Tara, AKT 8811, Vipula	Early to medium duration, high yield and red seed
Karda	Maruti, ICPH 2671, Vipula	Resistance to wilt or sterility mosaic

5. Results from early adoption surveys

Early adoption surveys were carried out to assess whether the new varieties identified through FPVS and other components of pigeonpea production technology have been adopted by the farmers and if any has created an impact on pigeonpea yields and income of the sample farmers. Before analyzing the results of the early adoption survey, the profile of the respondents was first examined to see the changes that occurred in the socioeconomic parameters in the two years (2009-10), when compared to the baseline survey (2007-08).

Andhra Pradesh

The early adoption survey was carried out in Rangareddy and Mahabubnagar districts of Andhra Pradesh during 2009-10. As the time was too short for spread of the improved varieties, the same farmers from adopted villages were taken as sample for early adoption survey. The sample farmers in the control villages were not included under early adoption surveys. So, all the results were only compared between baseline and early adoption surveys among adopted/treated villages.

Changes in demographic characteristics

Even with the same sample in adopted villages, the operational holdings changed marginally in the three adopted villages (see Table 5.1). The number of farmers in marginal, small and medium groups increased while those in large group decreased in the pooled sample of adopted villages in both Rangareddy and Mahabubnagar districts of Andhra Pradesh. There was a decrease in average operational holdings of the large farmers due to crop failure and crop losses during 2009-10.

Table 5.1. Distribution of sample farmers according to farm size in early adoption surveys in adopted villages in Andhra Pradesh.

	Farmers in early adoption (2009-10)		% change over baseline[1]
Category	No.	%	
Marginal	8	8.89	33.33
Small	31	34.44	3.33
Medium	18	20.00	5.88
Large	33	36.67	-10.81
Total	90	100.00	-

1. Data of baseline survey (2007-08) is given in Table 2.3.

During the baseline survey, all the pooled sample households were headed by men whereas in early adoption survey period one female-headed household in adopted villages was noticed due to the death and changes in the family structure (Table 5.2).

Table 5.2. Changes in household head by gender in adopted villages in Andhra Pradesh.

	Baseline (2007-08)		Early adoption (2009-10)		% change over baseline
Category	No.	%	No.	%	
Female	0	0	1	1.11	+1.11
Male	90	100	89	98.89	-1.11

Changes in cropping pattern and pigeonpea area

Comparison of the baseline and early adoption surveys indicated that the rainy season cropped area significantly decreased by 24% in the adopted villages (Table 5.3). Similarly, the postrainy season cropped area decreased by 22%. Even the total cropped area in the three adopted villages significantly declined from 424.4 to 322.85 ha. The decline in cropped area was largely due to seasonal aberrations during 2009-10. In the adopted villages, the proportion of area under sole pigeonpea and pigeonpea intercrop to the total rainy season cropped area increased from 80.1% in baseline survey to 95.1% in early adoption survey. Nearly 10% of the total cropped area covered with castor, sorghum, paddy, and green gram in the baseline survey completely vanished in the early adoption survey due to severity of drought. Area under cotton increased from 0.81 ha in baseline survey to 6.48 ha in early adoption survey.

Table 5.3. Area (ha) of different crops on sample farms in Andhra Pradesh.

	Baseline survey (2007-08)		Early adoption survey[1] (2009-10)
Crop	Adopted villages	Control villages	Adopted villages
Rainy season			
Pigeonpea	324.77	125.25	261.03
Chickpea	8.50	11.33	0
Black gram	9.71	2.83	2.43
Cotton	0.81	0	6.48
Castor	2.43	2.02	0
Green gram	0.40	0	0
Sorghum	40.87	4.86	5.26
Mango	1.62	0	0
Orange	3.24	1.62	0
Paddy	8.90	19.22	0
Pigeonpea + black gram	6.96	0	12.14
Pigeonpea + green gram	0	0	12.34
Pigeonpea + sorghum	0	0	13.76
Safflower	5.67	0	0
Groundnut	0	4.05	1.21
Onion	0	2.43	0
Total	413.88	173.61	314.65
Postrainy season			
Sorghum	2.83	0	-
Sorghum + safflower	4.45	3.24	5.20
Paddy	0.40	0.81	-
Chickpea	2.02	0	2.5
Safflower	0.81	0	0.5
Groundnut	0	0	-
Onion	0	4.86	-
Chickpea + safflower	0	1.21	-
Total	10.52	10.11	8.20
Total cropped area	424.40	183.72	322.85

1. Control villages were not included in the survey.

Trends in early adoption

The details of varietal composition of pigeonpea in early adoption surveys in three adopted villages are summarized in Table 5.4. Asha was a dominant variety (62%) during baseline survey (2007-08) but lost its share significantly to 43% by 2009-10. Abhaya, another dominant variety during baseline survey completely disappeared in the early adoption survey. LRG 41 and local cultivar (Nallakandi) gained significant pigeonpea area. PRG 158 was also accepted by farmers through FPVS trials and cultivated on 8% area by 2009-10. The old improved variety Maruti was dominant during baseline survey but started losing its area over a period of time. These changes in improved varietal composition indicate that the FPVS trials clearly demonstrated the potential of technology as well as created good interest among sample farmers in the adopted villages.

Table 5.4. Varietal composition of pigeonpea in adopted villages in Andhra Pradesh, 2009-10.

Variety	Early adoption survey (2009-10)		Change in area over baseline (ha)[1]
	Area (ha)	% area	
Asha	128.68	43	-75.89
Abhaya	-	-	-36.83
Durga	-	-	-6.48
LRG 30	8.97	3	6.54
LRG 41	59.85	20	57.83
Maruti	14.96	5	-9.93
PRG 158	23.94	8	23.94
Lakshmi	14.96	5	-1.23
Local (Nallakandi)	47.88	16	10.77
White pigeonpea	-	-	-
Total	299.24	100	-32.46

1. Data of baseline survey (2007-08) is given in Table 3.10.

The details of relative performance of mean pigeonpea productivity levels between baseline and early adoption surveys are summarized in Table 5.5. All the improved varieties grown in the adopted villages showed enhancement of yields from baseline to early adoption surveys. The highest yield was noticed during 2009-10 in Asha followed by LRG 41 and LRG 30. However, the percentage increase in yield was highest in LRG 41 (25.8%) followed by Maruti (15.7%) and Asha (8.6%). Due to drought during 2009-10, the improved varieties did not yield their full potential. Overall, the sample farmers showed their clear interest towards LRG 41 and PRG 158. The local variety Nallakandi also exhibited 9% increase in yield.

Table 5.5. Changes in pigeonpea productivity levels in adopted villages in Andhra Pradesh.

Variety	Yield (kg ha^{-1})		Yield increase (%) over baseline
	Baseline (2007-08)	Early adoption (2009-10)	
Asha	1150	1250	8.6
LRG 30	1070	1150	7.4
LRG 41	930	1170	25.8
Maruti	950	1100	15.7
PRG 158	-	1120	-
Lakshmi	970	1050	8.2
Local	750	820	9.3

Unit cost reduction due to improved technology

The costs and returns from three pigeonpea varieties during early adoption survey in three adopted household samples in Andhra Pradesh are summarized in Table 5.6. The unit cost of cultivation was slightly lower in Asha when compared with other two varieties. The average productivity of Asha was highest followed by LRG 41 and local cultivar. The gross and net returns per ha were significantly highest in Asha followed by LRG 41. A significant reduction in cost of production per 100 kg was observed between local and improved varieties.

Table 5.6. Cost of production and returns of pigeonpea varieties during early adoption survey in adopted villages in Andhra Pradesh, 2009-10.

Particulars	Local cultivar	Asha	LRG 41
Fixed cost (₹ ha^{-1})	3200.50	3250.40	3310.50
Variable cost (₹ ha^{-1})	11525.50	11100.50	11500.50
Total cost of cultivation (₹ ha^{-1})	14726	14350.90	14811
Cost of production (₹ per 100 kg)	1600.60	1148.07	1384.20
Grain yield (kg ha^{-1})	920	1250	1070
Gross returns (₹ ha^{-1})	41400	56250	48150
Net returns (₹ ha^{-1})	26674	41899.10	33339
Benefit-cost ratio	2.81	3.91	3.25

The impact of improved pigeonpea technology in the study districts of Andhra Pradesh is presented in Table 5.7. The improved pigeonpea varieties introduced by the TL-II Project showed a significant reduction in unit cost of production. On an average, a reduction of about ₹450 per 100 kg was noticed with Asha when compared with the local cultivar. The project not only introduced improved varieties but also educated the sample farmers about crop and pest and disease management technology through training programs and mass media. The impact is reflected in higher yields and a reduction in cost of production. On an average, 15-20% reduction in cost of production per 100 kg was observed in improved varieties compared to the local varieties.

Table 5.7. Cost of production of pigeonpea in baseline and early adoption surveys in Andhra Pradesh.

Item	Local cultivar	Asha	LRG 41
Cost of production in baseline (2007-08) (₹ per 100 kg)	1795.70	1426.60	-
Cost of production in early adoption (2009-10) (₹ per 100 kg)	1600.60	1148.07	1384.20
Reduction in cost of production (₹ per 100 kg)	195.10	278.53	216.40[1]
Percentage reduction in unit cost of production	10.8	19.5	13.5[1]

1. In comparison with local cultivar.

Constraints in adoption of improved varieties

The spread of new FPVS introduced improved varieties was rather slow. The dominant variety Asha started losing ground slowly during baseline survey. New cultivars like LRG 41, LRG 30 and PRG 158 were diffusing slowly in the study villages of Rangareddy and Mahabubnagar districts. But huge scope

still exists for further diffusion of these improved varieties in these districts. The vagaries of climate are the main constraint influencing pigeonpea cultivation in the study area. The cropped area has been dwindling significantly from 2007-08 to 2009-10 due to unfavorable climatic conditions. The second major limiting factor for the spread of improved varieties is timely availability of quality seeds. Some of the sample farmers in the study area still cultivate the local cultivar; hence its area increased during the early adoption survey period. The third major constraint is lack of information about the recommended varieties and package of practices. Very few farmers have good exposure about recommended package of practices in the study area. Non-availability of credit and marketing problems are some of the other constraints experienced by the sample farmers in the study districts.

Maharashtra

The details of early adoption surveys conducted in Akola district of Maharashtra are summarized below.

Changes in cropping pattern and pigeonpea area

The same sample of farmers as in the baseline survey (2007-08) in Maharashtra were revisited for collecting the information during the early adoption survey. But information on household demographics and socioeconomic details were not collected during the early adoption surveys conducted in February 2010 in both adopted and control villages. The details about cropping pattern, varietal composition, average productivity levels and finally costs and returns from pigeonpea were only elicited from sample farmers.

The details of changes in cropping pattern of Maharashtra sample villages are summarized in Table 5.8. Both in adopted and control villages, the total cropped area slightly increased in early adoption survey period over baseline survey period. Due to the increase (14.4%) in the total cropped area in the adopted villages, the relative area under sole pigeonpea and pigeonpea intercrop also increased from 197.44 ha in 2007-08 to 225.04 ha in 2009-10. However, the share of pigeonpea in the total cropped area did not change much (93%). Similarly, the total cropped area in control villages increased from 96.77 ha in 2007-08 to 140.43 ha (45.1%) in 2009-10. Correspondingly, there was a significant increase in pigeonpea area but the relative share in the total cropped area declined slightly.

Trends in early adoption survey

The details of pigeonpea varietal composition during baseline and early adoption are compared among study villages in Maharashtra and presented in Table 5.9. Maruti was the single dominant variety found during baseline survey (2007-08) in both adopted and control villages. Its presence was much prominent in control villages than in adopted villages. Asha and traces of Vipula and Durga were also present. However, the proportion of area under Maruti declined significantly during early adoption survey. A significant share of Maruti area has been diverted to the new improved varieties (BSMR 736, BSMR 853 and PVK Tara) introduced by the project. Among the three new varieties, BSMR 736 diffused and was accepted by sample farmers very well. It was followed by BSMR 853 and PVK Tara. Because of resistance to sterility mosaic, BSMR 736 and BSMR 853 were preferred by farmers when compared to Maruti which is susceptible to the disease. Similarly, few sample farmers in the study villages also preferred Asha because of its high yield and resistance to sterility mosaic. The results clearly indicate farmers' preference towards new improved varieties/technology demonstrated under the project.

The average yields of improved pigeonpea varieties obtained by the sample farmers slightly increased in early adoption survey period (Table 5.10). New varieties like BSMR 853 and BSMR 736 gave better yields than existing baseline varieties like Maruti and Asha. This clearly demonstrated the potential of new improved varieties introduced in the project sites. Nearly 10-15% higher yields were perceived by the sample farmers during early adoption survey.

Table 5.8. Area (ha) of different crops on sample farms in Maharashtra.

Rainy season crop	Baseline (2007-08)		Early adoption (2009-10)	
	Adopted villages	Control villages	Adopted villages	Control villages
Cotton + green gram + pigeonpea	35.43	0.00	42.30	1.50
Cotton + pigeonpea	76.86	61.63	80.70	75.76
Sorghum + pigeonpea	0.40	0.00	1.20	0.00
Sorghum + cotton + pigeonpea	28.10	1.82	25.32	0.00
Pigeonpea + green gram	12.02	1.62	12.50	0.00
Cotton	1.51	0.00	5.00	12.00
Cotton + green gram	0.80	0.00	1.20	0.00
Green gram	1.51	0.00	2.00	0.00
Soybean	3.85	2.83	5.50	5.50
Sorghum	1.21	0.84	0.50	0.00
Soybean + pigeonpea	43.42	26.31	62.52	45.67
Soybean + pigeonpea + sorghum	0.81	0.00	0.00	0.00
Pigeonpea	0.40	0.00	0.50	0.00
Cotton + sorghum	4.05	0.00	2.50	0.00
Sorghum + green gram	0.81	0.00	0.00	0.00
Sunflower + pigeonpea	0.00	1.72	0.00	0.00
Total cropped area	211.22	96.77	241.74	140.43
Area under pigeonpea (sole and intercrop)	197.44	93.1	225.04	122.93
% share of pigeonpea in the total cropped area	93.5	96.2	93.1	87.5

Table 5.9. Varietal composition of pigeonpea in sample farms in Maharashtra, 2009-10.

Variety	Early adoption, 2009-10					
	Adopted villages		Change in area over baseline (ha)[1]	Control villages		Change in area over baseline (ha)[1]
	Area (ha)	% area		Area (ha)	% area	
Asha	29.2	13	13.48	18.4	15	15.16
Maruti	105.7	47	-71.0	67.6	55	-20.64
BSMR 736	56.3	25	56.3	20.8	17	20.8
BSMR 853	22.5	10	22.5	12.4	10	12.4
PVK Tara	11.3	5	11.3	3.7	3	3.7
Durga	-	-	-1.22	-	-	0.00
Vipula	-	-	-3.76	-	-	-1.62
Total	225.0	100.0	27.6	122.9	100.0	29.8

1. Data of baseline survey (2007-08) is given in Table 3.31.

Table 5.10. Change in pigeonpea productivity on sample farms in adopted villages in Maharashtra, 2009-10.

	Yield (kg ha^{-1})		
Variety	Baseline (2007-08)	Early adoption (2009-10)	Increase over baseline
Asha	970	1080	110
Maruti	920	1030	110
BSMR 736[1]	-	1120	-
BSMR 853[1]	-	1160	-
PKV Tara[1]	-	940	-
Durga	850	-	-

1. New improved varieties.

Unit cost reduction due to improved technology

The cost of cultivation of three pigeonpea varieties is summarized in Table 5.11. The cost of cultivation per ha was lower in BSMR 853 followed by BSMR 736 and Maruti. The lowest grain yield and gross returns per ha was observed in Maruti. Relatively, due to higher productivity and lower cost of cultivation per ha in BSMR 853, the net returns per ha was the highest. High benefit-cost ratio was also noticed in BSMR 853 followed by BSMR 736.

Table 5.11. Cost of production and returns of pigeonpea varieties in Akola district, Maharashtra, 2009-10.

Particulars	Maruti	BSMR 736	BSMR 853
Fixed cost (₹ ha^{-1})	5300	4950	5200
Variable cost (₹ ha^{-1})	12967	12534	11987
Total cost of cultivation (₹ ha^{-1})	18267	17484	17187
Cost of production (₹ per 100 kg	1773	1561	1482
Grain yield (kg ha^{-1})	1030	1120	1160
Gross returns (₹ ha^{-1})	46350	50400	52200
Net returns (₹ ha^{-1})	28083	32916	35013
Benefit-cost ratio	2.53	2.88	3.03

The impact of improved pigeonpea technology in Maharashtra is summarized in Table 5.12. The average cost of production per 100 kg of pigeonpea in Maharashtra was ₹1880 during the baseline survey (2007-08). With the introduction of new improved varieties, the cost of production reduced to ₹1561 per 100 kg in BSMR 736 and ₹1482 per 100 kg in BSMR 853. On an average, cost of production decreased by ₹300-400 per 100 kg because of increased production of new varieties. Cost of production per 100 kg declined by about 15-20% and benefitted the sample farmers in the project.

Bantilan and Joshi (1996) quantified the research benefits generated by Maruti in Karnataka state. Maruti (ICP 8863), a wilt resistant variety, was released in 1986 in Karnataka and occupied an area of 60% by 1996 in the primary targeted zones. In comparison to the existing best cultivar, ICP 8863 gave 57% higher yield and reduced the unit cost of production by 42%. The total net benefit value from collaborative Fusarium wilt research was assessed at US$62 million, representing an internal rate of return of 65%.

Table 5.12. Cost of production of pigeonpea in baseline and early adoption surveys in Akola district, Maharashtra.

Item	Maruti	BSMR 756	BSMR 853
Cost of production in baseline survey (2007-08) (₹ per 100 kg)	1880.30	-	-
Cost of production in early adoption survey (2009-10) (₹ per 100 kg)	1773.00	1561.00	1482.0
Reduction in cost of production (₹ per 100 kg)	107.30	319.30[1]	398.30[1]
Percentage reduction in unit cost of production	5.7	16.9[1]	21.1[1]

1. In comparison with Maruti.

Shiferaw et al. (2005) assessed the adoption and impact of pigeonpea improved cultivars in Tanzania. The new introductions of pigeonpea ICEAP 00040 and 00053 which are Fusarium wilt resistant in Babati saved farmers' crop losses significantly (about 57%) when compared with the local variety (Babati white). The average yield of the local variety is about 425 kg ha^{-1} but that of improved varieties is about 709 kg ha^{-1}. Much of this gain is realized from the reduced productivity loss as a result of wilt resistant varieties. Compared to the local landraces, the new varieties provided about 67% higher yields and 26% lower production cost, which translates to higher income to adopting farmers.

Constraints in adoption of improved varieties

In general, farmers in Maharashtra prefer wilt resistant, medium, bold, red seeded varieties of pigeonpea which are suitable for intercropping with crops like soybean, cotton, mung bean and black gram. Sometimes, farmers' choice of improved varieties varies from village to village depending on soil type, cropping system and prevalent diseases like wilt and sterility mosaic. At present, the most dominant variety Maruti is being replaced by other improved varieties like BSMR 736, BSMR 853 and BDN 703. However, the main constraints faced by the farmers are: (i) Lack of assured sources of quality seed and timely availability and (ii) Marketing and value chain issues for securing remunerative price for the seed. Respondent farmers opined the need for a high-yielding drought tolerant pigeonpea variety and also for a pigeonpea hybrid technology with less risk in seed production.

6. Synthesis and lessons learnt

Synthesis of the study

In India with the concerted research efforts from both the national and international research Institutes, the orphan crop pigeonpea has transformed from subsistence level to versatile and high-yielding crop. It also showed a significant improvement in terms of area expansion and increase in production during the last five decades particularly in Southern and Central India due to development of medium-duration varieties with wilt and sterility mosaic resistance. In northern states, area under pigeonpea has significantly dropped because of shift to other commercial crops with increased irrigation facilities. However, pigeonpea is still preferred in crop rotations with wheat due to the development of short-duration varieties which fit well into the numerous cropping systems. On discovery of CGMS technology, niche-specific farmer-preferred varieties were developed which resulted in increased adoption of improved cultivars, improved yield levels and higher returns compared to local cultivars. The short supply of pigeonpea in the market for the growing population resulted in soaring prices particularly in the last three years. However, there is a huge scope in crop improvement to reach the potential yield levels and to attain self-sufficiency and nutritional security in the country.

The TL-II Phase 1 Project funded by BMGF has provided the opportunity to ICRISAT and its research partners to test some of the promising varieties of the research stations on farmers' fields in some selected villages of Andhra Pradesh and Maharashtra through FPVS trials. Under Phase I of TL-II Project, Rangareddy and Mahabubnagar districts in Andhra Pradesh and Akola district in Maharashtra were chosen for introduction of new varieties and technologies. In each state, three villages were selected for intervention and were designated as "adopted" villages and three more villages were chosen as non-intervention villages and were designated as "control" villages. From each of the adopted villages, a sample of 30 farmers was chosen, while 15 farmers were selected from each of the control villages. Thus, in each state, a sample of 90 farmers was drawn from the adopted villages, while 45 farmers were chosen from the control villages. A baseline survey was conducted during 2007-08, immediately after the cropping season to assess the socioeconomic status of the farmers, adoption and yield levels and benefit-cost ratio of pigeonpea vis-à-vis other competing crops. Farmer participatory varietal selection trials were conducted during the rainy season of 2008/09 in the so-called adopted villages. Some new varieties were tested vis-à-vis the ruling varieties in the region to assess their comparative performance. Farmers were asked to rank the varieties based on the traits preferred by them. The varieties selected by the farmers were taken up for seed multiplication. The farmers were supplied with small quantities of seed so that they could multiply the seeds and bulk the supply and gradually switch over to the preferred varieties. In 2009-10, an early adoption survey was commissioned to assess the impact of the new varieties and whether this adoption has caused any improvement in the yields and incomes.

The baseline study found that pigeonpea crop had a dominant presence in the cropping pattern and contributed significantly to the crop incomes of the farmers. But it was found that the farmers are still cultivating old varieties like Asha, Abhaya, and local cultivar in Andhra Pradesh and Maruti in Maharashtra. FPVS trials were conducted with several new varieties and the ruling variety as check. The FPVS results established that the new varieties outyielded the check varieties. Farmers accepted the new varieties with the highest yield potential than the check. For instance, farmers in Andhra Pradesh started replacing Asha with LRG 41, LRG 30, ICPH 2671 and PRG 158. In Maharashtra, new improved varieties introduced in the project like BSMR 736, BSMR 853 and BDN 703 substituted Maruti significantly. The spread of farmer-preferred varieties was reasonably good by 2009-10, when the early adoption surveys were conducted. Further diffusion of these varieties will take place in the subsequent period of time.

Lessons learnt

- Recurrent droughts are the major constraint for the low productivity of pigeonpea, especially in Maharashtra. Majority of pigeonpea is cultivated under rainfed conditions and marginal lands in India. Farmers prefer to grow it as an intercrop rather than a sole crop. So, there is a need to develop varieties that are more drought resistant and/or that mature slightly earlier to escape terminal stress, suited to central and southern states. Hybrids/varieties of 150-160 days (medium) duration are the need of the hour in view of the changing climate.
- Conduct of FPVS trials has helped ICRISAT and NARS partners not only to demonstrate the potential of the technology but also to gain quicker farmer acceptance about the adoption and diffusion.
- Concerted efforts are required for demonstrating the hybrid pigeonpea technology along with seed production and multiplication training programs. Awareness has to be created about proper isolation distances and seed production techniques, etc. With efficient seed production, particularly the hybrid technology may lead to revolution in the country.
- Pigeonpea is often a cross-pollinated crop. Seed collected and bulked for further use may deteriorate the genetic purity. Therefore, use of farmer produced product as seed should not be encouraged. Additional efforts are needed for strengthening the seed production and supply in the project targeted sites.
- Timely availability of quality seed of improved varieties is a problem expressed by sample farmers. Alternate arrangements have to be made for strengthening the seed production and multiplication of new varieties. If possible, a private seed company can be involved for rapid production and distribution of seeds in shorter period of time. Community seed systems approach can also be tried to hasten the process of diffusion of the varieties selected by the farmers in the FPVS trials.

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Appendices

Baseline Survey for Targeting Legumes Breeding and Seed Delivery Efforts to Enhance Impact on the Livelihoods of the Poor in South Asia, Tropical Legumes-II, (Phase-1), 2007

PART-1

Module 1. Basic information:	
1.1. Date of interview	----------
1.2. Name of the investigator	----------
1.3. Name of the main crop referred for the survey	----------
1.4. Country	India
1.5. State	----------
1.6. District/division	----------
1.7. Block/taluka/mandal/township	----------
1.8. Village	----------
1.9. Adopted/control village	----------
1.10. Farm size (marginal, small, medium and large)*	----------
1.11. Household number	----------
1.10. Head (who takes major decisions) in the household	----------
1.12. Son/daughter/wife of	----------
1.13. Gender	----------
1.14. Age (completed years)	----------
1.15. Education (completed years of schooling)	----------
1.16. Member of any elected/nominated body	Yes/No
1.17. If yes, name of the body/organization	----------
1.18. Caste and Category (BC, SC, ST and FC)	----------
1.19. Religion	----------
1.20. Main occupation (major proportion of income)	----------
1.21. Secondary occupation (secondary source of income)	----------
1.22. Total family members: ---------- Male: ---------- Female: ---------- Children (<12 years) ----------	
1.23. No. Of literates: ---------- No. of persons working on own farm: ----------	

* Households operating < 2.5 acres of land (marginal), 2.51 to 5 acres (small), 5.01 to 10 acres (medium) and more than 10 acres (large).

Module 2. Land holding as in July 2007.				
Particulars	Dry (acres)	Irrigated (acres)	Permanent fallow (acres)	Total (acres)
Own land	-	-	-	-
Leased/shared in land	-	-	-	-
Leased/shared out land	-	-	-	-
Operated land (own land+leased/shared in – leased/shared out land)	-	-	-	-

Module 3. Resource endowments as in July 2007.		
Type	Quantity	Present total value in rupees
1. Land:	**-**	**-**
1.1. Dryland including fallow (acres)	-	-
1.2. Irrigable land (acres)	-	-
2. Livestock:	**-**	**-**
2.1. Draft animal	-	-
2.2. Local cows	-	-
2.3. Improved/jersey cows	-	-
2.4. Local/improved she buffaloes	-	-
2.5. Young stock	-	-
2.6. Goat and sheep	-	-
2.7. Poultry	-	-
2.8. Others	-	-
3. Farm implements*:	**-**	**-**
3.1. Tractor with implements	-	-
3.2. Harvesters/threshers/groundnut sheller	-	-
3.3. Sprinkler sets/drip irrigation	-	-
3.4. Trucks/autos/4 wheelers	-	-
3.5. Cane crusher/agro-processing equipment	-	-
3.6. Rice/flour mills	-	-
3.7. Electric pumpsets a (1) (2)	-	-
3.8. Diesel pumpsets	-	-
3. 9. Broad bed and furrow (BBF marker)	-	-
3.10. Bullock cart	-	-
3.11. Manual/power sprayers	**-**	**-**

Module 3. Resource endowments as in July 2007.		
Type	Quantity	Present total value in rupees
3.12. Others (specify)	-	-
4. Residential house and consumer durables:	-	-
4.1. Residential house and plots	-	-
4.2. Farm house (cattle-shed)	-	-
4.3. Two wheelers/bicycles	-	-
4.4. Television sets	-	-
4.5. Fridge	-	-
4.6. Washing machine	-	-
4.7. Radio/tape recorder	-	-
4.8. Air coolers/fans	-	-

*Write share and value if farmer owns a share in the pumpsets and farm implements

Module 4. Financial assets and liabilities as in July 2007.			
Sources	Outstanding amount (₹)	Purpose	Interest rate (%)
1. Loans			
1.1. Co-operatives	**-**	**-**	**-**
1.2. Nationalized banks	-	-	-
1.3. Self Help Groups	-	-	-
1.4. Friends & relatives	-	-	-
1.5. Finance companies	-	-	-
1.6. Moneylenders	-	-	-
1.7. Others	-	-	-
2. Lending	-	-	-
2.1. Villagers	-	-	-
2.2. Friends/relatives	**-**	**-**	**-**
2.3. Others	-	-	-
3. Savings	-	-	-
3.1. Banks	-	-	-
3.2. LIC/PLI policies	-	-	-
3.3. Share market	-	-	-
3.4. Co-operatives	-	-	-
3.5. Chit funds	-	-	-
3.6. Self Help Groups	-	-	-
3.7. Mahila mandal	-	-	-
3.8. Post office	-	-	-
3.9. Others	-	-	-

Module 5. Major sources of household net income during the year.	
Sources of income	Net income (₹)
1. Income from crops	-
2. Farm work (labor earnings)	-
3. Non-farm work (labor earnings)	-
4. Regular Farm Servant (RFS)	-
5. Livestock (milk and milk products selling)	-
6. Income from hiring out bullocks	-
7. Income from selling sheep, goat, chicken, meat, eggs etc.	-
8. Selling of water for agriculture purpose	-
9. Selling CPR (firewood, fruits, stones, and mats etc)	-
10. Selling handicrafts (specify)	-
11. Rental income (tractor, auto, sprayer, & truck etc.)	-
12. Rent from land, building and machinery etc.	-
13. Caste occupations (specify)	-
14. Business (specify)	-
15. Regular salaried jobs (Govt./private)	-
16. Out migration	-
17. Remittances	-
18. Interest on savings and from money lending	-
19. Cash and kind gifts including dowry received	-
20. Pension from employer	-
21. Government welfare/development Programs	-
22. Others 1	-
23. Others 2	-

Module 6. Cropping pattern for pigeonpea July 2006 to June 2007 (groundnut and chickpea July 2007 to June 2008).

Plot name	Owner ship*	Area (acres)	Soil type**	Season ***	Name of the crop	Row arrangement/ proportion	Name of the variety	Cropped area (acres)	Irrigated yes/no	Source of irrigation	Main production (kg)	Harvest price/ kg	By-product (qt)****	Harvest price/qt

* Use the codes. Own land (OW), leased-in (LI), leased-out (LO), shared-in (SI), and shared-out (SO).

** Deep black-1, Medium black-2, Medium to shallow black-3, Deep red-4, shallow red-5, Gravelly-6, Saline and alkaline-7 and others (specify) ---------- 8

*** Season codes: K-*kharif* (rainy), R-*rabi* (postrainy), S-summer, and P-perennial.

**** If farmer reported by-product in bundles or cart loads/truck loads convert and record in quintals by asking the approximate weight of each bundle

Module 7. Consumption expenditure for July to June (one year).

Total members of the household consumed the food (adults) ---------- (children >12 years)

Item	Code ** D/W/M/Y	Average quantity consumed kg/liter	Average unit price (₹)	Total value (₹)
1. Food expenditure:	-	-	-	-
PDS rice *	-	-	-	-
Rice	-	-	-	-
PDS wheat *	-	-	-	-
Wheat	-	-	-	-
Sorghum	-	-	-	-
Pearl millet	-	-	-	-
Finger millet	-	-	-	-
Other cereals	-	-	-	-
Pigeonpea	-	-	-	-
Chickpea	-	-	-	-
Green gram	-	-	-	-
Black gram	-	-	-	-
Others pulses	-	-	-	-
Milk	-	-	-	-
Other milk products	-	-	-	-
Cooking oil	-	-	-	-
Groundnut kernels	-	-	-	-
Non-veg	-	-	-	-
Fruits	-	-	-	-
Vegetables	-	-	-	-
Tea, coffee, sugar & gur	-	-	-	-
All spices	-	-	-	-
Processed food items & hotel expenses	-	-	-	-
Other food items	-	-	-	-
2. Non-food expenditure:	-	-	-	-
Health expenditure	-	-	-	-
Entertainment/travel/vehicle	-	-	-	-
Education/stationery	-	-	-	-
Clothing/shoes	-	-	-	-
Ceremonies	-	-	-	-
Toddy & alcohol	-	-	-	-
Cosmetics (hair oil, soaps etc)	-	-	-	-
Taxes/maintenance/phone bill	-	-	-	-
Pan, beedi, cigarettes etc.	-	-	-	-

* Received on subsidy from public distribution system (PDS) for BPL families

** D-day, W- week, M- month, and Y- year

PART II CROP SPECIFIC MODULES

Module 8. History of the crop

Name of the main crop referred for the survey (groundnut, chickpea, pigeonpea):----------

(Note: all following questions refer to the selected crop)

1. Which year did you starts growing this crop? ----------

2. Reasons for growing this crop.

Purpose	Rank (order of importance)
1. Food/home consumption	-
2. Fodder/animal consumption	-
3. Higher Income	-
4. Restore soil fertility	-
5. Fitted well into the present cropping system	-
6. Best suited to my land	-
7. Fits well into a rotation	-
8. Others (specify)	-

3. Once in how many years do you grow this crop on same land (crop rotation)?

(a) Every season (b) every year (c) once in two years (d) once in three years (e) once in four years ( )

4. What are the crops planted by you before and after this crop in your field?

Before		After	
Season	Crop	Season	Crop
-	-	-	-
-	-	-	-

5. Area under this crop increasing/decreasing/constant in the last five years?----------

6. What are the crops replaced by this crop, if the area is increasing?

(a) ---------- (b) ---------- (c) ----------

7. What are the crops replacing this crop, if the area is decreasing?

(a) ---------- (b) ---------- (c) ----------

8. Is this crop grown as sole/inter crop? ---------- If inter crop, what are the crop

(a) ---------- (b) ---------- (c) ----------

9. In which year the area under this crop is maximum? Year ---------- Area (acres) ----------

10. Average yield harvest by this household (kg/acre).

	Rainy season (*kharif*)		Postrainy season (*rabi*)	
Year	Irrigated	Rainfed (dry)	Irrigated	Rainfed (dry)
Good year	-	-	-	-
Bad year	-	-	-	-
Best yield recorded so far	-	-	-	-

11. What varieties (cultivars) did you grow in the last three years?

(Please show seed sample boxes to identify the varieties grown by the household)

		2006-07		2005-06		2004-05	
Crop varieties	Season (*kharif*/*rabi*)	Source of seed	Area (acres)	Source of seed	Area (acres)	Source of seed	Area (acres)
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
	-	-	-	-	-	-	-

12. When did you start growing these cultivars/varieties?

	First year of Adoption					Peak adoption	
Cultivars	Year	Area sown (acres)	Source of information	Source of seed	Decision maker to adopt *	Year	Area sown (acres)
1. Local	-	-	-	-	-	-	-
2.	-	-	-	-	-	-	-
3.	-	-	-	-	-	-	-
4.	-	-	-	-	-	-	-
5.	-	-	-	-	-	-	-

* Husband-1, wife-2, both wife and husband-3, son-4 and other family members-5

13. Steps followed by the household in selecting seeds from his own crop?

(1) ----------

(2) ----------

(3) ----------

(4) ----------

14. Precautions followed by the household in storage of own seed?

(1) ----------

(2) ----------

(3) ----------

(4) ----------

15. What factors do you or household members consider when purchasing seed?	
(1) Brand name	Yes/no
(2) Price (₹/kg)	Yes/no
(3) Certification	Yes/no
(4) Good packing	Yes/no
(5) Others ----------	Yes/no

16. What are the major constraints in purchasing seed (rank)?	**Rank**
(a) Lack of information about recommended variety	---------
(b) Non-availability of required variety	---------
(c) Seed is not of good quality (up to expectation level)	---------
(d) High seed price	---------
(e) Need to travel long distances	---------
(f) Credit facility not available	---------
(f) Others (specify) ----------	---------

17.What are the major pests and diseases affecting this crop on your field?	
Major pests	Major diseases
1.	1.
2.	2.
3.	3.

18. Frequency of occurrence and yield loss estimated by the household in the last 5 years?

Year	Type of pest /disease	% area affected	% Yield loss
	-	-	-
	-	-	-
	-	-	-
	-	-	-

19. Are the pest and disease problems increasing? Yes/No----------

20. If yes, what is causing increased incidence of pest and diseases?	**Rank**
(a) Growing it every year without rotation	----------
(b) Growing other crops, which are alternative hosts	----------
(c) Weather related reasons	----------
(d) Growing susceptible varieties	----------
(e) Not adopting IPM/IDM technologies	----------
(f) Others (Specify)	----------

21. How do you control pest?	**Rank**
(a) Relying only on chemical pesticides	----------
(b) Adopting IPM/IDM technologies	----------
(c) Traditional control (farmers practices) measures (specify)	----------
(d) Altering sowing time	----------
(e) Others (specify)	----------

22. How do you control diseases?	**Rank**
(a) Relying only on chemical pesticides	----------
(b) Adopting IPM/IDM technologies	----------
(c) Traditional control (farmers practices) measures (specify)	----------
(d) Altering sowing time	----------
(e) Others (specify)	----------

23. Source of information about pest control measures (Rank in order of importance).

Decision	TV	Radio	News papers	Agrl. Magazine Diary/news letter	Farmers	Friends/ relatives	Input supplier	Research Institute	NGO
When to apply	-	-	-	-	-	-	-	-	-
Type of pesticide	-	-	-	-	-	-	-	-	-
Quantity to use	-	-	-	-	-	-	-	-	-
Mixing chemical	-	-	-	-	-	-	-	-	-

24. Constraints and characteristics in the cultivars grown by the household (Rank with in each group).

	Variety 1	Variety 2	Variety 3	Variety 4	Variety 5
Characteristics	Local	-	-	-	-
1. Constraints	**-**	**-**	**-**	**-**	**-**
Low yield	-	-	-	-	-
High pest incidence	-	-	-	-	-
High disease incidence	-	-	-	-	-
Long duration	-	-	-	-	-
Small grain size	-	-	-	-	-
Poor color	-	-	-	-	-
Poor taste	-	-	-	-	-
Low recovery/shelling %	-	-	-	-	-
Low market price	-	-	-	-	-
Not fit into cropping system	-	-	-	-	-
Poor fodder quality	-	-	-	-	-
Susceptible to storage pest	-	-	-	-	-
2. Prefered traits	-	-	-	-	-
2.1. Production:	-	-	-	-	-
High yield	-	-	-	-	-
Short duration	-	-	-	-	-
Drought resistance	-	-	-	-	-
Pest resistance	-	-	-	-	-
Disease resistance	-	-	-	-	-
Fit into existing cropping system	-	-	-	-	-
Improve soil fertility	-	-	-	-	-
More recovery/shelling %	-	-	-	-	-
More oil content	-	-	-	-	-
2. 2. Consumption:	-	-	-	-	-
Better taste	-	-	-	-	-
Less cooking time	-	-	-	-	-
High keeping quality	-	-	-	-	-
2.3. Fodder:	-	-	-	-	-
More fodder quantity with leafy	-	-	-	-	-
Palatability (quality/taste)	-	-	-	-	-
More durability of fodder	-	-	-	-	-
2.4. Marketing:	-	-	-	-	-
High demand	-	-	-	-	-
Fetches higher price	-	-	-	-	-
Low price fluctuations	-	-	-	-	-
Bigger grain size	-	-	-	-	-

25. List four major characteristics are you/household members looking for in a new variety/ cultivar?

	Existing Market Price ₹/kg willing to pay	New premium price ₹/kg at present
a) ----------	----------	----------
b) ----------	----------	----------
c) ----------	----------	----------
d) ----------	----------	----------

Module 9. Pattern of utilization of output.

1. Utilization of production for Chickpea 2006-07 (Groundnut and pigeonpea 2007-08).

Variety	Grain output (kg)	Consu-med (kg)	Other uses* (kg)	Own seed (kg)	Sold as seed (kg)	Seed sale price ₹/kg	Sold (kg)	Prod. of byproduct (qt)	Own Use (qt)	Sold (qt)	Sale price (₹/qt)
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-

* Includes kind wages, gifts and feed to cattle etc.

2. Marketing of crop production (Chickpea 2006-07, groundnut and pigeonpea 2007-08).

Total sale during the year: ---------- kg

			Marketing cost (₹/qt)						
Name of market	Place	Dista-nce	Bag-ing	Trans-port	Commission agent	Market fee	Hamali (labor)	Quantity sold (kgs)	Sale price (₹/kg)
Village	-	-	-	-	-	-	-	-	-
Weekly	-	-	-	-	-	-	-	-	-
Regulated	-	-	-	-	-	-	-	-	-

3. Did you sell crop output immediately after harvest? Yes/No.

If yes, what are reasons? (tick)	If no, what are the reasons? (tick)
Lack of money in hand	1. Expecting higher price
Repayment of loan	2. No urgent requirement of money
For household functions	3. To meet the future needs
To invest in business	4. Others (specify)
No storage facility	-
Others (specify)	

4. How do you store (storage structures) crop produce?

(a) Gunny bags ----------

(b) Cane made bins ----------

(c) Mud pots ----------

(d) Under ground storage ----------

(e) Storage rooms ----------

(f) Others (specify) ----------

5. How long do you store the crop production after harvest?

(a) Days ----------

(b) Months ----------

6. What precautions do you generally take while storing grain against pest and diseases problems?

(a) ----------

(b) ----------

(c) ----------

7. Do you obtain information on market prices prior to the sale?		Yes/ No
If yes, list important sources of information (rank)?		
Sl. No.	Source of information	Rank
1.	Relatives, friends and neighbors	-
2.	Community bulletin board	-
3.	Local newspapers	-
4.	National newspapers	-
5.	Radio/Television	-
6.	Group or association (specify)	-
7.	Community leaders	-
8.	Government agent	-
9.	NGO	-
10.	Internet	-
11.	Input dealer	-
12.	Farmer's service centers	-
13.	Commission agent/trader	-
14.	Others (specify)	-

8. Does this information influence your decision on when, where and whom to sell? Yes/ No.

a. Village ---------- b. Market ----------

9. What are the advantages and disadvantages if the household sells the production to middlemen/ broker in the village?.	
Advantages	Disadvantages
-	-
-	-
-	-

10. What are the advantages and disadvantages if the household sells the production in markets?	
Advantages	Disadvantages
-	-
-	-
-	-

Module 10. Role of gender (Collect the following information from women only).

1. Role of gender in groundnut/chickpea/pigeonpea crop cultivation (Tick the crop):

	Who does		
Activity	Primarily done by men	Primarily done by women	Joint activity (men & women)
1. Selection of crop	-	-	-
2. Selection of variety	-	-	-
3. Field cleaning	-	-	-
4. Land preparation	-	-	-
5. Transport of manure and application	-	-	-
6. Seed treatment	-	-	-
7. Sowing seed	-	-	-
8. Chemical fertilizer application	-	-	-
9. Hand weeding	-	-	-
10. Interculture/mechanical weeding	-	-	-
11. Plant protection measures	-	-	-
12. Irrigation	-	-	-
13. Watching	-	-	-
14. Harvesting main crop	-	-	-
15. Threshing	-	-	-
16. Transport of grain	-	-	-
17. Storage of produce	-	-	-
18. Fodder harvesting	-	-	-
19. Transport and stacking fodder	-	-	-
20. Seed selection and storage	-	-	-

2. Resource analysis:

Resources	Ownership Male/ female/both	Decision making Male/ female/both	Who influences the utilization
1. Assets	-	-	-
Land	-	-	-
Livestock	-	-	-
Credit	-	-	-
Implements	-	-	-
Machinery	-	-	-
Investment	-	-	-
2. Inputs	-	-	-
Seeds	-	-	-
Fertilizers	-	-	-
Pesticides	-	-	-
Own labor	-	-	-
Hired labor	-	-	-
3. Outputs	-	-	-
Crop production	-	-	-
Sale quantity	-	-	-
Fodder	-	-	-
4. Others	-	-	-
Household maintenance	-	-	-
Education of children	-	-	-
Children marriage	-	-	-
Migration	-	-	-

3. What are the most important sources of information about government programs (agricultural extension, welfare and new cultivars)?

Sl. No.	Source of information	Rank
1.	Relatives, friends and neighbors	-
2.	Community bulletin board	-
3.	Community or local newspapers	-
4.	National newspapers	-
5.	Radio	-
6.	Television	-
7.	Group or association (specify)	-
8.	Community leaders	-
9.	Government agent	-
10.	NGO	-
11.	Internet	-
12.	Field days	-
13.	Training melas	-
14.	Krishi (farmers) mela	-

4. Constraints and characteristics in the cultivars grown by the household (Rank with in each group)

(Please show seed sample boxes to identify the varieties grown by the household)

	Variety 1	Variety 2	Variety 3	Variety 4	Variety 5
Characteristics	Local	-	-	-	-
1. Constraints	-	-	-	-	-
Low yield	-	-	-	-	-
High pest incidence	-	-	-	-	-
High disease incidence	-	-	-	-	-
Long duration	-	-	-	-	-
Small grain size	-	-	-	-	-
Poor color	-	-	-	-	-
Poor taste	-	-	-	-	-
Low recovery/shelling %	-	-	-	-	-
Low market price	-	-	-	-	-
Not fit into present cropping system	-	-	-	-	-
Susceptible to storage pest	-	-	-	-	-
Poor fodder quality	-	-	-	-	-
2. Prefered traits	-	-	-	-	-
2.1. Production:	-	-	-	-	-
High yield	-	-	-	-	-
Short duration	-	-	-	-	-
Drought resistance	-	-	-	-	-
Pest resistance	-	-	-	-	-
Disease resistance	-	-	-	-	-
Fit into existing cropping system	-	-	-	-	-
Improve soil fertility	-	-	-	-	-
More recovery/shelling %	-	-	-	-	-
More oil content	-	-	-	-	-
2. 2. Consumption:	-	-	-	-	-
Better taste	-	-	-	-	-
Less cooking time	-	-	-	-	-
High keeping quality	-	-	-	-	-
2.3. Fodder:	-	-	-	-	-
More fodder quantity and leafy	-	-	-	-	-

4. Constraints and characteristics in the cultivars grown by the household (Rank with in each group).

(Please show seed sample boxes to identify the varieties grown by the household)

	Variety 1	Variety 2	Variety 3	Variety 4	Variety 5
Characteristics	Local	-	-	-	-
Palatability (quality/taste)	-	-	-	-	-
More durability of fodder (free from pest and diseases)	-	-	-	-	-
2.4. Marketing:	-	-	-	-	-
High demand	-	-	-	-	-
Fetches higher price	-	-	-	-	-
Low price fluctuations	-	-	-	-	-
Bigger grain size	-	-	-	-	-

5. List four major characteristics you/household members are looking for in a new variety/ cultivar.

	Existing Market Price ₹/kg at present	New premium price ₹/kg willing to pay
a) ----------	----------	----------
b) ----------	----------	----------
c) ----------	----------	----------
d) ----------	----------	----------

PART III. Input-output information module:

Village: ---------- Block/mandal/taluka/township: ----------District/division: ----------

State: ---------- Country ----------Farmer's name:---------- Plot name:----------

Crop/crop mixtures: ---------- Variety:---------- Year: ----------

Season:---------- Crop area (acres): ---------- Proportion: ----------

Operations		Labor use[1]			Input/Output		
		Unit	Quantity	Wage rate	Quantity	Unit price	Remarks
1A. Land preparation (Ploughing primary and secondary tillage)	M	D					
	F	D					
	B	D					
	T	HR					
1B. Seedbed preparation	M	D					
(BBF/NBF/FLAT)	F	D					
	B	D					
	T	HR					
2. FYM/C Compost/Sheep penning/ Tank silt application	M	D					
	F	D					
	B	D					
	T	HR					
FYM/Compost/poultry		QT					
Animal penning		NO					
Date of sowing							
3. Planting/Sowing	M	D					
	F	D					
	B	D					
4A. Seed: Crop1		KG					
Crop2		KG					
Crop3		KG					
4B. Seed treatment	M	D					
	F	D					
		GM					
		GM					
5A. Fertilizer application	M	D					
	F	D					

Continued

Continued

Operations		Labor use[1]			Input/Output		
		Unit	Quantity	Wage rate	Quantity	Unit price	Remarks
		KG					
		KG					
		KG					
		KG					
5B. Micronutrient application	M	D					
	F	D					
		KG					
		KG					
6. Interculture	M	D					
	F	D					
	B	D					
7. Weeding/Weedicide application	M	D					
	F	D					
Type (sprayer/duster/other)	SP	HR					
		LT					
		LT					
8. PlantprotectionSpraying/Dusting/ Shaking /Hand picking pest)	M	D					
	F	D					
	B	D					
Type (sprayer/duster/other)	SP	HR					
	DU	HR					
9. Irrigation	M	D					
	F	D					
Source of Irrigation							
10. Watching (Birds, Pigs etc.,)	M	D					
	F	D					
Date of harvesting main crop							
11. Harvesting[2] : Crop1 Date of Harvesting: Crop2 Crop3	M	D					
	F	D					
Crop 2	M	D					
	F	D					
Crop 3	M	D					
	F	D					
12. Threshing Crop 1	M	D					

Continued

Operations		Labor use[1]			Input/Output		
		Unit	Quantity	Wage rate	Quantity	Unit price	Remarks
	F	D					
	B	D					
	TH	HR					
Crop 2	M	D					
	F	D					
	B	D					
	TH	HR					
Crop 3	M	D					
	F	D					
	B	D					
	TH	HR					
13. Marketing (including transport, and storage)	M	D					
	F	D					
	B	D					
	T	HR					
14. Fixed Cost: Land Rent (Ac) Cash		RS					
Kind		KG					
Land tax (Acre)		RS					
15. Grain Yield: Crop1		KG					
Crop 2		KG					
Crop 3		KG					
16. Fodder yield: Crop1		QT					
Crop 2		QT					
Crop 3		QT					
		QT					
		QT					
17. Stalk: Crop 1		QT					
Crop 2		QT					

1. Labor input includes total labor days of family and hired labor for each operation. Specify male and female labor as well as bullock labor separately wherever necessary.

2. Estimate the labor requirement if you had given to contractor for harvesting.

M = Male labor, F = Female labor, B = Bullock pair labor,

T = Tractor/Truck, TH = Thresher, SP = Sprayer, DU = Duster.

Note : Irrigation (Open dugwell, borewell, Submersible pump, tank, canal, and others (specify)---------

Note : Cost of hiring tractors\bullocks pair includes cost of operator.

Note : Ask\calculate land rent (₹/acre) for that particular crop.

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PART-1

Module 1. Basic information:

1.1. Date of interview ----------

1.2. Name of the investigator ----------

1.3. Name of the main crop referred for the survey ----------

1.4. Country ----------

1.5. State ----------

1.6. District/division ----------

1.7. Block/taluka/mandal/township ----------

1.8. Village ----------

1.9. Adopted/control village ----------

1.10. If adopted, is this household selected for experimental trial Yes/No

1.11. If yes, type of trial: Mother/Baby trial

1.12. Farm size (marginal, small, medium and large) ----------

1.13. Household number ----------

1.14. Head (who takes major decisions) in the household ----------

1.15. Son/daughter/wife (Write member ID) ----------

Module 2. Family composition as in July 2009.

Sr no	Name of the member	Relation To head[a]	Member ID	Gender M/F	Age years	Marital status[b]	Completed years of education[c]	Main occupation	Secondary occupation	Working on own farm Yes/No
1		Head	01							
2			02							
3			03							
4			04							
5			05							
6			06							
7			07							
8			08							
9			09							
10			10							

a First write the name of the head of the household and then other members who are staying with this household and their relationship with the head

b Married, unmarried, widow, and divorced etc.

c Write zero if the person is illiterate

2. A. Resource analysis.

Resources	Ownership (Member ID)	Decision making (Member ID)	Who influences the utilization (Member ID)
Irrigated land			
Rainfed Land			
Livestock			
Machinery			
Investment			
Seeds			
Fertilizers and pesticides			
Own labor			
Others (specify)			

Module 3. Sources of credit and information (chickpea, pigeonpea and groundnut 2008-09).

1. Are there times you have critical shortage of available funds for agricultural activities?

[1] Yes [2] No (If no go to question 2)

If yes, provide information on the cash and input credit you received during 2008-09

Item	Amount (₹)	Source[1]	Interest rate (%)	Form of repayment[2]	Was credit received on time? Yes = 1 No=2
Production cash credit	-	-	-	-	-
Consumption cash credit	-	-	-	-	-
Input credit – Write selected crop name					-
1. Seed	-	-	-	-	-
2. Fertilizers	-	-	-	-	-
3. Pesticides	-	-	-	-	-
4. Others (Specify)	-	-	-	-	-

[1]Source of credit: 0= N/A
1= Financial institution
2= Money lender
3= Neighbor
4= Relative
5= Government program
6= Self help groups (SHG)
7= Others

[2]Repayment: 1= Cash
2= Crop output
3= Cash & output
4= Others

2. During 2008-09, did you attend field days/demonstrations organized by the following organizations?

Organization	No. of field days attended 0=None	No. of field demonstrations attended 0=None	Number of times you discussed about crop 0=None
ICRISAT	-	-	-
Agricultural Extension Services	-	-	-
Agricultural Research Institute	-	-	-
NGO (specify)	-	-	-
Seed Company	-	-	-
Others (Specify)	-	-	-

3. What are your frequent sources of extension messages?

[1] Agric extension staff [2] Extension bulletins [3] News paper [4] Radio [5] Television [6] Other (specify):

4. How many times did you interact with Agri.extension agencies on crop production in 2008-09?

Module 4. Cropping pattern (chickpea, pigeonpea and groundnut, July 2008 to June 2009).

Plot name	Owner ship*	Area of the plot (acres)	Member ID who owns this land	Soil type**	Season ***	NAME OF THE CROPS				Area under this cropping system	Member ID who decides to grow this crop	Row arrange-ment	Irrigated Area (Ac)	Source of irrigation	CROP VARIETIES			
						Crop 1	Crop 2	Crop 3	Crop 4						Crop 1	Crop 2	Crop 3	Crop 4

Plot Name	Crop 1				Crop 2				Crop 3				Crop 4			
	Main production (kg)	Harvest price (₹/kg)	By-product (qt)	Harvest price (₹/qt)	Main production (kg)	Harvest price (₹/kg)	By-product (qt)	Harvest price (₹/qt)	Main production (kg)	Harvest price (₹/kg)	By-product (qt)	Harvest price (₹/qt)	Main production (kg)	Harvest price (₹/kg)	By-product (qt)	Harvest price (₹/qt)

* Use the codes. Own land (OW), leased-in (LI), leased-out (LO), shared-in (SI), and shared-out (SO).

** Deep black-1, Medium black-2, Medium to shallow black-3, Deep red-4, shallow red-5, Gravelly-6, Saline and alkaline-7 and others (specify) ---------- 8

*** Season codes: K-*kharif* (rainy), R-rabi (post rainy), S-summer, and P-perennial.

**** If farmer reported by-product in bundles or cart loads/truck loads convert and record in quintals by asking the approximate weight of each bundle

PART - II

Crop Specific Modules

Module 5. Name of the main crop referred for the survey (groundnut, chickpea, pigeonpea).

(Note: all following questions refers to the selected crop only)

1. What varieties (cultivars) did you grow during this year?

(Please show seed sample boxes to identify the varieties grown by the household)

Crop varieties	Local/Improved/ Hybrid	Season (*Kharif*/ *Rabi*/Summer)*	Source of information	Source of seed	Decision maker to adopt (Member ID)
-	-	-	-	-	-
-	-	-	-	-	-

* Collect by season if farmer is growing this crop in different seasons

Note: If any crop varieties purchased/borrowed, then answer the following, if not go to question 4

2. What factors did you considered while purchasing/borrowing seed during this year? (Rank).

List the varieties grown	Crop varieties			
	-	-	-	-
(1) Brand name	-	-	-	-
(2) Price (₹/kg)	-	-	-	-
(3) Good quality seed	-	-	-	-
(4) Certification	-	-	-	-
(5) Good packing	-	-	-	-

3. What are the major constraints did the household faced in purchasing/borrowing seed during this year?

List the varieties grown	Crop varieties			
	-	-	-	-
Non-availability of required variety	-	-	-	-
Seed is not of good quality	-	-	-	-
High seed price	-	-	-	-
Need to travel long distances	-	-	-	-
Credit facility not available				

4. What are the major pests and diseases affecting crop production on your field during this year?

Varieties grown	Major pest	Control measure[1]	% yield loss	Major diseases	Control measure[1]	% yield loss
-	-	-	-	-	-	-
-	-	-	-	-	-	-

1. Control measures: 0= No control measures, 1= Relying only on chemical pesticides, 2= Adopting IPM/IDM technologies, 3= Traditional control (farmers practices) (specify) ---------- 4= Others (specify) ----------

5. Constraints and preferred traits in the cultivars grown by the household (Rank with in each group).

	Perceptions of head (Male)				Perceptions of Female[1]			
	Variety 1	Variety 2	Variety 3	Variety 4	Variety 1	Variety 2	Variety 3	Variety 4
Characteristics	Local				Local			
1. Constraints								
Low yield (%----------)								
High pest incidence								
High disease incidence								
Long duration (days-------)								
Small grain size								
Poor color (----------)								
Poor taste								
Low recovery/shelling ---%								
Low market price (₹------)								
Poor fodder quality								
Susceptible to storage pest								
2. Preferred traits								
2.1. Production:								
High yield (%----------)								
Short duration (Days-------)								
Drought resistance								
Pest resistance								
Disease resistance								
Improve soil fertility								
More recovery/shelling --%								
More oil content (-------%)								
2. 2. Consumption:								
Better taste								
Less cooking time (min----)								
High keeping quality								
2.3. Fodder:								
More fodder quantity (---%)								
Palatability (quality/taste)								
More durability of fodder								
2.4. Marketing:								
High demand								
Fetches higher price (-----%)								
Bigger grain size								

1. Information to be recorded preferably by women field investigators from women (spouse or any women dealing with crop activity)

6. Utilization of production for chickpea, pigeonpea and groundnut 2008-09.

Variety	Grain output (kg)	Consumed (kg)	Other uses* (kg)	Own seed (kg)	Sold as seed (kg)	Grain sold in market	Sale price ₹/kg	Type of market**	Unsold stock	Prod. byproduct (qt)	Own Use (qt)	If sold (qt)	Sale price (₹/qt)
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-

* Includes kind wages, gifts and feed to cattle etc.

** Village-1, Weekly market-2, Regulated market-3), Others (Specify)----------4

7. Tracking of seed sale:

Crop variety	Selling to whom[1]	Sale quantity (kg)	Price (₹/kg)	Distance (km)
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

1. Seed company-1, Village farmers-2, Farmers belong to neighboring villages-3, Farmers belong to faraway villages –4, Others (Specify) ------5

Module 7. Adopting to and mitigating effects of dry-spell and drought.

1. What is the most important source of vulnerability?

(a) Drought (b) Pests/Diseases (c) Heavy/Untimely rains (d) Others (Specify)----------

2. How do you consider the climatic conditions (rainfall) during 2008-09 cropping year?
   (a) Good (b) Very good (c) Normal (d) Bad (e) Very bad
3. How often does drought occur? Once in ---------- years

4. What are your perceptions about rainfall pattern at present compared to 10 years ago?	Is this drought problem 1= Increasing 2= decreasing 3= No change	Effects on harvest? 1= reduced seed size 2= change in seed color 3= poor quality seed 4= reduced the yield 5= Others (specify
1. Arrival of monsoons		
2. Distribution of rainfall		
3. Number of rainy days		
4. Mid season drought		
5. Quantum of rainfall		
6. Availability of water		
7. Heavy rains		
8. Temperature		

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5. Did you experience any severe drought that affected crop production (selected crop) in the last 5 years? Yes/No.

If Yes, Frequency of occurrence and yield loss estimated by the household in the last 5 years?

Year	Type of drought[1]	% area affected due to drought	% Yield loss due to drought	Any other Remarks
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

1. Late rains –1, Rains ending early-2 Mid season rainfall gaps –3, and Low amount of rain overall -4

6. Did you adopt any coping mechanisms when crops failed because of severe drought? Yes/No.

If yes, what are they?	Rank
(a) _____	_____
(b) _____	_____
(c) _____	_____
(d) _____	_____
(e) _____	_____

About ICRISAT

ICRISAT Science with a human face

International Crops Research Institute for the Semi-Arid Tropics

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, Telangana, India, with two regional hubs and five 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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