Chickpea Baseline and Early Adoption Surveys in South Asia

Insights from TL-II (phase –I) Project

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ABSTRACT

Chickpea is the most important pulse crop in India. Its area reached a peak at the beginning of the green revolution in India .But the rapid strides in wheat productivity have encouraged the farmers in north western India to substitute wheat for chickpea, causing a fall in its area and production. But soon the crop found a new home in the central and southern states of the country. It was a big challenge for the chickpea scientists in India's national program and at the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) to breed short duration but high yielding varieties and develop package of practices suitable to the warmer growing conditions. Very soon, the crop recovered areas as well as production on the back of rising productivity. For ICRISAT, the generous support received from the Bill and Melinda Gates Foundation (BMGF) was an excellent opportunity to work with its research and development partners in India to accelerate the productivity growth by following the strategy of Farmer Preferred Varietal Selection (FPVS). This approach shortens the time needed to popularize the new varieties by exposing them to farmers and by backing up the varieties preferred by the farmers through intensive seed production efforts. This report documents the rapid strides made in taking the new varieties to the farmers by the Farmer Preferred Varietal Selection process and producing and supplying the seeds of varieties preferred by them during the years of 2007-10.

Chapter 1

Introduction

1.1 Introduction

In the perpetual race between population growth and food production, the later has surged ahead during the last five decades, largely aided by the technological advancements that ushered in green, white, blue and brown revolutions, one after another, in the developing world. South Asia, which is one of the hotspots of hunger and poverty in the world along with the Sub-Saharan Africa, benefitted from these revolutions and liberated itself from famines and food imports. India, the largest of the South Asian countries, is marching ahead from self-sufficiency towards ensuring food and nutritional security to its people. During the 65 years after Independence, the food grain production increased by five times, crossing 250 million tons during 2011-12, while the population of the country nearly quadrupled in the same period. But the major blemish in this phenomenal growth has been the slow growth in pulse production, resulting in a rapid drop in the per capita availability of pulses. Based on FAO data analysis, Akibode and Maredia (2011) reported that grain legumes provide 7.5% of total protein intake in the developing world, three times higher than the 2.5% proportion found in the developed world. However, In India, across all strata, per capita consumption of pulses increased from 11.4 to 12.9 kgs from 1990 to 2007. According to Reddy (2004 and 2009),pulses still remain the main source of protein for the poorest segment of both rural and urban India than the milk and meat products. The out stripping of demand than the supply has prompted India to take aggressive steps to foster increased grain legume production, such as raising minimum support prices and launching the Accelerated Pulses Production Program (APPP). Apart from that, harnessing the potential of technology is crucial for increasing pulse production and ensuring nutrition security to the people, a majority of whom are vegetarian in food habits. The Tropical Legumes-II project funded by Bill& Melinda Gates foundation (BMGF) is an excellent opportunity to the International Crops Research Institute for Semi- arid Tropics (ICRISAT) and its partners to take the new varieties and production technologies in case of chickpea, pigeon pea and groundnut to the farmers in a substantial scale and contribute to the national goals of its host country, besides serving its own mandate of benefitting the poor in SAT India.

Chickpea (*Cicer arietinum* L.) is an important pulse crop, contributing 20% to the pulse production in the world. Its share in India's pulse production is even more pronounced at more than 40%. India is the largest chickpea producing country in the world, accounting for 67% of the chickpea production in the world. Despite being the largest producer in the world, India is importing chickpea in substantial quantities. Chickpea is very nutritious with 20-22% of protein, besides being rich in fiber, minerals and beta carotene. Chickpea haulms are used as animal fodder and they are more nutritious than the cereal fodders. It also helps in fixing atmospheric nitrogen and contributes to the buildup of organic matter in the soil.There are two types of chickpea-*desi* (with dark colored seed coat and smaller size) and *Kabuli* (with white or cream colored seed coat and larger size). In India, *desi* varieties account for 80% of production and *Kabuli* varieties contribute the remainder.

The area under chickpea increased rapidly in the first decade after independence from 7.57 million ha in 1950-51 toan all-time high of 10.33 million ha in 1959-60. The productivity also increased from 484 kg in 1950- 51 to 697 kg per ha and the production touched a high of 7.02 million tons in 1958-59. But during the period, 1964-65 to 2008-09, chickpea area declined by 4.4 million ha in Northern Indian states (from 5.14 million ha to 0.73 million ha), while it increased by 3.5 million ha in Central and Southern states (from 2.05 million ha to 5.56 million ha). Chickpea lost area to wheat and other crops which witnessed rapid growth in productivity in the Northern states of India. Chickpea is generally grown in the post-rainy season on the black and other heavy soils that can retain moisture till the crop matures. In the Central and Northern states, it is sown with the help of irrigation after the kharif crop is harvested. In the Peninsular India, it is sown rainfed and it benefits from sporadic winter rains and matures with the help of stored moisture. ICRISAT and its research partners have developed shorter duration, high yielding varieties such that the crop escapes from terminal drought, which was a constraining factor with long duration varieties. These varieties have rapidly become popular in the Southern and Central states. The chickpea area reached 9.21 million ha in 2010-11 and production surged to 8.25 million tons, with the productivity touching an all time high of 896 kg/ha. The growth in production lags behind the increase in demand, causing an increasing dependence on imports. India spent about Rs. 4400 million per year, on an average, between 2005 and 2008 (FAO, 2011) for the imports. The *desi* types of chickpea are imported, while the *Kabuli* types of chickpea are both imported as well as exported, depending on the price dynamics and production trends. In 2007-08, India's chickpea exports exceeded the imports in value, but in all other years preceding and succeeding it, but remained as a net importer of chickpea. The irrigation coverage to chickpea crop increased from about 12.5 per cent in 1950-51 to 33.6 per cent in 2008-09, which also might have contributed to growth in productivity.

1.2 Recent trends of chickpea in India and major states

Table 1.1 Performance of chickpea and total pulses in India in the last three decades
(Base: T.E.1981-82=100) (Annual compound growth rate (%)

Crop	Period	Area	Production	Per ha productivity
Chickpea	1980-81 to 1989-90	-1.41	-0.81	0.61
	1990-91 to 1999-00	1.26	2.96	1.68
	2000-01 to 2009-10	4.34	5.89	1.48
Total pulses	1980-81 to 1989-90	-0.09	1.52	1.61
	1990-91 to 1999-00	-0.60	0.59	0.93
	2000-01 to 2009-10	1.17	2.61	1.64

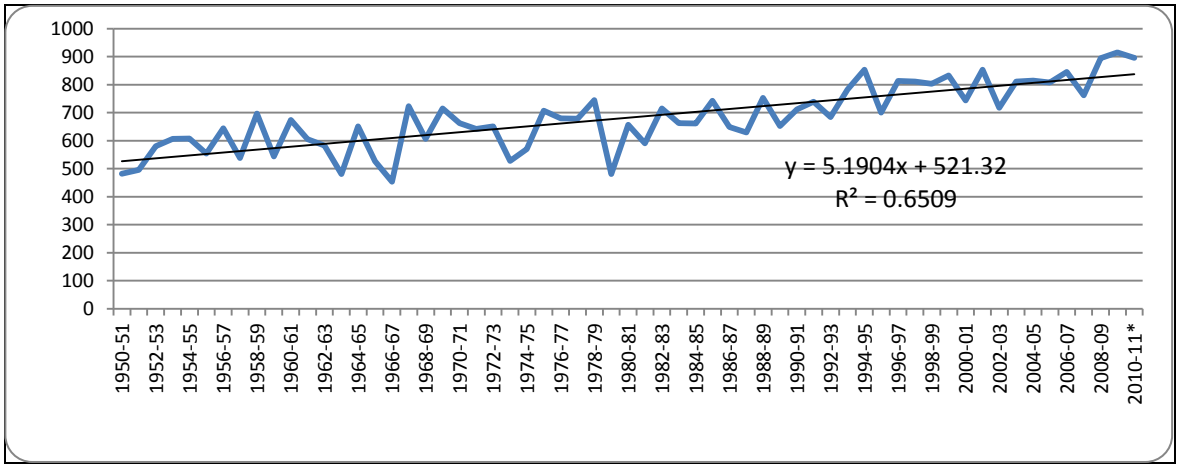
Source: *Directorate of Economics and Statistics*, Department of Agriculture and cooperation, GOI

The growth performance of chickpea in India during the last three decades is summarized in Table 1.1 along with a comparison with that of total pulses. During the 1980s, chickpea lost area at a compound growth rate of 1.41 per cent per annum. The production of chickpea also

registered a negative growth, despite an increase in productivity at a slow pace. Compared to chickpea, total pulses performed better both in case of productivity and production during the eighties. But in the next two decades, chickpea performed much better than the total pulses, marking a growth rate of 2.96 per cent in production during the nineties which accelerated further to 5.89 per cent during 2000-01 to 2009-10. During the last decade, it gained area at more than four per cent per year, although its yield growth fell short of that recorded in case of total pulses.

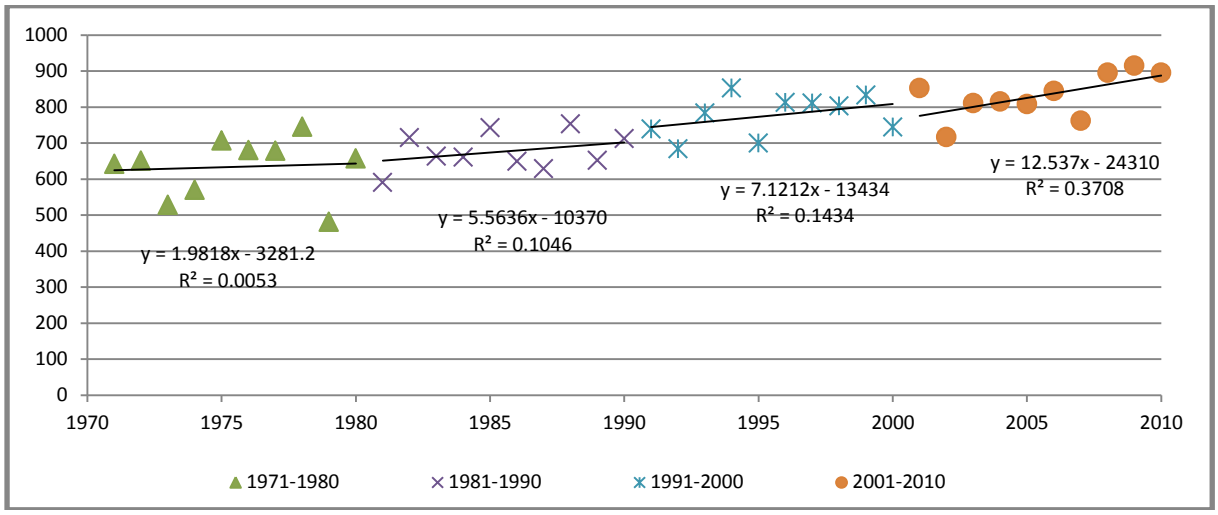
The trends in area and productivity of chickpea in the major growing states of India are captured in Table 1.2 by computing triennium averages at decadal intervals during the period 1971 to 2009. Although it started from a low base, the progress of chickpea has been phenomenal in Andhra Pradesh. The area under chickpea went up nearly by ten times, while the productivity more than quadrupled. As a result, the production went up by about 42 times over the 38 years period. The progress has been quite rapid after the 1990s. In case of Gujarat, the fluctuations in area and productivity of chickpea have been quite wild. The area more than doubled in the seventies from 50,000 ha to 122,000 ha, when the productivity was stable, but dropped to 85,000 ha by the turn of the century, when the yields dropped. The area under chickpea went up rapidly again between 2006-07 and 2008-09, as the yield looked up sharply. Karnataka and Maharashtra showed steady progress in chickpea area and productivity during the period under study. In Karnataka, area went up by 5.2 times and yield increased by 70%. As a result, the production went up by 8.9 times. Increase in production was even higher by 9.8 times in Maharashtra, as the area went up by 3.5 times and productivity increased by 2.8 times. Madhya Pradesh emerged as the largest producer of chickpea by clocking a 62% increase in area and a 43% increase in productivity on an already large base of production. But Rajasthan and Uttar Pradesh lost areas to more profitable crops, despite achieving small but steady increases in productivity. At the all India level, the area under chickpea remained around the same level (7.64 million ha) as in the base year of analysis (7.92 million ha), despite achieving a 31% increase in productivity. The linear trend line computed for productivity for the period, 1950-51 to 2010-11, indicated that the productivity increased by about 5 kg per year (Fig 1.1). However, the productivity enhancement is much significant during last one decade than earlier periods (see Fig 1.2).

Fig 1.1 Productivity of Chickpea in India, 1950-51 to 2010-11



Source: *Directorate of Economics and Statistics*, Department of Agriculture and cooperation, GOI

Fig 1.2 Decadal-wise productivity of chickpea in India, 1970-2010



1.2 Performance of Chickpea in major producing states of India

(A=Area in '000 ha, Y=yield in kg/ha)

Statistic	A.P		Gujarat		Karnataka		Mahara-shtra		Rajasthan		M.P		U.P		India	
	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y	A	Y
Average of triennium ending																
1973	65	323	50	814	147	343	356	284	1449	561	1721	645	1955	694	7919	652
1983	57	422	122	842	142	450	464	383	1829	669	2174	679	1479	825	7283	654
1993	71	622	96	597	236	400	569	570	1233	607	2275	795	1060	885	6517	712
2003	359	1112	85	647	483	482	800	580	846	716	2605	854	825	967	5840	771
2009	629	1389	173	978	767	583	1262	789	1124	617	2790	921	558	849	7640	857
Instability index (CV)																
Raw data																
1980-2009	97	51	47	21	57	22	35	27	36	16	17	17	31	11	11	11
1980-1989	11	23	45	19	21	22	15	25	27	12	7	5	7	10	9	8
1990-1999	35	24	29	17	24	22	20	17	34	15	7	10	13	8	12	8
2000-2009	35	17	56	24	33	16	25	18	26	21	12	13	17	14	13	8
Detrended																
1980-2009	47	23	43	21	26	19	16	16	34	16	8	10	7	11	11	7
1980-1989	23	16	37	19	9	21	5	16	29	12	6	5	8	9	9	7
1990-1999	34	28	31	17	20	19	12	17	36	15	6	7	5	8	12	6
2000-2009	42	22	63	24	38	18	25	16	25	21	11	14	5	14	13	7

(Source of data: Directorate of Economics and statistics, Department of Agriculture and Cooperation, Government of India.

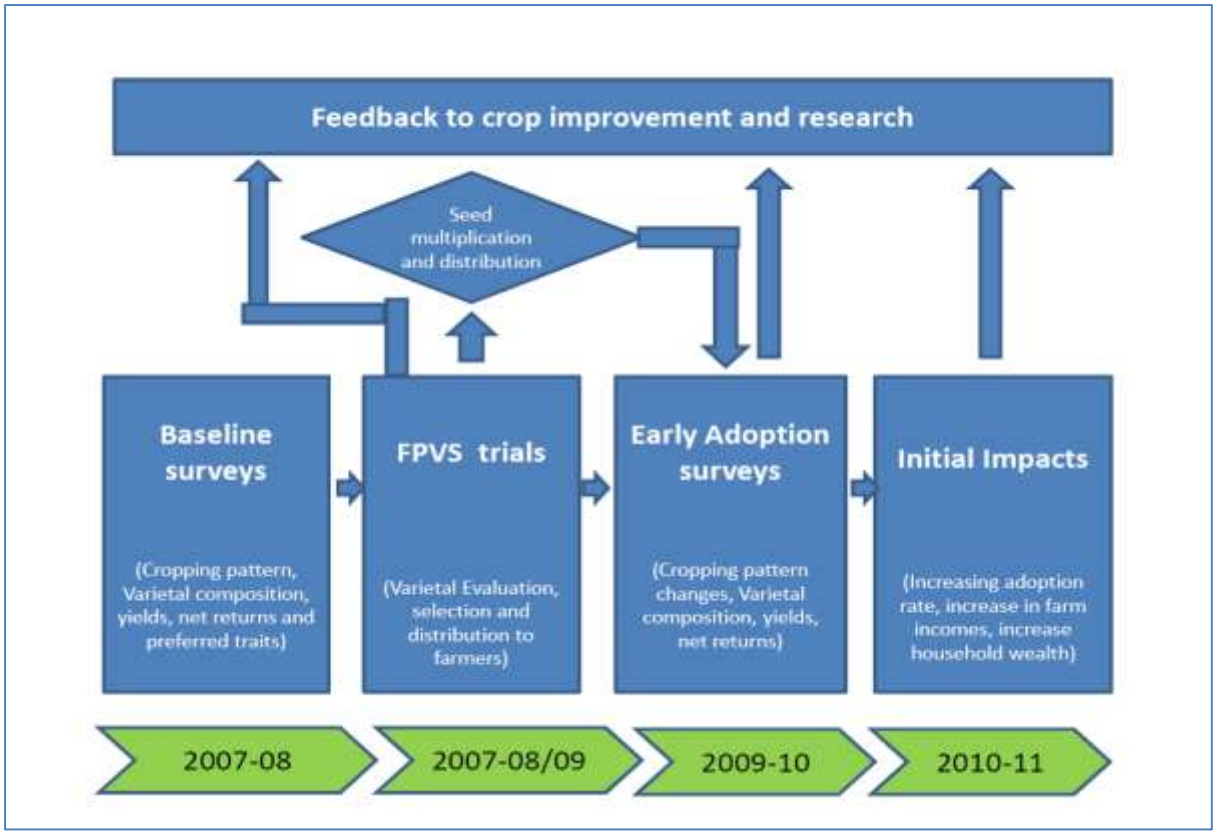
Yet, the instability in area and productivity of chickpea remain high at the level of individual states, while it gets moderated at the all India level (Table 1.2). The instability indices are the lowest in the largest chickpea growing state of Madhya Pradesh and highest in Gujarat and Andhra Pradesh, followed by Rajasthan. Karnataka experienced greater instability than Maharashtra in the indices. Although chickpea is showing a declining trend in Uttar Pradesh, the measures of instability were rather low in its case. In general, the instability was greater in case of area under chickpea than that in productivity for a large majority of states. When

the trend was removed, the instability indices for the total period of analysis, 1980-2009, reported lower values when compared with the same computed for raw data. But in case of decadal sub-periods, de-trending of data did not lead to a reduction in instability measures computed for state level data. But in case of all India data, the instability indices computed from de-trended data were marginally lower than those computed from raw data even in case of decadal sub-periods. It can be inferred that instability remains substantial in case of chickpea, particularly in case of area, because of weather conditions and competition from other crops.

1.3 Scope of the study

This report focuses on how the interventions made under Tropical Legumes-II project during 2007-10 through Farmer Participatory Varietal Selection (FPVS) have generated interest among the farmers to grow some of the new varieties. When backed up by sustained production of the seeds of improved varieties and distribution of the same in small quantities to the farmers in adopted villages, it brought about a change in the composition of the chickpea varieties in the study area between the base year in 2006-07 and the year of early adoption study in 2009-10 (see Figure 1.3).

Figure 1.3 TL-II (Phase-1) Project and interventions



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 (2012-2014) of the project. During the three years of implementation in the first phase, the Tropical Legumes-II project had a target of achieving a 5% increase in the productivity of the legumes

by achieving 10% coverage of area under the crop in the study area under new and high yielding varieties. Globally, the project aimed to accomplish net benefits to the tune of $75 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, Cow pea and Soy bean. In South Asia, the intervention is limited to the first three crops falling under the mandate of International Crops Research Institute for Semi-arid Tropics (ICRISAT). The intervention strategyin the Tropical Legumes (TL-II) project is presented in the form of a diagram in Figure 1.3. Andhra Pradesh and Karnataka states of India were chosen for implementing the project strategy in case of chickpea.

1.4 Plan of the report

This introductory first chapter provided the general introduction about chickpea crop and its recent trends of performance in terms of area, production and productivity in the major states of India and the country as a whole during the last three decades period. The causes of shift in chickpea area from cooler North Indian States with long growing season to warmer central and Southern states with shorter growing season were discussed. How the change in research strategy by ICRISAT and its research partners succeeded in evolving short duration, high yielding varieties suitable to the new growing environments was briefly touched. Yet, the measures of instability in area and productivity remain to be high due to the rain-fed nature of the crop. The scope of the study was highlighted by focusing on the strategy of Tropical Legumes –II projectand how it was implemented in the study area.

Chapter 2 is devoted to the description of the study areas and listing of the adopted or intervention villages and control villages in the four districts. The simple tools and techniques used in the study to achieve the objectives of the study are described. Chapter 3 is devoted to the description of the scenario in the baseline study. Its first part described the baseline situation in the selected villages of Kurnool and Prakasam districts of Andhra Pradesh., while the second part dealt with the baseline situation in the selected villages of Dharwad and Gulbarga districts.Chapter 4 detailed the Farmer Participatory Varietal Trials (FPVS) conducted in the selected villages of Kurnool and Prakasam districts of Andhra Pradesh and Dharwad and Gulbarga districts of Karnataka. The varieties tried in the mother-baby trials and their results are discussed. The process of farmers' selection of varieties is documented by recording the trait preferences of the farmers who participated in the exercise. Chapter 5 looked at the results of early adoption surveys conducted in 2009-10. Its first part was devoted to the results from Andhra Pradesh and the second part dealt with the results from Karnataka. Finally, the synthesis of the studies in the two states and the lessons learnt are summarized in Chapter 6. The appendices at the end of the report contain the questionnaires used in baseline and early adoption studies.

Chapter 2

Sampling and Methodology

2.1 Status of Chickpea in the selected districts for study

The data presented in Table 1.2 suggest that Madhya Pradesh, Maharashtra and Rajasthan remain to be the top three chickpea growing states of India. Yet, the Tropical Legumes-II project has selected Andhra Pradesh and Karnataka states for intervention, as they have shown a rapid growth in chickpea production in the recent past and still have a lot of potential for showing impact. The two top chickpea growing districts, Kurnool and Prakasam were chosen in Andhra Pradesh for the introduction of new varieties and crop technologies. In the same way, the two top chickpea growing districts of Karnataka, Gulbarga and Dharwad, were chosen for the implementation of the project. In each of the four selected districts, three villages were selected for intervention and another three villages which are similar to the intervention villages were picked up as control villages, for the sake of comparison. 30 chickpea growers were randomly chosen from each of the adopted villages, while 15 chickpea 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 in each of the two states, while 90 farmers from the control villages were chosen for the same purpose. Data relating to marketing aspects were collected from the traders, processors, retailers and consumers, besides from the sample farmers. 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 Karnataka states as well as from the Directorate of Economics and Statistics, Government of India.

Table 2.1 documents the rapid growth witnessed in chickpea area, production and productivity between 1970 and 2009 in the districts chosen for introduction of technology. In Kurnool district, the chickpea area went up by 58 times between 1971-73 (average) and the productivity rose by four times, recording a phenomenal increase in production by 230 times. Prakasam district fared even better than Kurnool district, with the chickpea area increasing by 139 times and productivity going up by 3.6 times. As a result, the production increased by a whopping 513 times! These phenomenal increases are also because of a low base in 1971-73 triennium years. Relatively, the base level area and production figures were higher for the study districts in Karnataka. Compared to these base years, the triennium averages for 2005-07 show an increase in chickpea production by nearly 17 times in Gulbarga and by more than nine times in Dharwad. In Gulbarga district, the chickpea area increased by nearly four times and the productivity increased by more than four times due to a low yield in 1972. In Dharwad district, area increased by more than four times and productivity went up by 63%.

Table 2.1 Trends in Area, Production and Productivity of Chickpea in the study districts and measures of instability
(A=Area in '000 ha; P =Production in '000 tons; Y= Productivity in kg/ha and CV in percent)

Triennium Averages Ending	Kurnool			Prakasam			Dharwad			Gulbarga		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1973	4.1	1.5	366	0.7	0.3	441	14.9	4.6	311	37.5	5.2	139
1983	5.0	2.3	460	1.1	0.6	545	15.0	6.0	400	41.6	17.6	423
1993	25.4	23.6	92.9	5.0	3.4	680	45.1	17.8	395	65.2	25.3	388
2003	140.3	147.7	105.3	63.0	103.7	1645	89.1	14.2	15.9	142.1	102.5	721
2009	236.3	344.7	1459	97.6	153.8	1576	84.8*	43.0*	507*	133.0*	86.4*	650*
CVs (Raw data)												
1980-2009	108.1	13.7	47.3	126.0	135.0	51.1	46.8	62.0	37.9	57.2	76.9	31.5
1980-1989	46.0	78.3	39.6	47.7	52.9	28.1	51.0	62.1	29.3	11.8	15.7	17.6
1990-99	40.44	34.4	40.0	60.3	81.0	42.3	16.4	34.0	27.4	43.4	57.9	26.9
2000-09	35.9	50.3	22.8	31.3	32.0	18.3	21.5	41.5	47.0	24.2	26.4	11.6
CVs (De-trended data)												
1980-2009	48.4	76.2	33.1	61.8	70.5	31.0	25.8	37.0	34.9	28.7	38.4	21.2
1980-89	22.9	25.9	17.7	27.2	29.1	16.9	18.9	22.8	26.8	16.9	23.9	18.0
1990-1999	33.2	92.8	48.3	78.9	126.7	39.8	13.6	25.4	25.1	37.2	48.5	22.2
2000-2009	45.9	76.5	27.7	37.5	43.6	33.4	36.3	58.3	29.9	29.9	41.1	19.2

*Averages for Triennium ending 2007

Yet, the measures of instability are quite high, suggesting fluctuations between years in area, production and productivity. The instability indices computed from the raw data for the entire study period, 1980-2009, were very high for all the four districts. After removing the trend in area, production and productivity, the instability indices showed moderate values. Same tendency was noted in case of the instability indices computed for the first decadal period, 1980-89, in case of Kurnool, Prakasam and Dharwad districts. But, the instability indices computed for Gulbarga district showed higher values for the de-trended data than for the raw data. For the second decadal period, 1990-99, the instability indices were lower for de-trended data of the two Karnataka districts, while they were lower for raw data of the two Andhra Pradesh districts. In case of the third decadal period, 2000-09, the instability indices computed from the raw data were uniformly lower than those computed from the de-trended data in case of all the four study districts. When there is a strong trend, indices get moderated when the trend is removed. But when the trend is weak, de-trending of data resulted in higher values for the instability indices. As the trend is strong in the long period data, instability indices get moderated after trend is removed. The instability indices were generally higher in case of area than in case of productivity. The instability in production is normally higher than the corresponding measures for either area or productivity.

2.2 Details of sample villages and size composition of farmers

Table-2.2 Sampling villages for baseline survey under TL-II Project in Andhra Pradesh

Districts	Treatment/ Adopted village	No. of farmers	Control village	No. of farmers	Total
Prakasam	Cherukurapadu	30	Paidipadu	15	
	Chirvanauppalapadu	30	Maddiralapadu	15	
	Kollavaripalem	30	Bodavada	15	
Sub-total		90		45	135
Kurnool	Balapanur	30	Munagala	15	
	Mitnala	30	Rasulpet	15	
	Pulimaddi	30	Brahmanapally	15	
Sub-total		90		45	135
Grand Total		180		90	270

Both the districts selected for baseline survey in the State are among the drought prone districts of the state. Kurnool district belongs to Rayalaseema part of the state, while Prakasam district forms part ofthe Coastal Andhra part. Prakasam district has a normal rainfall of 871 mm, part of which occurs during the North-East monsoon period, which coincides with the crop growth period of chickpea. So, chickpea is sown late to escape the fury of cyclones and the showers that occur during the crop growth period contribute to better yield. Kurnool district receives a normal rainfall of 670 mm, with much less probability of rains in the post-rainy season. It is sown early and matures largely with the help of moisture stored in the soil. In both the districts, about a quarter of the cultivated area is irrigated. The villages selected for intervention and control and

the sample units chosen from them are listed in Table 2.2. InKurnool district Balapanur, Mitnala and Pulimaddi were the villages chosen for intervention, while Munagala, Rasulpet and Brahmanapally were selected as control villages. In Prakasam district, Cherukurapadu, Chiruvanuppalapadu and Kollavaripalem were the adopted villages, while Paidipadu, Maddiralapadu and Bodavada were picked up as the control villages. The distribution of the sample among different size groups is summarized in Table 2.3.

Table-2.3 Distribution of sample among different farm size categories in Andhra Pradesh

Farm size	Kurnool				Prakasam				Overall			
	A	%	C	%	A	%	C	%	A	%	C	%
Marginal	21	23	7	16	30	34.	9	20	51	28.	16	18
Small	16	18	9	20	16	18	11	24	32	18	20	22
Medium	17	19	14	31	22	24.	12	27	39	22	26	29
Large	36	40	15	33	22	24.	13	29	58	32	28	31
Total	90	100	45	100	90	100	45	100	180	100	90	100
A – Adopted village, C – Control village												

In the sample from the adopted villages of Kurnool district, large farmers dominate with a 40 per cent share, followed by marginal farmers with 23 per cent share (Table 2.3). In the control villages also, large farmers had a 33% share in the sample. But, relatively the proportions of farmers belonging to small and medium categories were higher in the control villages. In the adopted villages of Prakasam district, the share of marginal farmers was the highest at 34 per cent. In the control villages, the shares of large and medium category farms were higher. In the pooled sample also, large farmers had the highest shares in both adopted and control villages. But marginal farmers were more in the sample of adopted villages, while the medium and small farmers had higher shares in the control villages.

It must be mentioned that the villages for intervention or for control were not chosen randomly. They were selected by the research scientists based on their prior contact with them. The breeders picked up those villages and farmers about whom they have a confidence for cooperating with them in conducting the Farmer Participatory Varietal Selection (FPVS) trials. In the selected districts, there are about a 1000 villages per district. Only three intervention and three control villages are chosen. The sampling fraction of the villages is only about 0.6. With a very small and purposively selected sample of villages and farmers, it cannot be expected that the sample is, in any way, represents the district. The selected villages and farmers tend to be more progressive and advanced in the adoption of technologies. Hence, no attempt should be made to extrapolate the results from the sample to draw any conclusions about the districts. The limited purpose which the small and purposive sample serves is to track the dynamics of trials and document early adoption and impact of technology on the sample farms. It would also serve as a dependable baseline for assessing the detailed impact of technology at a later date in a full adoption study. These observations are valid for the sample drawn from the Karnataka districts as well.

Table 2.4 Sampling villages for baseline survey under TL-II Project in Karnataka

Districts	Intervention/ Adopted village	No. of farmers	Control village	No. of farmers	Total
Dharwad	Harobelwadi	30	Hansi	15	
	Kumaragoppa	30	Kabbenur	15	
	Shirkol	30	Yemnur	15	
Sub-total		90		45	135
Gulbarga	Farhatabad	30	Bennur	15	
	Gotur	30	Bhushangi	15	
	Kurikota	30	Honnakirangi	15	
Sub-total		90		45	135
Grand Total		180		90	270

Dharwad district is better endowed with respect to irrigation, infrastructure facilities and socio-cultural development than Gulbarga district. But Gulbarga district has better soils and is reputed as the pulse bowl of the state. The former belongs to the Bombay Karnataka region, while the later is drawn from the erstwhile Hyderabad Karnataka part. These two are together expected to provide the diversity and contrasting conditions for chickpea cultivation in the state. Harobelwadi, Kumaragoppa and Shirkol villages from Dharwad district were chosen for the conduct of mother baby trials during 2007-08 (Table 2.4). No such trials were planned in case of the three control villages, Hansi, Kabbenur and Yemnur. In the same way, the three intervention villages chosen in Gulbarga district were Farhatabad, Gotur and Kurikota. The three villages, Bennur, Bhushangi and Honnakirangi, were chosen as control villages for the purpose of comparison.

Table 2.5 Distribution of Karnataka sample among different farmsize categories

Farm size	Dharwad				Gulbarga				Pooled			
	A	%	C	%	A	%	C	%	A	%	C	%
Marginal	15	16.67	6	13.33	25	27.78	10	22.22	40	22.22	16	17.78
Small	31	34.44	16	35.56	24	26.67	15	33.33	55	30.56	31	34.44
Medium	24	26.67	14	31.11	25	27.78	14	31.11	49	27.22	28	31.11
Large	20	22.22	9	20.00	16	17.78	6	13.33	36	20.00	15	16.67
Grand Total	90	100.00	45	100.00	90	100.00	45	100.00	180	100.00	90	100.00
A: - Adopted village, C: - Control village												

In Dharwad villages, large farmers are relatively more when compared with Gulbarga villages, which had a higher proportion of marginal farmers (Table 2.5). In the pooled control sample, small farmers constitute 34 per cent of the sample, followed by medium farmers with a share of 31 per cent. Marginal farmers from 18 per cent of the sample and the large farmers account for the remaining 17 per cent. Two thirds of the total sample (270 farmers) is drawn from the adopted villages selected for technology interventions and the remaining one third belongs to the control villages where no such deliberate interventions are planned. But, because of the close proximity of the control villages to the adopted villages, the diffusion effect of the technologies can be quite high.

2.3 Analytical techniques

2.3.1 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.

2.3.2 Growth rate analysis

For assessing the trends in area, production and productivity of chickpea in different states and the study districts of Andhra Pradesh and Karnataka states, the following growth rate formula was employed.

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

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 the equation (1), we get the equation (2).

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

This is of the linear form.

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

Where,

Yt = lnYt

A = lna

B = lnb

et = lnut

The linear regression of the above form (3) was fitted separately for area, production and productivity of chickpea. 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 anti-logarithms of 'A' and 'B' values as,

a = Anti log A

b = Anti log B

Average annual compound growth rate was calculated as

b = 1 + g

g = b – 1

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

2.3.3 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 forming part of the sample in each district was asked to rank the preferences based on their priorities using ranksfrom 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 jth individual

(j = 1, 2…….,n)

Nj stands for number of factors ranked by jth 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.

2.3.4 Coefficient of variation (CV)

Coefficient of variationexplains the deviation in the observation over a period around its mean value.

CV (per cent) = (Standard deviation/mean)*100

Chapter 3

Insights from baseline surveys

3.1 Andhra Pradesh

3.1.1 Socio-economic profile

The male headed households were relatively more in Prakasam district (96 per cent) than in Kurnool district (93 per cent) (Table 3.1). The household head is slightly older in the adopted villages of Prakasam district (51 years) than those in the adopted villages of Kurnool district (47 years). But the age of the household head was the same at 48 years in the control villages of both the districts. The average education level of the household heads was also the same at seven years of schooling in both the adopted and control villages of the two districts. A slightly higher percentage of household heads participated in the local bodies in the sample of Prakasam district than in Kurnool sample. Interestingly, sample households in control villages of Prakasam district had a higher participation than those in the adopted villages. Similarly, a larger proportion of households in Prakasam district belonged to forward communities than those in Kurnool district and this proportion was higher in control villages than in adopted villages. A larger proportion of households in the adopted villages of Kurnool district belonged to minority community than in Prakasam district. Representation of minorities was very low in the control villages of both the districts. Relatively a larger proportion of sample farmers had agriculture as the main occupation in control villages of Kurnool district than in the adopted villages. In case of Prakasam district, the reverse was true with a larger proportion of households in adopted villages having agriculture as the main occupation than in the control villages. Business or service as the main or secondary sources of income was prevalent more in adopted villages of Kurnool district and control villages of Prakasam district. Ownership of a two wheelers or bicycle was universal in the control villages of Prakasam district, while only about one half of the households possessed them in control villages of Kurnool district and the adopted villages of both the districts. Ownership of television sets was almost universal in the adopted villages of Kurnool district, but was limited to only 57 per cent of the households in control villages. The ownership of television sets was less prevalent in Prakasam district, with only 27 per cent in adopted villages and 33 per cent in control villages possessing them. The ownership of radios/ tape recorders was restricted to about a quarter of households in all the sample villages.

Table 3.1 Socio-economic profile of sample farmers in Andhra Pradesh, 2006-07

Socio-economic issue	Kurnool sample		Prakasam sample		Pooled sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Male headed households (%)	93	93	96	96	94	94
Household size (No)	5	5	5	5	5	5
Male Workers (No)	2	2	2	2	2	2
Female Workers (No)	1	1	1	1	1	1
Dependency Ratio*	0.7	0.7	0.7	0.7	0.7	0.7
Age of Household head (Years)	47	48	51	48	49	48
Education Level of household head (no. of years)	7	7	7	7	7	7
Participation in local bodies (%)	9	9	10	16	9	11
Proportion belonging to forward castes (%)	50	56	69	84	63	70
Proportion belonging to religious minorities (%)	12	2	7	2	9	2
Proportion with agriculture as the main occupation (%)	92	98	99	96	96	97
Proportion with business/service as main /secondary occupation (%)	16	4	2	9	9	7
Ownership of two wheelers/bicycles (%)	48	57	47	100	47	81
Ownership of television sets (%)	95	57	27	33	61	45
Ownership of radio/tape recorder (%)	24	14	27	22	25	19
*Dependency ratio= (Family size-number of workers)/Number of workers						

3.1.2 Assets and liabilities

The size of holding was larger in the control villages of Kurnool district than the same in control villages of Prakasam district (Table 3.2). The size of the holding was about the same in the adopted villages of both the districts. Irrigation coverage was slightly higher in case of sample farmers in Kurnool district than the same in case of Prakasam district, both in adopted and control villages. The value of land owned was the highest in the control villages of Kurnool district, followed by the adopted villages of Kurnool district, adopted villages of Prakasam district and control villages of Prakasam district.

Table 3.2 Value of land owned by sample farmers in Andhra Pradesh, 2006-07

Type of Land	Kurnool				Prakasam			
	Adopted		Control		Adopted		Control	
	Area (ha)	Value (Rs)	Area (ha)	Value (Rs)	Area (ha)	Value (Rs)	Area (ha)	Value (Rs)
Irrigated land	0.88	234,451	0.76	178,567	0.12	75,152	0.03	15,880
Rainfed land	4.10	765,678	3.40	630,667	4.58	09,482	4.51	840,018
Fallow land	0.02	3,221	4.16	809,234	0.02	3,476	0	0
Total land	5.00	1,003,350	8.33	1,618,468	4.72	988,110	4.54	855,898

The sample farmers from the adopted villages of Prakasam district owned more number of livestock than their counter parts in the adopted villages of Kurnool district (Table 3.3). But the sample farmers from the control villages of Kurnool district possessed relatively more number of livestock than those from the control villages in Prakasam district. But the value of livestock owned by the sample farmers did not differ much among the sample villages of both the districts.

Table 3.3 Value of Livestock owned by sample farmers in Andhra Pradesh, 2006-07

Type of Livestock	Kurnool				Prakasam			
	Adopted		Control		Adopted		Control	
	Number	Value (Rs.)	Number	Value (Rs.)	Number	Value (Rs.)	Number	Value (Rs.)
Draft animals	0.45	5,423	0.32	3,422	0.56	5,673	0.31	3,688
Cows	0.10	1,223	0.37	4,509	0.48	4,571	0.34	4,290
Buffaloes	0.20	2,897	0.39	3,877	0.47	2,345	0.17	3,201
Others	-	-	-	-	-	-	-	-
Total livestock	0.75	9,543	1.08	11,808	1.51	12,589	0.82	11,179

Table 3.4 Value of farm implements owned by sample farmers in Andhra Pradesh, 2006-07

Type of Implement	Kurnool				Prakasam			
	Adopted		Control		Adopted		Control	
	Number	Value (Rs.)	Number	Value (Rs.)	Number	Value (Rs.)	Number	Value (Rs.)
Tractor and accessories	0.04	12,889	0.04	8,889	0.08	46,556	0.11	66,667
Electrical pump sets	0.10	794	0.09	3,244	0.03	267	0.02	267
Bullock drawn tools	0.43	4,067	0.46	4,511	0.02	183	0.02	222
Others tools	0.01	63,333	0.02	8,889	0.05	15,756	0.02	8,889
Total farm implements	0.58	81,083	0.61	25,533	0.18	62,762	0.17	76,045

Ownership of tractors was relatively more prevalent in Prakasam district, while the ownership of other farm implements was higher in Kurnool sample (Table 3.4). In terms of value of farm implements owned, adopted villages of Kurnool district stood first, followed by the control villages and adopted villages of Prakasam district, with the control villages of Kurnool district recording the lowest value.

Table 3.5 Value of Consumer durables owned by sample farmers in Andhra Pradesh, 2006-07

Type of Consumer durables	Kurnool				Prakasam			
	Adopted		Control		Adopted		Control	
	Number	Value (Rs.)	Number	Value (Rs.)	Number	Value (Rs.)	Number	Value (Rs.)
Residential house	0.98	132,956	1.00	111,222	0.98	170,333	1.00	101,500
Cattle shed	0.53	11,023	0.66	9,980	0.43	19,255	0.53	18,544
Cycle/two-wheelers	0.58	9,199	0.55	10,878	0.63	19,667	0.71	19,647
Others	2.22	7,184	2.07	6,948	1.86	9,174	2.19	10,321
Total consumer durables	4.31	160,362	4.28	139,028	3.90	218,429	4.43	150,012

The adopted villages of Prakasam district led others in the value of consumer durables owned by the sample households (Table 3.5). The adopted villages of Kurnool district stood second with the control villages of Prakasam district faring better than the control villages of Kurnool district.

Table 3.6 Financial liabilities and assets of sample farmers in Andhra Pradesh, 2006-07

Financial Liabilities and Assets	Kurnool (Rs per Hh)		Prakasam (Rs per Hh)	
	Adopted	Control	Adopted	Control
Borrowings (-)	405,739	240,033	439,553	568,591
Lending's (+)	130,152	91,875	30,000	0
Savings (+)	198,462	106,543	370,630	217,340
Net Liabilities	77,125	41,615	38,923	351,251

Table 3.6 gives an account of the financial assets and liabilities of the sample farmers. The sample farmers of control villages in Prakasam district had the highest borrowings, followed by the adopted villages of Prakasam district and adopted villages of Kurnool district. The control villages of Kurnool district recorded the lowest borrowings. The households of Kurnool district lent more money to others than their counterparts in Prakasam district. But, Prakasam households had more savings than the Kurnool households. In terms of net liabilities, the sample households from control villages in Prakasam district topped the list, while those from the adopted villages in Prakasam district were at the bottom.

Table 3.7 Net worth of sample farmers in Andhra Pradesh, 2006-07 (Rs.'000)

Assets and Liabilities	Kurnool		Prakasam	
	Adopted	Control	Adopted	Control
Value of Land	1,003	1,618	988	856
Value of Livestock	10	12	13	12
Value of Farm Implements	81	26	63	76
Value of Consumer durables	160	139	218	150
Total Assets	1,254	1,795	1,282	1,094
Net Liabilities	77	42	39	351
Net worth	1,177	1,753	1,243	743

The asset-liability position of the sample households is summarized in Table 3.7. The sample households from control villages in Kurnool district turned out to be the wealthiest of the four groups with the highest net worth. The sample households from adopted villages of Prakasam district had slightly higher net worth than their counterparts in the adopted villages of Kurnool district. The sample households from control villages of Prakasam district were the poorest with the lowest net worth. Not only did they have lowest value of assets, but also are saddled with high liabilities.

3.1.3 Income and Consumption expenditure

Table 3.8 Annual average net household income of sample households in Andhra Pradesh, 2006-07

Sources of income	Kurnool (Rs./year per Hh)		Prakasam (Rs./year per Hh)	
	Adopted	Control	Adopted	Control
Income from crops	108,934	78,947	122,512	182,806
Farm work (labor earnings)	5,340	3,756	4,720	1,967
Non-farm work (labor earnings)	3,716	533	122	344
Regular Farm Servant (RFS)	867	0	0	0
Livestock (milk and milk products selling)	8,928	9,444	6,265	7,196
Income from hiring out bullocks	1,056	722	129	356
Income from selling sheep, goat, chicken, meat, eggs etc.	67	844	672	0
Selling of water for agriculture purpose	0	0	0	0
Selling CPR (firewood, fruits, stones, and mats etc.)	0	0	0	0
Selling handicrafts (specify)	500	0	0	0
Rental income (tractor, auto, sprayer, & truck etc.)	2,333	3,778	4,311	2,911
Rent from land, building and machinery etc.	833	5,644	0	222
Caste occupations (specify)	0	0	389	0
Business (specify)	1,278	178	4,678	1,356
Regular salaried jobs (Govt./private)	5,811	4,000	3,067	4,778
Out migration	0	0	667	0
Remittances	320	276	774	156
Interest on savings and from money lending	2,342	1,156	786	567
Cash and kind gifts including dowry received	2,128	1,777	37	222
Pension from employer	27	1,867	804	489
Government welfare/development Programs	278	489	89	467
Others if any	0	667	1,344	27
Grand total	144,758	114,078	151,366	203,864

Income from crops alone accounted for three-fourths of net household income of sample farmers in adopted villages of Kurnool district (Table 3.8). Income from livestock sources (including sale of milk and milk products, sheep/goat/chicken and hiring out bullocks) together contributed 6.9 per cent of the income. By hiring out labor (including farm labor, regular farm servants and non-farm labor work), a household, on an average, earned another 6.9 per cent of income. Subsidiary sources like salaried jobs, pensions and business, selling handicrafts etc., together contributed 5.2 per cent of the net household income. Income from renting out assets and lending capital contributed about 4 per cent of household income. The remainder of household income came from cash and kind gifts, remittances and government welfare programs. The contribution of crop income was the lowest at 69.2 per cent in case of sample households from control villages of Kurnool district. Livestock sources accounted for 9.7 per cent of total household income, while

they earned 3.8 per cent by hiring out labor. Salaried jobs, pensions and business sources provided 5.3 per cent of income. By renting out assets and by lending capital, they earned as much as 9.3 per cent of the income. The remaining income came from cash and kind gifts and government welfare programs. The share of crop income was higher at 80.9 per cent in the adopted villages of Prakasam district. Livestock sources contributed only 4.7 per cent, while hiring out labor gave them 3.2 per cent of the income. Business, salaried jobs and pensions provided them 5.6 per cent of income. Rent and interest had a share of 3.4 per cent in the household income. The remainder of income came from remittances, outmigration, gifts and government welfare programs. Of all the village groups, control villages of Prakasam district showed the highest dependence on income from crops. As much as 89.7 per cent of the household income came from crops. Livestock sources provided only 3.7 per cent of the total household income. Only 1.1 per cent of total income was earned by hiring out labor. Subsidiary sources like salaried jobs, business and pensions accounted for 3.2 per cent of the total household income. Rental and interest income constituted 1.8 per cent of income. The remaining 0.5 per cent of income was made up of gifts, remittances and government welfare programs. It is interesting to note that the sample farmers of control villages of Prakasam district reported highest annual average net income, despite having the lowest net worth among the four village groups.

Table 3.9 presents the pattern of household consumer expenditure in the sample villages of Andhra Pradesh. The expenditure on cereals was almost uniform in all the study villages. The expenditure on pulses, edible oils and non- vegetarian foods was higher in Kurnool villages, while the expenditure on milk and milk products, fruits and vegetables and other food items was higher in Prakasam villages. Yet, the expenditure on food was nearly the same across the four groups of villages. But the expenditure on non-food items was much higher in Prakasam villages than on food items. In Kurnool district, the expenditure on food items was higher than that on non-food items. Among the non-food items, Kurnool district households spent more than their counterparts in Prakasam district only in case of toddy/alcohol*/beedi*/cigarettes. They spent about the same on health. But the expenditure on all other non-food items was much higher in case of Prakasam sample. Expenditure on education was the single largest component of non-food items in case of all the four groups. But it was much higher in Prakasam district, particularly in case of control villages. The sample households from control villages of Prakasam district reported the highest consumer expenditure, followed by those from the adopted villages of Prakasam district. It is no coincidence that the sample farmers from control villages of Prakasam district also had the highest net household income. The consumer expenditure was about the same in the adopted and control villages of Kurnool district.

Table 3.9 Consumption expenditure of sample farmers in Andhra Pradesh, 2006-07

Item of Consumption	Kurnool (Rs/year/Hh)		Prakasam (Rs/year/Hh)	
	Adopted	Control	Adopted	Control
Cereals	11,525	11,971	10,887	10,992
Pulses	5,564	5,135	3,659	3,308
Oils and Oil seeds	2,973	3,212	2,835	2,751
Non-Veg. foods	2,297	1,863	1,708	1,617
Milk and Milk products	5,099	4,614	6,294	6,388
Fruits and vegetables	2,901	2,800	3,595	3,357
Other food items	3,995	3,853	4,637	4,055
Total Food expenditure	**34,354**	**33,448**	**33,615**	**32,468**
Health	4,559	4,829	4,620	5,078
Education	14,532	13,844	23,661	33,665
Clothing/shoes	4,188	4,884	4,938	5,756
Toddy & alcohol, Bid and Cigarettes	6,006	6,205	4,174	4,005
Entertainment and Travel	1,865	1,569	4,597	6,417
Other non-food items including Ceremonies	4,918	5,108	6,853	7,233
Total Non-food expenditure	**36,068**	**36,439**	**48,843**	**62,154**
Total Expenditure	**70,422**	**69,887**	**82,458**	**94,622**

3.1.4 Cropping pattern and chickpea varieties

In case of Kurnool villages, chickpea area constituted 57 per cent of the post-rainy season cropped area in adopted villages and 70 per cent of the post-rainy season cropped area in control villages (Table 3.10). Similarly, it constituted a little more than one half of the total cropped area in adopted villages and about 48 per cent of the cropped area in control villages. These figures point to the pre-eminent position of chickpea in the cropping pattern of the study villages in Kurnool district. Its importance in the cropping pattern is even more pronounced in case of Prakasam district. Chickpea accounted for as much as 90 per cent of the post-rainy season cropped area in the adopted villages and 85 per cent of the same in control villages. Since the rainy season cropped area is little or nothing, chickpea had a lion share of 89 per cent of the cropped area in adopted villages and 85 per cent of the cropped area in control villages. In the pooled sample, chickpea area had a share of 71 per cent of the cropped area in the post-rainy season and 65 per cent of the total cropped area in the adopted villages. In the control villages, chickpea area constituted 79 per cent of the cropped area in the post-rainy season and 67 per cent of the total cropped area. Such an excessive dependence on a single crop may not be desirable for the reasons of crop rotation and risk generally associated with specialization.

Table 3.10 Relative importance of chickpea in Andhra Pradesh sample farms, 2006-07

Cropped area	Kurnool Sample		Prakasam Sample		Pooled Sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Rainy season cropped area (ha)	75	58	4	0	79	58
Post rainy season cropped area (ha)	565	131	389	202	954	333
Area under chickpea (ha)	324	91	351	171	675	262
Proportion of chickpea area to post rainy area (%)	57	70	90	85	71	79
Proportion of chickpea area in total cropped area (%)	51	48	89	85	65	67

Table 3.11 Composition of chickpea varieties in A.P (Area in ha.), 2006-07

Variety	Kurnool Sample		Prakasam Sample		Pooled Sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Annigeri	150(46)	38(42)	84(24)	44(26)	234(35)	82(31)
ICCV-2	0	0	40(11)	11(6)	40(6)	11(4)
KAK-2	6(2)	0	108(31)	30(18)	114(17)	30(12)
JG-11	168(52)	53(58)	119(34)	86(50)	287(42)	139(53)
Total	324 (100)	91(100)	351(100)	171(100)	675(100)	262(100)

(Figures in parentheses represent percentages to total chickpea area)

In 2006-07 itself, the new variety, JG-11, accounted for 52 per cent of the chickpea area in the adopted villages of Kurnool district and 58 per cent of the chickpea area in control villages of the same district (Table 3.11). The *Kabuli* variety, KAK-2, occupied 2 per cent of chickpea area in adopted villages. Annigeri variety, which was introduced 40 years ago in the country but only in the recent decade in Andhra Pradesh, covered the remaining area (46 per cent in adopted villages and 42 per cent in control villages). But, in Prakasam district, farmers have largely moved away from Annigeri, with only 24 and 26 per cent of the area under it in adopted and control villages respectively. In the adopted villages, 34 per cent area was under JG-11, followed by KAK-2 in 31 per cent area and ICCV-2 in the remaining 11 per cent area. In the control villages, 50 per cent of the area was occupied by JG-11, followed by 18 per cent area under KAK-2 and 6 per cent area under ICCV-2. The spread of newly released varieties was already impressive in the year of baseline survey itself in both the study districts. It was largely because of the prior contacts the sample farmers had with the research stations and scientists and consequent early exposure to new varieties and other improved technologies.

Table 3.12 Productivity levels of chickpea (kg/ha) perceived by sample farmers, 2006-07

Perceived Yield	Kurnool Sample		Prakasam Sample		Pooled Sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Rain fed						
Good	1,876	1,673	2,398	2,511	2,137	2,092
Bad	971	897	1,432	1,499	1,202	1,198
Best	1,889	1,677	2,433	2,581	2,161	2,129
Irrigated						
Good	2,100	2,062	2,717	2,642	2,409	2,390
Bad	1,547	1,235	1,976	1,882	1,792	1,606
Best	2,111	2,012	2,717	2,758	2,414	2,390

As a part of the baseline survey, sample farmers were asked to give their perceptions of possible chickpea yields under different weather situations. In a good year, chickpea yields were perceived to be quite high even under rain fed situation (Table 3.12). In a bad year, the yields were believed to fall to nearly 50 per cent of the good yield in Kurnool district and to about 65 per cent in Prakasam district. Even in the best year, the perceived yields are believed to be only a shade better than those perceived in good year. The good yields are expected to go up by only 10 per cent if irrigation support is provided. But when irrigation support is available, even the bad year yields are expected to go up. The best yields are about the same as good yields when irrigation cover is available.

3.1.5 Economics of chickpea and other crops

Table 3.13 Gross returns (Rs.'000/ha) from different crops by AP sample farmers, 2006-07

Gross Income from crops	Kurnool sample		Prakasam sample		Pooled sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Chickpea	15	10	21	25	18	18
Groundnut	5	4	-	-	5	4
Sorghum	15	10	-	-	15	10
Paddy	15	15	8	-	12	15
Sunflower	11	8	-	-	11	8
Tobacco(Natu)	17	7	54	37	36	22
Tobacco (Virginia)	-	-	31	55	31	55
- Not grown						

When farmers were asked to indicate the gross returns expected from different crops grown by the farmers, they gave their estimates, which are reported in Table 3.13. Farmers from the adopted villages in Kurnool district reported the same gross returns from chickpea, sorghum and paddy. They perceived that the gross returns from tobacco (Natu) could be slightly higher. They perceived that the returns from sun flower and ground nut could be lower. Farmers from control villages of Kurnool district felt that the gross returns could be higher with paddy. They expressed

that the gross returns from sorghum and chickpea could be the same. They perceived much lower returns from sunflower, tobacco (Natu) and ground nut. In Prakasam district, the farmers from both the adopted and control villages felt that the Natu and Virginia varieties of tobacco can give higher returns than any other crop. Chickpea is the next best alternative, as the returns from paddy are perceived to be lower than that. With the restrictions on tobacco cultivation (Crop holiday announced by Government of India in 2000), chickpea is the obvious choice for the farmers.

Table 3.14 Economics of local and improved varieties of chickpea in AP sample farms, 2006-07 (Rs/ha)

Cost /returns	Kurnool		Prakasam	
	Adopted	Control	Adopted	Control
Variety (Local / check)				
Yield (kg/ha)	1,025	995	1,040	1,136
COC(Rs/ha)	16,344	16,221	17,823	18,232
Gross returns(Rs/ha)	23,227	22,498	23,920	26,128
Net returns (Rs/ha)	6,883	6,277	6,097	7,896
BCR	1.42	1.39	1.34	1.43
Improved variety				
Yield (kg/ha)	1,250	1,202	1,261	1,315
COC (Rs/ha)	18,667	18,457	20,131	22,152
Gross returns (Rs/ha)	28,211	27,128	31,198	32,534
Net returns (Rs/ha)	9,544	8,671	10,068	10,382
BCR	1.51	1.47	1.48	1.47

The economics of chickpea cultivation in the sample villages of the two study districts are presented in Table 3.14. In Kurnool district, chickpea yields with both the local and improved varieties were higher in the adopted villages than in the control villages. The cost of cultivation was about the same in both the adopted and control villages for both the types of varieties. The gross and net returns were slightly higher in the adopted villages of Kurnool district. The benefit cost ratio of chickpea in adopted villages was marginally higherthan in control villages for both the local and improved varieties.

In Prakasam district, control villages reported better yields than the adopted villages in case of both the local and improved varieties. It could be because of better soils and high investments that the sample farmers make on the crop. The difference in yields between control and adopted villages was more pronounced in case of improved varieties than in case of local variety. The cost of cultivation was also higher in control villages in case of both local and improved varieties. So were the gross and net returns. The benefit cost ratio was also marginally higher in control villages in case of local varieties. It was about the same in case of improved varieties in adopted and control villages of Prakasam district.

3.1.6 Sources of information

Table 3.15 Sources of information on technology to sample farmers in AP, 2006-07

(Percent farmers getting information from the source)

Sources of information	Kurnool		Prakasam	
	Adopted	Control	Adopted	Control
TV	31 (6)	-	36 (6)	46 (4)
Radio	-	28 (6)	-	40 (6)
News paper/ Agriculture Magazines	28 (7)	-	28 (7)	28 (7)
Agril. Extension Officials	46 (5)	48 (4)	57 (2)	43 (5)
Other farmers	60 (2)	50 (3)	49 (3)	60 (2)
Friends/relatives	47 (4)	42 (5)	47 (4)	47 (3)
Input supplier	50 (3)	65 (1)	65 (1)	66 (1)
Research institute	61 (1)	58 (2)	44 (5)	25 (8)

(Figures in the parentheses indicate rank of importance as source of information)

The sample households from adopted villages largely depended on research institutes for obtaining information on technology inputs, like improved seeds, plant protection chemicals etc. (Table 3.15). After the research institutes, other farmers served as the next important source of information about technology. Input suppliers, friends and relatives and agricultural extension staff were the other important sources of information. Television and newspapers also provided information to some farmers. But, in the control villages of Kurnool district, input suppliers emerged as the most important source of information than the research institutes. Other farmers, agricultural extension officials and friends/relatives also served as important sources, relegating radio to the last position as a source of information. In case of Prakasam sample, input suppliers were the most important source of information to the farmers in both adopted and control villages. For the farmers in adopted villages, agricultural extension staff, other farmers, friends/relatives and research institutes were the other important sources of information. Television and newspapers also provided information to them to some extent. For the farmers from control villages, other farmers, friends/relatives, television and agricultural extension staff were the important sources of information on technology. Radio, newspapers and research institutes were of minor importance as sources of information.

3.1.7 Preferred traits of Chickpea and price premiums for traits

Table 3.16 Farmer preferred traits of Chickpea, Andhra Pradesh, 2006-07 (Garette scores)

Traits	Kurnool		Prakasam	
	Adopted	Control	Adopted	Control
High Yield	65(1)	57(1)	68(1)	66(1)
Short Duration	58(2)	56(2)	60(2)	57(3)
Disease Resistance	42(5)	38(7)	34(6)	35(5)
Pest Resistance	39(6)	42(5)	41(4)	42(4)
Drought resistance	50(4)	55(3)	52(3)	58(2)
High recovery of splits (dal)	33(8)	31(8)	32(7)	32(6)
Fits into cropping system	38(7)	40(6)	38(5)	32(6)
Easy to Market	52(3)	44(4)	29(8)	28(7)

(Figures in parentheses represent ranks in descending order of importance)

The agronomic trait of chickpea which farmers prefer the most is high yield, followed by short duration (Table 3.16). Drought resistance is preferred next, followed by resistance to pests and diseases. Other traits liked by the farmers are high recovery of splits (dal), acceptability in the market and ability to fit in to the cropping system.

Table 3.17 Farmers market preferred traits of Chickpea, Andhra Pradesh,2006-07

Market Preferred	Kurnool		Prakasam	
	Adopted	Control	Adopted	Control
High Demand	63(1)	56(1)	56(1)	58(1)
Fetches High Price	47(2)	53(2)	54(2)	49(2)
Less Price Fluctuations	44(3)	43(3)	43(3)	43(4)
Big Grain Size	43(4)	43(3)	43(3)	46(3)

(Figures in parentheses represent ranks in descending order of importance)

The traits preferred in the market are high market demand and ability to fetch high price in the market (Table 3.17). Less price fluctuations and bigger grain size are also liked in the market.

Table 3.18 Price premiums which farmers are willing to pay for Chickpea traits, AP, 2006-07

Traits	Kurnool (%)		Prakasam (%)	
	Adopted	Control	Adopted	Control
Better quality	10	9	36	7
Better taste	17	17	9	8
Better yield	24	20	28	22
Big grain size	11	10	12	14
Disease & Pest resistance	27	21	15	20
Drought resistance	16	14	16	12
High market price	45	14	16	5
Short duration	16	12	14	14

When farmers were asked how much they are willing to pay more for the seeds incorporating the desired traits, they responded positively. The responses were averaged and are presented in Table 3.18. Overall, high or better yield is the most desired trait for which the farmers are willing to pay 23.5 per cent more price to the seed incorporating it. Next, they expressed willingness to pay 20.8 per cent for the seeds incorporating high pest and disease resistance. The variety which fetches high market price will be bought at 20 per cent higher price. A variety with better quality grain will be paid 15.5 per cent more price. A variety with reliable drought resistance will be bought at 14.5 per cent higher price. A shorter duration variety with similar yield potential will be offered 14 per cent higher price. Better tasting variety will be paid 12.8 per cent more. Bigger grain size is the trait for which farmers would pay 11.8 per cent higher price.

3.1.8 Gender analysis

Women constitute about 50 per cent of the population. But in a male dominated society like India, they have very little ownership rights. Only 2 women out of a total sample of 270 own some irrigated land (Table 3.19). In case of rain fed land, which is normally less productive, 19 women own it. But livestock ownership is more egalitarian between the genders. 103 women do own some livestock or the other as against 167 men owning them. Although there is no clear ownership of animals either by men or women, it could be that women bring animals as a gift from her parents or are purchased with loans from self-help groups (SHG). In such cases, there is an informal attribution of ownership with in the family. But, again, the ownership of a capital item like machinery is heavily biased towards men. Only nine women own some of them. Ownership by women is largely confined to women-headed households, except, perhaps, in case of livestock.

Table 3.19: Ownership of assets by gender, A.P sample, 2006-07

Resource	Gender	Kurnool		Prakasam	
		Adopted	Control	Adopted	Control
Irrigated Land	Female (no.)	1	0	1	0
	Male (no.)	89	45	89	45
Rain fed Land	Female (no.)	7	2	10	0
	Male (no.)	83	43	80	45
Livestock	Female (no.)	39	28	23	13
	Male (no.)	51	17	67	32
Machinery	Female (no.)	4	0	3	2
	Male (no.)	86	45	87	43

Table 3.20 Decision making by Gender, A.P sample, 2006-07

Resource	Gender	Kurnool		Prakasam	
		Adopted	Control	Adopted	Control
Irrigated Land	Female (no.)	1	0	1	0
	Male (no.)	2	4	8	3
	Both (no.)	87	41	81	42
Rain fed Land	Female (no.)	7	6	4	0
	Male (no.)	81	39	83	45
	Both (no.)	2	0	3	0
Livestock	Female (no.)	45	26	20	14
	Male (no.)	19	15	19	13
	Both (no.)	26	4	51	18
Machinery	Female (no.)	8	2	2	4
	Male (no.)	60	28	52	26
	Both (no.)	22	15	36	15
Labor Use	Female (no.)	16	11	30	11
	Male (no.)	71	33	56	32
	Both (no.)	3	1	4	2
Children's marriage	Female (no.)	6	0	2	2
	Male (no.)	6	7	12	11
	Both (no.)	78	38	76	32
Education of children	Female (no.)	10	0	4	2
	Male (no.)	14	13	23	18
	Both (no.)	66	32	63	80
Household maintenance	Female (no.)	19	16	14	9
	Male (no.)	20	9	19	15
	Both (no.)	51	20	57	21

Due to lack of ownership, women also do not count much in decision making (Table 3.20). Decisions relating to land, machinery and labor use, are largely taken by men. Women have a little edge only in case of decisions relating to livestock. But a majority of decisions relating to

household maintenance, education of children and marriages of children are jointly taken by men and women. Women also emerge as decision makers in some of the households with respect to these social activities. The family members work together for the maximization of family welfare. Even when the decisions are taken by men, it is not that women are not aware of them or do not agree with the decisions. But because relatively men are more exposed to information sources, they feel that they are better equipped to take decisions. But, in fact, most of the decisions relating to both farm and family are taken jointly.

Table 3.21 Performance of operations by Gender, A.P sample, 2006-07

Operation	Gender	Kurnool		Prakasam	
		Adopted	Control	Adopted	Control
Field cleaning	By female (%)	7	9	8	4
	By male (%)	47	53	61	67
	Jointly (%)	46	38	31	29
Land preparation	By female (%)	0	0	0	2
	By male (%)	93	98	87	84
	Jointly (%)	7	2	13	14
Sowing seed	By female (%)	0	0	13	18
	By male (%)	24	13	53	64
	Jointly (%)	76	87	34	18
Hand weeding	By female (%)	43	49	54	47
	By male (%)	6	4	9	6
	Jointly (%)	51	47	37	47
Fertilizer application	By female (%)	0	0	2	0
	By male (%)	50	51	64	58
	Jointly (%)	50	49	34	42
Plant Protection measures	By female (%)	4	4	10	7
	By male (%)	94	96	87	93
	Jointly (%)	2	0	3	0
Harvesting main crop	By female (%)	8	0	23	27
	By male (%)	24	29	8	15
	Jointly (%)	68	71	69	58
Harvesting Fodder	By female (%)	6	0	7	4
	By male (%)	38	47	66	69
	Jointly (%)	56	53	27	27

Due to their pre-occupation with household work, women take part less in agricultural activities when compared to men (Table 3.21). They share more of hand weeding than men and contribute significantly to other operations like harvesting of main crop and fodder as well as in field cleaning, seeding and fertilizer application in chickpea. However, their contribution is limited in case of some other operations like land preparation and plant protection.

3.2 Karnataka

3.2.1 Socio-economic and demographic characteristics of sample

In Dharwad sample, 98 per cent of the households were headed by males, while this proportion came down to 93 per cent in Gulbarga sample (Table 3.22).

Table 3.22 Socio-economic profiles of sample farmers from Karnataka, 2006-07

Socio-economic issue	Dharwad sample		Gulbarga sample		Pooled sample	
	A	C	A	C	A	C
Male-headed house hold (%)	98	98	93	93	96	96
Household size (Number)	7	9	7	7	7	8
Male work force (no)	2	2	2	2	2	2
Female work force (no)	2	2	2	2	2	2
Dependency ratio[a]	0.75	1.25	0.75	0.75	0.75	1.0
Age of household (Years)	53	48	47	49	50	48
Education of household head (Years)	7	7	8	4	7	5
Participation in local bodies (%)	8	16	6	9	7	12
Proportion belonging to forward castes (%)	64	64	64	56	64	60
Proportion belonging to religious minorities' (%)	4	2	6	13	5	8
Proportion with agriculture as the main occupation (%)	97	96	89	93	93	94
Proportion with business or service as the main or secondary occupation (%)	7	6	21	16	15	11
Ownership of two wheelers/bicycles (%)	32	33	33	27	33	30
Ownership of television sets (%)	41	40	32	31	37	36
Ownership of radio/tape recorders (%)	33	29	28	24	31	27
Distance from Market (Km)	18	19	26	29	22	24

[a]Dependency ratio = (Family size – Total workforce)/Total workforce
A: Adopted village; C: Control village

The average age of family head varied between 47 and 53 years in the adopted villages while it ranged between 48 and 49 years in control villages. There was little variation in the average age of household heads across different farm sizes and also between districts. This indicated that farmers in the adopted and control villages are found to be in the productive age group and are experienced enough to make management decisions, taking calculated risks inherent in them. The educational level measured in terms of number of years of schooling completed by the household headsshowed that farmers in adopted villages had a little higher educational status (7

to 8 years) than those from the control villages (5-6 years). It was observed that the level of education increased with an increase in the farm size among the farmers both in the adopted and control villages of Dharwad and Gulbarga districts.

Only about 10 per cent of the farmers in the sample participated in local bodies. Among the different groups of villages, participation in local bodies was higher in control villages of Dharwad district. It was found that forward caste farmers were found more in medium and large categories than in the marginal and small categories. Farmers belonging to backward, scheduled caste and scheduled tribe categories were more likely to own marginal and small sizes of land holding. Thus, caste is an important determinant factor in explaining the ownership of land. A large majority of the sample farmers belonged to Hindu religion. Only 4% of the sample farmers were Muslims in Dharwad district while their proportion stood at 8% in Gulbarga district.

For nearly 94% of the sample farmers, agriculture was the main occupation. About 12% of the sample farmers obtained most of their income from business or service sector. Very few sample farmers depended on business or other occupations for their main income. Nearly 90% of the sample farmers did not have any secondary occupation. A few sample farmers obtained some supplementary income from business activities. Those who depended on service as their main occupation earned supplementary income from agriculture.

The average family size was nearly 8 in the adopted villages while it was close to 7 in the control villages. The family size, in general, increased with the size of holding. It may be because joint families are more common in families with larger landholding while the nuclear families are more common with those having smaller holdings. But there was no significant difference in the size of family between the two study districts. Nearly one half of the family members are working members. The dependency ratio was 0.75 in all the groups of villages except in case of control villages of Dharwad district where the dependency ratio was higher at 1.25. About one third of the sample households owned two wheelers/bicycles, television sets and radios. The villages in Dharwad district are located at 18 to 19 km distance, while those in Gulbarga district are located at a distance of 26 to 29 km from the market.

3.2.2 Assets and liabilities

The proportion of irrigated land in the total land holding was much higher in Dharwad district when compared to Gulbarga district (Table 3.23). In both the districts, farmers in the control villages had a better access to irrigation than the farmers in the adopted villages. In Dharwad district, marginal and small farmers in the adopted villages had a higher access to irrigation than those with larger holdings, but in the control villages, access to irrigation improved with the increase in the size of holding. In Gulbarga district, access to irrigation was better for small farmers than the medium size holdings. In both adopted and control villages of Gulbarga district, marginal and large farmers did not have any access to irrigation.

Table 3.23Value of land owned by sample farms, 2006-07 (Area in ha and value in Rs'000)

Type of Land	Dharwad sample				Gulbarga sample				Pooled sample			
	Adopted		Control		Adopted		Control		Adopted		Control	
	Area	Value	Area	Value	Area	Value	Area	Value	Area	Value	Area	Value
Dry land	1.30	321	0.48	119	1.32	326	1.09	269	1.31	324	0.79	195
Irrigated land	0.55	272	1.04	514	0.05	26	0.09	44	0.30	148	0.57	282
Fallow land	0.00	0	0.03	7	0.00	0	0.00	0	0.00	0	0.01	2
Total land	1.85	593	1.55	640	1.37	352	1.18	313	1.61	472	1.37	479
Leased in land	0.13	N.A	0.06	N.A	0.08	N.A	0.00	N.A	0.10	N.A	0.03	N.A

The average size of holding was higher in Dharwad district than in Gulbarga district in both the adopted and control villages. In both the districts, sample farmers in adopted villages had larger sizes of holding than in the respective control villages. The proportion of the irrigated land was also higher in Dharwad villages. In the control villages of Dharwad district, irrigated land fraction was higher than that of the rain fed land. Because of larger holdings and greater irrigation coverage, the value of land was much higher in Dharwad villages than in Gulbarga villages

Table 3.24 Value of livestock owned by sample farms, 2006-07 (Rs/household)

Type of livestock	Dharwad	Gulbarga	Pooled
Draft animal	31,171	44,223	37,697
Local cows	6,163	9,039	7,601
Improved cows	2,969	504	1,737
Buffaloes	9,162	3,496	6,329
Young stock	111	383	247
Goat/sheep	499	1,633	1,066
Poultry	6	26	16
Total	50,081	59,314	54,693

The value of draft animals was higher in Gulbarga district, but that of milch animals was higher in Dharwad district (Table 3.24). The value of small ruminants was higher in Gulbarga district. The total value of livestock was higher in Gulbarga district by about 20%.

Table 3.25 Value of farm implements owned by sample farms, 2006-07 (Rs/household)

Farm implement/asset	Dharwad		Gulbarga		Pooled sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Tractor with implements	73,111	133,778	37,389	5,556	55,250	69,667
Bullock cart	5,117	4,511	3,939	4,800	4,528	4,656
Manual/power sprayers	423	251	439	146	431	198
Seed driller	389	0	0	0	194	0
Welding shop	1,667	0	0	0	833	0
Harvester/Thresher/Groundnut sheller	8,222	13,556	2,722	778	5,472	7,167
Sprinkler sets/Groundnut sheller	1,000	0	0	0	500	0
Trucks/autos/4 wheelers	13,333	5,556	0	0	6,667	2,778
Electric pump set (1)	178	4,000	178	0	178	2,000
Electric pump set (2)	0	222	0	0	0	111
Diesel pump sets	528	0	0	0	264	0
Others	0	0	20	0	10	0
Grand Total	103,968	161,873	44,687	11,279	74,327	86,576

Sample farmers from both the adopted and control villages of Dharwad district owned more tractors and accessories than their counterparts in Gulbarga district (Table 3.25). They also owned more transport equipment and sprinkler sets than in Gulbarga district. The value of farm implements was the highest in the control villages of Dharwad district, followed by the adopted villages of the same district. In Gulbarga district, the value of farm implements was quite less, particularly in the control villages.

Table 3.26 Value of household durable assets owned by sample, 2006-07(Rs/Household)

Durable asset	Dharwad		Gulbarga		Overall	
	Adopted	Control	Adopted	Control	Adopted	Control
Residential house and plots	219,373	191,556	314,111	223,000	266,742	207,278
Farm house (cattle-shed)	3,006	2222	2,778	0	2,892	1,111
Two wheelers/bicycles	10,103	8,173	6,366	3,373	8,234	5,773
Television sets	2,419	2,324	2,490	1,789	2,454	2,057
Fridge	133	0	89	0	111	0
Washing machine	6	4	0	0	3	2
Radio/tape recorder	220	170	129	104	174	137
Air coolers/fans	88	52	120	38	104	45
Grand Total	235,348	204,502	326,082	228,304	280,715	216,403

In terms of household durable assets, the sample farmers from the adopted villages are better endowed when compared with those from the control villages in both the districts (Table 3.26). The value of household durable assets was higher in case of Gulbarga villages than in Dharwad villages with respect to both samples from adopted and control villages. It is because the value of residential house was higher in Gulbarga villages. The value of two wheelers/bicycles was higher in case of Dharwad samples from adopted and control villages when compared with Gulbarga

samples. Both the Dharwad and Gulbarga samples seem to have similar penetration of television sets. Other durable assets like fridge, washing machine, air coolers/fans and radio/tape recorders are rarely owned by the sample households of both the districts.

Table 3.27 Financial liabilities of sample households, 2006-07 (Rs/household)

Particulars	Dharwad		Gulbarga		Overall	
	Adopted	Control	Adopted	Control	Adopted	Control
Co-operatives	18,889	63,089	7,933	4,222	13,411	33,656
Nationalized banks	37,200	21,578	36,811	22,267	37,006	21,922
Friends & relatives	0.00	0.00	111	222	56	111
Moneylenders	0.00	0.00	0.00	1,778	0.00	889
Others	0.00	0.00	333	0.00	167	0.00
Total borrowings	56,089	84,667	45,188	28,489	50,640	56,578
Lending & Savings	0	136	67	111	34	74
Net Borrowings	56,089	84,531	45,121	28,378	50,606	56,504

The financial liabilities of sample households are summarized in Table 3.27. The sample households have neither lent money nor have savings to any appreciable degree. The net borrowings were the highest in case of sample households from the control villages of Dharwad district, followed by the same from adopted villages of Dharwad district and adopted villages of Gulbarga district. The sample households from the control villages of Gulbarga district had the least net borrowings.

Table 3.28 Net worth of sample households, 2006-07 (Rs '000/ household)

Durable asset	Dharwad		Gulbarga		Pooled sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Value of land	593	640	352	313	472	479
Value of livestock	50	50	59	59	55	55
Value of farm implements	104	162	45	11	74	87
Value of durable assets	235	205	326	228	281	216
Total value of assets	982	1,057	782	611	882	837
Total value of liabilities	56	85	45	28	51	57
Net worth of household	906	972	737	583	831	780

The value of all assets and liabilities of the sample households are presented in Table 3.28 and their networth were worked out. The sample households from control villages of Dharwad district have the highest value of assets as well as the highest liabilities. Yet they led others in the net worth, followed by the samples from adopted villages of Dharwad and Gulbarga districts. The sample households from the control villages of Gulbarga district lag all others in total value of assets, net liabilities as well as in net worth.

3.2.3 Income and consumption expenditure

Table 3.29 Net household income of sample households of Karnataka (Rs.000/ year)

Source	Dharwad		Gulbarga		Overall	
	Adopted	Control	Adopted	Control	Adopted	Control
Income from crops	40	45	29	26	35	35
Regular salaried jobs	5	2	7	1	6	2
Business	2	-	1	5	1	2
Farm labor	2	1	1	1	1	1
Pensions	2	1	1	-	2	1
Rental income	1	1	1	1	1	1
Migrant labor	0	3	0	0	0	1
Livestock	1	1	1	1	1	1
Others	-	-	2	-	1	1
Grand Total	53	54	43	35	48	45

The average net household income was higher in Dharwad sample when compared to Gulbarga sample (Table 3.29). Income from crops accounted for 76 per cent of the household income in the adopted villages of Dharwad district. The dependence on income from crops was even higher at 83 per cent in the control villages. The contribution from business, salaried jobs and pensions were higher in adopted villages, while migrant labor income contributed significantly to household income in control villages. In Gulbarga district, income from crops accounted for 73 per cent of household income in adopted villages. Income sources were more diversified with salaried jobs and other sources contributing substantially to household income. Business, pensions, farm labor, rental income and livestock also added trickles to the household income. But the sources of income were not much diversified in control villages, with income from crops contributing as much as 78 per cent to the household income. Business contributed only 4 per cent to the household income. Other sources like salaried jobs, farm labor, rental income and livestock added trickles to the household income.

Table 3.30 Consumption expenditure of sample households in AP, 2006-07 (Rs. '000 /year)

Item of consumption	Dharwad		Gulbarga		Pooled sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Cereals	9	9	8	8	9	8
Pulses	5	5	4	4	5	5
Edible oils	2	2	2	2	2	2
Milk & products	6	6	7	7	6	6
Fruits & Vegetables	1	1	1	1	1	1
Other foods	2	2	1	-	1	1
Total foods expenses	25	25	23	22	24	23
Clothing	3	3	2	2	2	2
Health	3	2	2	2	2	2
Ceremonies	2	3	2	2	2	2
Education	3	2	2	2	2	2

Entertainment	1	1	1	1	1	1
Transport & Communication	1	1	1	1	1	1
Others	1	1	-	-	1	1
Total Non-food	14	13	10	10	11	11
Total Expenditure	39	38	33	32	35	34

Relatively, consumption expenditure was noted to be higher in Dharwad district than in Gulbarga district (Table 3.30). Expenditure on food accounted for nearly two-third of the consumption expenditure in all the sample households of both the districts. Cereals had a share of 36 per cent in the expenditure on food across the sample households. Expenditure on pulses was a little higher in Dharwad villages, while Gulbarga households spent more on milk and milk products. The expenditures on edible oils and fruits and vegetables were uniform across all the sample households. The sample households from adopted villages of Dharwad district spent more on clothing, health and education when compared to others. Households from Gulbarga district were more frugal with the non-food expenditure. The households from control villages of Dharwad district incurred more expenditure than others on ceremonies. The expenditures on entertainment and transport and communications were stable across all groups of villages.

3.2.4 Cropping pattern and chickpea yields

Table 3.31 Relative importance of chickpea in the cropped area, 2006-07

Crop area	Dharwad		Gulbarga		Pooled sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Rainy season cropped area (ha/farm)	247	122	199	86	446	208
Post-rainy season cropped area (ha/farm)	204	109	136	59	340	168
Area under chickpea (ha/farm)	162	85	134	58	296	143
Proportion of chickpea area in post-rainy area (%)	79	79	99	98	87	85
Proportion of chickpea area in total cropped area (%)	36	37	40	40	38	38

Chickpea occupied 79 per cent of the post-rainy season cropped area in both adopted and control villages in Dharwad district (Table 3.31). In the total cropped area of the sample farmers, chickpea had a share of 36 per cent in adopted villages and 37 per cent in control villages. Thus, chickpea had an important place in the cropping pattern of the district. But compared to Dharwad district, chickpea had a more prominent place in Gulbarga district. It accounted for 99 per cent of the post-rainy season cropped area in adopted villages and 98 per cent of the same in control villages. Its share in the total cropped area was 40 per cent in both adopted villages and control villages of Gulbarga district. In the pooled sample, chickpea had a share of 87 per cent of the cropped area in the post-rainy season and a share of 38 per cent in the total cropped area in

the adopted villages. In the control villages, chickpea area accounted for 85 per cent of the cropped area in the post-rainy season and a share of 38 per cent in the total cropped area.

Table 3.32 Composition of chickpea varieties on sample farms of Karnataka, 2006-07

Variety	Dharwad sample		Gulbarga sample		Pooled sample	
	% farms	% area	% farms	% area	% farms	% area
Annigeri	94.8	91.5	92.6	93.9	93.3	92.6
Bhima	3.7	2.4	-	-	1.9	1.3
Kabuli (KAK-2)	5.2	4.9	3.0	1.6	4.1	3.5
Local	2.2	1.2	4.4	4.5	3.3	2.6
Total	100	100	100	100	100	100

In 2006-07, 92 per cent of chickpea area in Dharwad sample was under Annigeri (Table 3.32). The *Kabuli* variety, KAK-2, covered only 5 per cent of the area, while Bhima occupied a little more than 2 per cent area. The remaining one per cent area was under local variety. In Gulbarga sample, Annigeri accounted for 94 per cent of the area. KAK-2 covered 1.6 per cent of the area and the remaining area was under local variety.

Table 3.33 Yields of chickpea on sample farms of Karnataka, 2006-07 (Kg/ha)

Variety	Dharwad	Gulbarga	Pooled
Annigeri	1023.8	1148.4	1086.1
Bhima	686.2	-	686.2
Kabuli (KAK-2)	992.9	1007.8	1000.4
Local	1009.4	955.1	982.2

In the baseline year, Annigeri variety of chickpea recorded a yield of 1024 kg/ha in Dharwad District (Table 3.33). Local variety and KAK-2 gave marginally lower yields than that. Bhima variety fared the poorest. The yield level of Annigeri was much higher in Gulbarga district than in Dharwad district. KAK-2, the only *kabuli* variety found in target districts gave marginally higher yield in Gulbarga district than in Dharwad sample. In general, the kabuli varieties give lower yield but attract higher market price than the desi varieties. The local variety of chickpea fared poorer in Gulbarga district when compared to the same in Dharwad district.

Table 3.34 Productivity levels of chickpea (Kg/ha) perceived by sample farmers

Particulars	Type of year	Dharwad		Gulbarga		Pooled	
		Adopted	Control	Adopted	Control	Adopted	Control
Rainfed	Normal	1,261	1,305	1,291	1,365	1,276	1,335
	Bad	475	431	579	627	527	529
	Best	1,545	1,579	1,501	1,606	1,523	1,592
Irrigated	Normal	1,503	1,564	N.A	1,894	1,503	1,729
	Bad	650	653	N.A	720	650	687
	Best	1,965	1,900	N.A	2,141	1,965	2,020

The perceived yields of chickpea under different weather situations are presented in Table 3.34. Normal yields of chickpea are higher in the control villages than the adopted villages in both Dharwad and Gulbarga districts. In a bad year, yield levels can fall to about 40 to 45per cent of the normal yields. The best yields are only about 20 per cent more than the normal yields. Under irrigated situation, the chickpea yields can go up by 20 per cent in all weather situations. The perceived yields of chickpea are slightly better in Gulbarga district than in Dharwad district.

3.2.5 Economics of chickpea and other crops

Table3.35 Perceived gross returns (Rs'000/ha) from different crops, 2006-07

Gross returns	Dharwad		Gulbarga		Pooled	
	Adopted	Control	Adopted	Control	Adopted	Control
Rainy season crops						
Maize	55	60	-	-	55	60
Green gram	12	12	15	19	14	16
Sorghum	25	28	32	9	29	19
Onion	45	25	55	-	50	25
Pigeon pea	-	-	20	25	20	25
Post rainy season crops						
Chickpea	20	22	25	26	23	24
Wheat	10	11	30	25	20	18
Sorghum	20	15	32	37	26	26

The gross returns perceived by sample farmers from different rainy and post rainy season crops are given in Table 3.35. In Dharwad district, maize was perceived as the crop with highest gross return. Onion and Sorghum crops were perceived to be giving substantial gross returns. Some of these rainy season crops received irrigation support. Mungbean was regarded as the rainy season crop with lowest gross return. Among the post-rainy season crops, chickpea was perceived to be the crop with highest gross return. Sorghum was expected to yield the same gross return as chickpea in adopted villages, but less return in control villages. The gross return from wheat was perceived to be lower in both adopted and control villages. In Gulbarga district, onion was perceived to give the highest gross return in the adopted villages, followed by

sorghum, pigeonpea and Mungbean. In the control villages, pigeonpea was perceived to be giving highest gross return, followed by mungbean and sorghum. In the post-rainy season, sorghum and wheat were perceived to be giving higher gross return than chickpea in the adopted villages. In the control villages, sorghum was perceived to be giving higher gross return than chickpea. While this may be the position with gross returns, net returns may be higher with chickpea. Otherwise, more than 90 per cent of the cropped area in the post-rainy season would not be allocated to chickpea.

Table 3.36 Profitability of chickpea (Annigeri) on sample farms *(Pooled over adopted and control villages)* **in 2006-07**

Costs and Returns	Dharwad	Gulbarga	Pooled
Total variable cost (Rs/ha)	12,463	12,330	12,379
Total fixed cost (Rs/ha)	3,721	3,603	3,661
Total cost (Rs/ha)	16,184	15,933	15,979
Yield of chickpea (kg/ha)	1,024	1,148	1,086
Gross returns (Rs/ha)	25,194	28,245	26,720
Net returns (Rs/ha)	9,010	12,312	10,661
Benefit-cost ratio	1.56	1.77	1.67

The cost of cultivation of Annigeri variety of chickpea was around Rs. 16000 per hectare in both the districts (Table 3.36). But since the yield is higher in Gulbarga district, the gross and net returns were also higher. The benefit cost ratio was much higher at 1.77 in Gulbarga district than 1.56 recorded in Dharwad district.

3.2.6 Sources of information about technology

Table 3.37 Sources of information on technology (Garrett scores), 2006-07

Sources of information	Dharwad		Gulbarga		Overall	
	Adopted	Control	Adopted	Control	Adopted	Control
Inputs suppliers	42(1)	45(1)	42(1)	42(1)	42(1)	44(1)
Other farmers	11(2)	11(2)	12(2)	15(2)	12(2)	13(2)
Friends and relatives	6(3)	6(3)	3(4)	3(3)	5(3)	4(3)
Research institutes	4(4)	2(4)	2(5)	3(4)	3(4)	2(5)
Others	2(5)	2(5)	4(3)	2(5)	2(5)	3(4)
radio	1(6)	1(6)	1(6)	1(6)	1(6)	1(6)

(Figures in the parentheses indicate ranks in the descending order of importance)

In all the four groups of villages belonging to both the districts, input suppliers emerged as the most important source of information about technology, followed by other farmers (Table 3.37). Friends and relatives and research institutes also served as next important sources of information about technology. Farmers also depended on radio and other sources for obtaining information about different aspects of technology.

3.2.7 Production and marketing traits preferred by farmers

3.38 Preferred traits of Chickpea and price premiums for traits

Among the different production traits, farmers prefer the high yielding trait the most, followed by drought resistance (Table 3.38). Short duration, pest resistance, disease resistance, high recovery of splits (dal), fitting in to cropping system and contribution to soil fertility are the other traits preferred by the farmers.

Table 3.38 Farmer preferred production traits of Chickpea, Karnataka, 2006-07 (Garette scores)

Traits	Dharwad		Gulbarga	
	Adopted	Control	Adopted	Control
High Yield	57(1)	71(1)	71(1)	72(1)
Short Duration	43(3)	19(4)	9(7)	6(7)
Disease Resistance	19(6)	21(3)	15(5)	14(5)
Pest Resistance	26(4)	30(2)	43(2)	34(3)
Drought resistance	46(2)	30(2)	39(3)	46(2)
High recovery of splits (dal)	16(7)	18(5)	20(4)	8(6)
Fits into cropping system	22(5)	19(4)	11(6)	20(4)
Contribution to Soil Fertility	10(8)	11(6)	8(8)	5(8)

(Figures in parentheses represent ranks in descending order of importance)

Table 3.39 Market preferred traits of chickpea, Karnataka sample, 2006-07(Garette scores)

Market Preferred	Dharwad		Gulbarga	
	Adopted	Control	Adopted	Control
High Demand	48(1)	68(1)	61(1)	62(1)
Fetches High Price	42(2)	34(2)	35(2)	37(2)
Less Price Fluctuations	30(3)	32(3)	32(3)	34(3)

Big Grain Size	18(4)	14(4)	12(4)	13(4)

(Figures in parentheses represent ranks in descending order of importance)

Among the traits preferred in the market, farmers prefer those varieties which are in high demand (Table 3.39). Those varieties which fetch high price are preferred next. Less price fluctuations and big grain size are the other market related traits preferred by the farmers.

Table 3.40 Price premium which farmers are willing to pay for Chickpea traits, Karnataka sample, 2006-07

Traits	Dharwad (%)		Gulbarga (%)	
	Adopted	Control	Adopted	Control
Better Taste	22	0	0	50
Better Yield	23	23	20	23
Big Grain Size	18	14	33	39
Disease & Pest Resistance	28	35	35	33
Drought Resistance	24	23	10	0
Short Duration	33	40	0	0

When farmers were asked to indicate the premium price they would pay for seeds incorporating the desired traits, they said that they will pay 33% more for seeds having pest and disease resistance (Table 3.40).They expressed willingness to pay 23 per cent more for varieties with high yielding trait. Sample farmers from Gulbarga are willing to pay 36 per cent more for big grain size, while the sample farmers from Dharwad district are prepared to pay only 16 per cent more for this trait. Sample farmers from Dharwad district are prepared to pay 36.5 per cent more price for varieties with short duration and 23.5 per cent more for those with drought resistance. Farmers from Gulbarga district attached little or no price premium for these traits. Better taste is a trait desired only by farmers from adopted villages of Dharwad district with a price premium of 22 per cent and by farmers from control villages of Gulbarga district at a price premium of 50 per cent.

3.2.8 Gender analysis

The ownership of assets was entirely by men in case of male headed households in both Dharwad and Gulbarga districts (Table 3.41). They are owned by women only in the women headed households. The ownership of non-land assets like livestock and machinery by women is only a shade better than in case of land.

Table 3.41 Ownership of assets by Gender, Karnataka sample, 2006-07

Resource	Gender	Dharwad		Gulbarga	
		Adopted	Control	Adopted	Control
Irrigated Land	Female (no.)	2	2	6	5
	Male (no.)	88	43	84	40
Rain fed Land	Female (no.)	2	2	7	5
	Male (no.)	88	88	83	40
Livestock	Female (no.)	5	4	8	9
	Male (no.)	95	96	92	91
Machinery	Female (no.)	4	3	8	9
	Male (no.)	96	97	92	91

Table 3.42 Decision making by Gender, Karnataka sample, 2006-07

Resource	Gender	Dharwad		Gulbarga	
		Adopted	Control	Adopted	Control
Irrigated Land	Female (no.)	2	2	6	5
	Male (no.)	86	43	84	40
	Both (no.)	2	0	0	0
Rain fed Land	Female (no.)	2	2	6	5
	Male (no.)	86	43	84	40
	Both (no.)	2	0	0	0
Livestock	Female (no.)	4	2	4	4
	Male (no.)	84	40	81	40
	Both (no.)	2	3	5	1
Machinery	Female (no.)	2	1	5	3
	Male (no.)	83	40	80	39
	Both (no.)	5	4	5	3
Labor Use	Female (no.)	2	2	7	7
	Male (no.)	88	45	76	35
	Both (no.)	5	4	7	3
Children's marriage	Female (no.)	2	0	1	0
	Male (no.)	32	31	52	51
	Both (no.)	56	14	37	39
Education of children	Female (no.)	4	0	0	0
	Male (no.)	33	31	51	28
	Both (no.)	53	14	39	17
Household maintenance	Female (no.)	26	19	6	4
	Male (no.)	33	20	40	20
	Both (no.)	31	6	44	21

Just as in case of ownership**,** the decision-making also revolves aroundmen in the male-headedhouseholds (Table 3.42). With respect the use of assets, women decide only when they

are heading the households. Even in case of input use decisions, like labor use, women are rarely consulted. But, in case of family related decisions like education and marriage of children, the decisions are generally taken jointly in about half of the cases. Men assert their supremacy in case of the remaining households even in case of social matters. Women have a say in household maintenance in about two thirds of households in Dharwad district, but they are rarely allowed to maintain the households in Gulbarga district. In male headed households, households are maintained either by men or jointly. In a study by Sperling*et al.* (1993) observed that the participation of women in bean variety development led to a faster identification and adoption of improved bean varieties suited to small production niches in Rwanda.

Table 3.43 Performance of operations by Gender, Karnataka sample, 2006-07

Operation	Gender	Dharwad		Gulbarga	
		Adopted	Control	Adopted	Control
Field Cleaning	By female (%)	2	0	0	0
	By male (%)	30	33	83	91
	Jointly (%)	68	67	17	9
Land Preparation	By female (%)	2	0	0	0
	By male (%)	54	42	91	98
	Jointly (%)	44	58	9	2
Sowing Seed	By female (%)	1	4	1	3
	By male (%)	31	29	57	53
	Jointly (%)	68	67	42	44
Hand Weeding	By female (%)	20	13	15	29
	By male (%)	9	9	22	20
	Jointly (%)	71	78	63	51
Fertilizer Application	By female (%)	2	3	2	2
	By male (%)	38	33	57	51
	Jointly (%)	60	64	41	47
Plant Protection Measures	By female (%)	1	2	2	3
	By male (%)	67	62	66	64
	Jointly (%)	32	36	32	33
Harvesting Main Crop	By female (%)	0	1	2	0
	By male (%)	19	15	44	31
	Jointly (%)	81	84	54	69
Harvesting Fodder	By female (%)	10	2	4	5
	By male (%)	20	29	38	53
	Jointly (%)	70	69	58	42

Even participation of women in field operations by themselves is limited in case of chickpea (Table 3.43). Almost all he operations are either jointly performed by men and women or exclusively by men.

Chapter 4

Farmers Participatory Varietals Trials (FPVS trails)

As per the TL-II strategy, farmer participatory varietal trials were conducted in the adopted villages of Kurnool and Prakasam districts in Andhra Pradesh and Dharwad and Gulbarga districts of Karnataka. Besides recording the yield data from the FPVS trials, farmers who visited the trials were asked to rank the varieties based on their trait preferences. The results of FPVS and farmers' selection for Andhra Pradesh are presented in section 4.1 and those for Karnataka are given in section 4.2.

The Farmer Participatory Varietal Selection (FPVS) trials aim to try new varieties on the farmers' fields so that they can select the varieties with the traits preferred by them. It was experienced earlier that some of the high yielding varieties did not become popular with the farmers because of un-desirable market traits. If an opportunity is provided to farmers, they are likely to choose varieties with desirable market traits along with production traits like high yield and disease resistance.

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 grain characteristics like size, shape, color and recovery percentage (splits). Since the 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 some farmers or the other, it is possible that the fertility status and management ability of the farmers may influence the performance of some varieties. For this reason, the analysis is restricted to only the results from mother trials so that the results will not be clouded by the un-controllable factors like soil fertility and management ability.

4.1 Andhra Pradesh

4.1.1 Results of FPVS trials in Andhra Pradesh

FPVS trials were conducted in Kurnool and Prakasam districts in 2007-08 seasons. While the trials were conducted successfully in Kurnool district during 2007-08, they were abandoned in Prakasam district due to heavy rains and floods just before the harvest stage. Hence, they were repeated in Prakasam district during 2008-09. While both mother and baby trials were conducted, only mother trials data were analysed. It is because all the varieties are included in the mother trials in the same fields. Baby trials were conducted at random with 2 or 3 varieties in

case of a farmer's field. The heterogeneity in location, soil type and irrigation support was very wide with the baby trials.

4.1.1.1Results of FPVS trials in Kurnool district

The average yields from the mother trials conducted in Kurnool district during 2007-08 are reported in Table 4.1.

Table 4.1 Average yields of mother trials conducted in adopted villages of Kurnool, 2007-08

Variety	Average yield (Kg per ha)	Percent change over the check variety
Desi Varieties		
ICCC-37	1952	+ 9.0
JG-11	2052	+14.6
JG-130	1915	+6.7
JAKI-9218	1898	+6.0
Annigeri (Check)	1791	
Kabuli Varieties		
Vihar	1660	+3.0
LBeG-7	1906	+18.3
JGK-2	1784	+10.7
ICCV-953334	1203	-7.5
KAK-2	1611	

Four improved *desi* varieties were tried along with the check variety, Annigeri in the mother trials. Similarly, four improved *Kabuli* varieties were tried in the mother trials along with the ruling variety, KAK-2 (Table 4.1). All the four improved *desi* varieties performed better than the check variety in the mother trials.The margin of yield increase was the highest with JG-11, which recorded 14.6 per cent increase in yield over the check variety. ICCC-37 gave an increase of 9 per cent in yield, while JG-130 gave only 6 per cent yield increase over the check variety, Annigeri. There was no local kabuli variety with seed size (>30 g per 100-seed), so no check was used for kabuli varieties. Among kabuli varieties tested in FPVS trials, the highest yield was given by LBeG 7 followed by JGK 2 and Vihar. Compared to KAK-2, LBeg-7 gave the highest yield increase of 18.3 per cent. The margin of yield advantage came down to 10.7 per cent with JGK-2 and further to 3 per cent with the bold seeded *Kabuli* variety, Vihar. Another *Kabuli* variety, ICCV-953334 yielded lower than the KAK 2. The FPVS mother trials conducted in Kurnool district pointed to the possibility of increasing average yields in the district by popularizing the new varieties tried in the mother trials.

4.1.1.2 Results of FPVS trials in Prakasam district

When mother trials were conducted in 2007-08, four improved varieties each were tried for *desi* and *Kabuli* types in the mother trials (Table 4.2). But these trials failed due to heavy rains and floods in the pre-harvest stage. When it was decided to repeat the mother trials in 2008-09, the number of entries was reduced to three in *desi* types and to two in *Kabuli* types, besides the check varieties. All the three new *desi* varieties gave higher yields than Annigeri, the check variety. JG-11 gave the highest yield increase of 23.6 per cent over the check variety. With the JAKI-9218, the margin of advantage came down to 16.7 percent. The yield increase got further moderated to 14.0 per cent with the JG-130 vaiety. Among the three improved *Kabuli* varieties, KAK 2 performed better followed by Vihar and JGK 2. The results of mother trials indicated that it is possible to increase the chickpea yields by introducing new *desi* varieties which proved superior in the mother trials. But in case of *Kabuli* varieties, KAK 2 has better prospects to diffuse further in the district. Gowda and Gaur, 2004 confirmed that by the introduction of extra-short duration *Kabuli* variety ICCV 2, which matures in about 85 days, expanded cultivation of *Kabuli* chickpeas in tropical environments in Southern India as well as in Myanmar. The short duration *desi* and *kabuli* varieties have helped expansion of chickpea area in Southern states (Andhra Pradesh and Karnataka) from 189,000 ha to 532,000 ha in the past two decades.

Table 4.2 Average yields of mother trials conducted in adopted villages of Prakasam,2008-09

Variety	Average yield (Kg per ha)	Percent change over the check variety
A. Desi Varieties		
JG-11	2169	+23.6
JG-130	2001	+14.0
JAKI-9218	2048	+16.7
Annigeri (Check)	1755	
B. Kabuli Varieties		
Vihar	1801	-3.5
JGK-2	1704	-8.7
KAK-2	1866	

4.1.2 Results of survey on Famers' Participatory Varietal Selection

An innovative attempt was made by the breeders and economists to collect the data on farmers' response about the performance of varieties in the trials. A schedule was prepared and data were collected from 95 farmers and brokers in the market to elicit information on preferred traits, which were susequently ranked based on Garette scores workedout from the data.

4.1.2.1 Socio-economic profile of the respondents

Out of the 95 farmer respondents, 48 belonged to kurnool district and the remaining 47 to Prakasam district. 79 of the 95 respondents belonged to the mature age groups ranging between 35 and 65 years. One half of the remaining 17 per cent of the respondents belonged to young farmer category of 25 to 35 years and the remaining half to very old category of above 65 years. About one half of the respondents were members of either farmers' associations or to commodity groups. About 20 per cent of the respondents were illiterate, while about 40 per cent were school graduates. The remaining 40 per cent were educated in school but dropped out of it at some stage or the other before graduation. In Kurnool district, farmers visited the trials during flowering or podding stage, while farmers in Prakasam district visited the trials during podding or maturity stage. Chickpea mother trials were conducted in the fields where either sorghum or tobacco or chickpea were grown in the previous season.

4.1.2.2 Traits and varieties preferred by farmersin Kurnool district

The Garette scores worked out from the preferences given by farmers in Kurnool district are summarized in Table 4.3. The JG-11 variety scored over others with respect to stability and vigor, biomass for fodder, number of pods per plant, number of seeds per pod, healthy pods per plant and expected grain yield. It also stood first in the overall ranking. JAKI 9218 also scored behind JG 11 in case most of the crop growth traits. JG-130 variety was preferred by the farmers for color of leaves, resistance to drought, early maturity, resistance to pests and diseases and fodder yield. Overall, JAKI 9218 and JG 130 were ranked second and third, much above Annigeri, among the desi varieties. The *Kabuli* variety, KAK-2, was preferred for size of pod and filling of pods. It was also preferred by the farmers as the kabuli variety with many preferred traits. It turned out that the same varieties that have good expected grain yields also were preferred by the farmers for most of the traits.

Table 4.3: Crop growth characters by variety in Kurnool district, 2007-08 (Garette Scores)

Crop growth trait	Annigeri	JG-11	JG-130	JAKI 9218	KAK-2
Stability, Vigour, and upright growth	50.18	73.36	55.04	67.74	48.7
Biomass for fodder	49.18	74.10	56.73	73.83	46.06
Colour of leaves	45.00	56.29	74.47	53.26	48.88
Resistance to drought	49.82	59.14	74.10	72.27	43.63
Resistance to pests	50.20	58.51	75.93	55.26	40.79
Resistance to diseases	45.00	54.20	74.67	51.04	50.34
No of pods per plant	50.24	74.42	56.26	70.53	45.95
Size of pod	42.75	47.20	61.55	51.25	74.24
No of seeds per pod	41.06	73.06	58.63	61.02	54.04
Filling of pods	42.32	51.67	62.34	59.53	72.34
Healthy pods per plant	55.95	69.38	58.38	57.53	43.89
Early maturity	39.39	60.75	75.38	75.04	50.44
Expected grain yield	40.12	75.16	59.16	74.53	56.04
Fodder yield	42.59	49.32	73.71	61.02	61.36
Over all rank	**39.38**	**76.02**	**71.69**	**73.06**	**60.85**

4.1.2.3 Traits and varieties preferred by farmers in Prakasam district

The traits and varieties preferred by the famers in Prakasam district are summerized in Table 4.4. The Garette scores computed from the farmers' preferrences indicated that KAK-2 emerged as the preferred variety in Prakasam district. It was scored highest with respect to vigour and growth, color of leaves, resistance to drought, resistance to pests and diseases and filling of pods. Although JG-11 was preferred for many characters like biomass for fodder, number of pods per plant, number of seeds per pod and expected grain yield, it was ranked second in the overall ranking. In 2008-09 season, the price of *Kabuli* varieties was much higher than that for *desi* varieties. This factor might have been at the back of farmers' mind in ranking *Kabuli* variety, KAK-2 at number 1. Among the other desi varieties, JG 130 and JAKI 9218 were preferred over Annigeri for many growth traits. Farmers of Prakasam district, thus, selected three desi varieties, JG 11, JG 130 and JAKI 9218 and one kabuli variety, KAK 2.

Table 4.4 Crop growth characters by variety – Prakasam - Garette Scores

Crop growth trait	Annigeri	JG 130	JG-11	JAKI 9218	KAK-2
Vigour and growth	31.36	57.10	54.10	39.38	67.69
Biomass for fodder	43.51	72.83	41.10	34.79	57.28
Colour of leaves	38.77	53.73	48.28	42.36	67.02
Resistance to drought	27.77	42.51	54.51	50.30	75.16
Resistance to pests	26.53	40.93	59.65	46.83	75.69
Resistance to diseases	34.00	34.93	59.02	46.53	74.85
No of pods per plant	57.81	71.46	46.95	35.83	53.42
Size of pod	33.38	35.53	74.04	53.93	53.79
No of seeds per pod	58.55	69.91	42.44	24.20	51.63
Filling of pods	34.51	47.34	66.57	33.46	68.73
Healthy pods per plant	45.12	57.67	45.77	29.12	69.57
Early maturity	33.87	48.40	54.34	38.06	76.00
Expected grain yield	42.69	71.91	50.91	35.32	68.18
Fodder yield	63.26	61.93	41.00	24.18	60.61
Over all rank	26.22	50.67	55.16	41.46	66.00

4.1.2.4 Preferences of market brokers/commission agents

As a part of the PVS survey, brokers who are regularly involved in marketing chickpea were also asked to indicate their preferred traits and varieties.These brokers had turn over ranging between 30 and 90 tons in the previous year. Some of them were residents of the villages and they procure and dispatch chickpea to wholesalersin other states. In Kurnool district, their preferences largely matched with those of the farmers. But in Prakasam district, they ranked Vihar at number 1 and KAK-2 at number 2, while the preferences of the farmers were in the reverse order. They ranked JAKI-9218 at number 3 and JG-11 at number 4, leaving Annigeri at the last place. But farmers ranked JG-11 at number 3 and JAKI-9218 at number 4. Thus, the

preferences of brokers were influenced more by market traits, while the preferences of the farmers were influenced both by market and crop growth traits.

4.1.2.5 Farmers' opinions in the participatory varietal selection trials 2007-08

Five mother trials with ten varieties were conducted in five villages of Kurnool district. Higher yields were recorded in four out of five villages. In one village (Udumalpuram) where crop was grown under rain fed condition, lower yields were recorded. The maximum yield was 2500 kg/ha with JG-11 and JG-130 varieties in Mitnala village of Nandyal Mandal. *Kabuli* variety LBeG 7 also recorded 2500 kg/ha in Allur Village of Uyyalawada Mandal. All four *desi* varieties viz., ICCV 37, JG-11, JG-130 and JAKI 9218 performed better when compared with the check variety, Annigeri, except in case of JG-130 in Pulimaddi village. Except ICCV 95334, an extra large seeded *Kabuli* type, all the *Kabuli* varieties performed better than KAK-2, with the exception of Vihar in Mitnala Village of Nandyal Mandal. 37 baby trials with three varieties were also organized (Table 4.5).

Table 4.5 Traits preferred by farmers as noted by breeders in Kurnool district

Varieties preferred by farmers (in order of preference)	Preferred traits
1. JG 11	1. Seed Size 2. Plant height 3.Duration 4.Seed colour 5.Yield
2. JAKI 9218	1. Seed Size 2.Duration 3.Seed colour 4. Yield
3. JG 130	1.Seed size 2. Yield

No such opinions were recorded by the breeders based on the mother trials conducted by them in Prakasam district during 2008-09. But the growing preference for *Kabuli* varieties was noted in Prakasam district because of the high market price they are fetching.Farmers have also started growing extra-large seeded (seed size more than 50 g per 100-seed) *Kabuli* chickpea varieties. These are unknown cultivars, which originated from other countries andentered our country through imports. No such extra-large seeded *Kabuli* varieties have been released in India by the research system. Farmers' preference to these unidentified cultivars like Dollar and Bolts from other countries was noted. Farmers call these extra-large *Kabuli* varieties by various names, such as "Dollar" and "Double Dollar". Some of them are spreading from farmer to farmer due to attractive prices they are fetching, despite low yields.

4.2Karnataka

4.2.1. FPVS trials in Karnataka

Mother baby trials were conducted on the fields of selected farmers in adopted villages of Dharwad and Gulbarga districts during 2007-08. The yields of different chickpea varieties recorded in the mother trials with different farmers were averaged and are taken up for comparative analysis.

4.2.1.1 Results of mother trials conducted in Dharwad district

The details of mother trials conducted in five villages of Dharwad district are presented in Table 4.6. Among the *desi* varieties, BGD 103 gave the highest average yield, followed by JAKI-9218, JG-130 and JG-11. All these four new varieties performed better than Annigeri-1, which was the check variety. But KAK-2, which was the ruling variety for *Kabuli* types, out yielded all the three new entries, Vihar, ICCV-95334, BG-1105 and MNK-1.

Table 4.6 Average yields of different varieties of chickpea (kg/ha) in mother trials of Dharwad, 2007-08

Varieties	Village Locations for mother trials in Dharwad district					
	Amminbhavi	Harobelvadi	Shirkol	Arekuratti	Kumarkoppa	Varietal Mean
BGD-103	1900	1750	2100	2000	2250	2000
JG-11	1550	1550	2000	1750	1400	1640
JG-130	1400	1500	2000	1750	2000	1730
JAKI-9218	1400	1500	1900	1800	2100	1740
Annigeri-1 (Check)	1500	1400	1750	1650	1400	1540
Vihar	1300	1250	1750	1700	1600	1520
MNK-1	1100	1100	1500	1500	1250	1255
ICCV-95334	1150	1100	1500	1400	1400	1310
KAK-2	1300	1400	1750	1800	1600	1570
Location Mean	1385	1370	1785	1705	1650	-

4.2.1.2 Results of mother trials conducted in Gulbarga district

Just as in case of Dharwad district, mother trials were conducted in five villages of Gulbarga district. The yields recorded by different chickpea varieties were averaged and are reported in Table 4.7.

Table 4.7 Average yields of different varieties (kg/ha) in mother trials of Gulbarga district

Entry	Kurikota	Gotoor	Farahatabad	Pattan	Gundgurti	Total
Desi types						
BGD-103	1532	1499	1506	1450	1640	1525
JG-11	1906	1416	1598	1520	1780	1644
JG-130	1032	1585	1021	1120	1480	1248
JAKI - 9218	1066	1250	1460	980	1280	1207
A – 1 (check)	1385	1374	1029	1250	1680	1344
Kabuli types						
Vihar	1039	1083	483	1420	1580	1121
ICCV - 95334	1039	1250	1333	1450	1390	1292
MNK - 1	1566	1041	1667	1620	1750	1529
KAK – 2	1032	1000	1150	1450	1560	1238

JG-11 performed the best among the *desi* varieties. BGD-103 also reported better performance than the check variety, Annigeri-1. But the other two entries, JG-130 and JAKI-9218 gave lower yields than the check variety. Among the *Kabuli* varieties, MNK-1 turned out the best performance, followed by ICCV-95334. But, Vihar gave lower yield than KAK-2.

4.2.2 Results of survey on Farmer Participatory Varietal Selection

A total of 130 farmers, 65 each from Dharwad and Gulbarga districts participated in the evaluation of the varieties.

4.2.2.1 Socio-economic profile of the respondents

29 per cent of the respondents belonged to middle age of 40 to 49 years, followed by older group of 50 to 59 years who formed 21 per cent of the sample. Another 18 per cent belonged to old group of 60 to 69 years. Only 4 per cent were young farmers aged below 30 years. As much as 11 per cent of the farmers were drawn from very old farmers aged above 70 years. Thus, the sample was dominated by older farmers. Farmers with only primary education constituted 38 per cent of the sample. Another 22 per cent received high school education. About 22 per cent did not have formal education, while 18 per cent have undergone college education. About 57 per cent of the respondents were members of some association or the other.Nearly 50 per cent of the respondents visited the trials during the harvest stage. About 30 per cent saw them during pod formation stage, while the remaining 20 per cent observed the trials during the flowering stage.

4.2.2.2 Trait preferences of farmers visiting FPVS trials in Dharwad district

Farmers who visited the trials in Dharwad district were asked to score the varieties against some traits. The scores given by individual farmers were averaged and are presented in Table 4.8. The variety, JG-11 got the highest score with respect to biomass for fodder, vigor in growth and resistance to pests. It was at par with BGD-103 and Annigeri with respect to color of leaves and with JAKI-9218 with respect to filling of pods. Annigeri scored higher than other varieties in the trials with respect to drought resistance, while JAKI-9218 received top score with respect to resistance to diseases. Besides the scoring for certain traits, observations were recorded on number of pods per plant, number of healthy pods per plant, number of seeds per pod, size of pod, 100 grain weight, early maturity, expected grain and fodder yields. Although the expected grain and fodder yields were the highest with BGD-103, JG-11 received the overall first rank because of many traits liked by the farmers. BGD-103 stood second, followed by JAKI-9218, Annigeri and KAK-2.

Table 4.8 Trait preferences of farmers in different chickpea varieties in Dharwad, 2007-08

Crop growth trait	JG-11	BGD-103	JAKI-9218	KAK-2	Annigeri-1
Biomass for fodder (Score out of 10)	8.3	7.9	7.9	6.9	7.1
Color of leaves (Score out of 10)	8.0	8.0	6.7	6.8	8.0
Resistance to drought (Score out of 10)	7.5	6.8	6.1	5.4	8.4
Vigor in growth (Score out of 10)	8.4	7.9	8.1	7.1	7.2
Filling of pods (Score out of 10)	8.0	7.0	8.0	7.0	7.0
Resistance to diseases (Score out of 10)	8.0	7.0	8.5	6.2	4.5
Resistance to pests (Score out of 10)	7.5	6.5	6.5	5.5	5.2
Healthy pods per plant	66-70	65-70	65-70	45-50	35-40
No of pods per plant	70-75	70-75	75-80	50-55	40-45
No of seeds per pod	1-2	1	1-2	1	1
Size of pod	Medium	Bold	Medium	Bold	Bold
100 grain weight (gm)	24-25	28-32	24-28	28-32	18-20
Early maturity	90-95	85-90	90-95	85-90	85-90
Expected grain yield (kg/ha)	1800	1826	1731	1348	1523
Fodder yield	940	960	748	682	638
Overall rank	1	2	3	5	4

Table 4.9 Rating of varieties as per economically desirable traits in Dharwad district

Crop trait	JG-11	BGD-103	JAKI-9218	KAK-2	Annigeri
Cooking quality & taste	Good	Good	Good	Good	Good
Expected farm price/kg	30	32	31.6	30.8	26.6
Keeping quality	Good	Good	Good	Good	Average
Marketability	8	8	7.5	7.5	9
Preference to bold grain size	Medium	Extra Bold	Medium	Bold	Small seeded
Preference for processing	7.9	8.2	7.4	6.6	6.6

Preference for storability	8.1	8.1	7.3	6.6	8.3
Fodder palatability	Good	Good	Good	Average	Good
Overall rank (farmer and trader)	1	2	3	4	5

The varieties were also rated by the farmers in terms of economically desirable traits and the responses are summarized in Table 4.9. JG-11 stood first in this rating process as well. All the five varieties in contention were rated good with respect to cooking quality and taste. Annigeri was rated below other varieties in case of keeping quality, while KAK-2 was rated below others with respect to palatability of fodder. BGD-103 and KAK-2 were rated higher with respect to size of grain. BGD-103, JAKI-9218 and KAK-2 were rated higher in terms of market price they are expected to fetch. Annigeri scored higher than others with respect to ease in marketing. BGD-103 was rated better with respect to amenability to processing, while Annigeri was preferred over others for storability. But, in the overall rating, JG-11 scored over BGD-103. JAKI-9218 was ranked third, followed by KAK-2 and Annigeri.

4.2.2.3 Trait preferences of farmers visiting FPVS trials in Gulbarga district

The average scores obtained by different varieties, when the farmers' preferences for traits were averaged, are reported in Table 4.10. These responses were on similar lines as in case of Dharwad district. JG-11 scored over others with respect to biomass for fodder, vigor in growth and resistance to pests. It was at par with Annigeri with respect to color of leaves. JAKI-9218 and MNK-1 were at par with it in respect of filling of pods. Annigeri scored the best with regard to drought resistance, while JAKI-9218 was preferred the most for disease resistance.BGD-103, MNK-1, KAK-2 and Annigeri mature about 5 days earlier than JG-11 and JAKI-9218. The expected grain yield was the highest from JG-11, while the expected fodder yield was the highest with BGD-103. JG-11 was ranked first in the overall ranking, followed by BGD-103, JAKI-9218, MNK-1, KAK-2 and Annigeri.

Table 4.10 Trait Preferences of farmers in different chickpea varieties in Gulbarga district, 2007-08

Crop growth trait	JG-11	BGD-103	JAKI-9218	MNK-1	KAK-2	Annigeri-1
Biomass for fodder (Score out of 10)	8.4	8.0	8.0	6.1	6.9	7.2
Color of leaves (Score out of 10)	8.1	8.0	6.8	6.0	6.9	8.1
Resistance to drought (Score out of 10)	7.4	7.0	6.2	5.7	5.5	8.1
Vigor in growth (Score out of 10)	8.5	8.1	8.0	6.1	7.2	7.4
Filling of pods (Score out of 10)	8.0	7.1	8.0	8.0	7.0	7.0
Resistance to diseases (Score out of 10)	8.1	7.0	8.2	6.1	6.2	4.5
Resistance to pests (Score out of 10)	7.2	6.5	6.4	5.5	5.8	5.2
Healthy pods per plant	66-70	65-70	65-70	35-40	45-50	35-40
No of pods per plant	65-70	70-75	75-80	40-45	50-55	40-45
No of seeds per pod	1-2	1	1-2	1	1	1
Size of pod	Medium	Extrabold	Medium	Bold	Bold	Small seeded
100 grain weight (gm)	24-25	28-32	24-28	50-52	38-40	18-20

Early maturity	90-95	85-90	90-95	85-90	85-90	85-90
Expected grain yield(kg/ha)	1711	1548	1211	1577	1357	1273
Fodder yield	880	960	748	682	682	638
Overall rank	1	2	3	4	5	6

Table 4.11 Economically preferred traits in Gulburga sample farmers

Crop trait	**JG-11**	**BGD-103**	**JAKI-9218**	**MNK-1**	**KAK-2**	**Annigeri**
Cooking quality & taste	Good	Good	Good	Good	Good	Good
Expected farm price	31	33	32	33	29	26.6
Keeping quality	Good	Good	Good	Average	Good	Average
Marketability	8.1	7.8	7.5	8	7.5	9
Preference to bold grain size	Medium	Bold	Medium	Bold	Bold	Small seeded
Preference for processing	8.3	8	7.5	7	6.6	6.6
Preference for storability	8.1	8.1	7.3	6.3	6.6	8.3
Fodder palatability	Good	Good	Average	Good	Average	Good
Overall rank (farmer and trader)	1	2	5	3	4	6

Just as in case of Dharwad district, JG-11 was rated at the top even with respect to economically desirable traits (Table 4.11). All the six varieties were rated good with respect to cooking quality and taste. MNK-1 and Annigeri were rated inferior with respect to keeping quality, while JAKI-9218 and KAK-2 were rated poorer with respect to palatability of fodder. BGD-103, JAKI-9218 and MNK-1 are preferred because of bold size of grain and, hence, are expected to fetch better price. JG-11 is preferred for processing, while Annigeri is preferred for storability. JG-11 was ranked at the top in overall ranking, followed by BGD-103, MNK-1, KAk-2, JAKI-9218 and Annigeri.

4.2.2.4 Varieties and preferred Traits in Karnataka, 2006-07

The scientists who conducted the FPVS summarized the choice of varieties and the traits which were responsible for the choice, after recording and averaging the responses of farmers in both Dharwad and Gulbarga districts (Table 4.12). JG-11 emerged as the most preferred variety, because of its plant height, branching pattern, duration, yield potential, seed size and seed color. BGD-103 was preferred for its yield potential, size and color of grain. The same traits were found in JAKI-9218 along with medium duration. KAK-2 was preferred by the farmers because of good cooking quality and taste, good keeping quality, bold grain size and yield potential.

Table 4.12 Most preferred traits in the selected cultivars

Varieties preferred by farmers (in order of preference)	Preferred traits
1. JG -11	1. Seed Size 2. Plant height 3. Duration 4. Seed colour 5. Yield potential 6. Branching pattern
2. BGD-103	1. Bold Seed size 2. Yield potential 3. Attractive grain colour
3. JAKI -9218	1. Seed Size 2. Duration 3. Seed colour 4. Yield potential
4. KAK-2	1. Bold grain size 2. Drought resistance 3. Duration 4. Yield potential

Chapter 5

Results from early adoption survey

5.1 Andhra Pradesh

5.1.1 Changes in demographic characteristics

The early adoption survey was conducted during 2010 with 2009-10 as the reference year using the same sample as in the baseline survey conducted in 2007-08. Even with the same sample, the operational holdings changed considerably (Table 5.1). The number of farmers in marginal and medium groups decreased while those in small and large groups increased in both adopted and control villages of Kurnool and Prakasam districts. The increase in operational holdings was due to increased leasing of land by the sample farmers.

Table 5.1 Change in sample distribution between baseline and early adoption surveys

Category	BaselinePooled		Early AdoptionPooled		Changes in Sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Marginal	51 (28)	16 (18)	47 (26)	14 (16)	-4 (-8%)	-2 (-4%)
Small	32 (18)	20 (22)	40 (22)	24 (27)	+8 (+25%)	+4 (+13%)
Medium	39 (22)	26 (29	13 (7)	8 (9)	-26 (-67%)	-18 (-69%)
Large	58 (32)	28 (31)	80 (45)	44 (49)	+22 (+38%)	+16 (+57%)
Total	180 (100)	90 (100)	180 (100)	90 (100)	0	0

During the baseline survey, 2006-07, there were 19 female headed households in the pooled sample (Table 5.2). This number increased to 24 during the early adoption survey because of deaths and changes in the family structure. The number of female-headed households decreased by three in the sample from adopted villages, while their number increased by eight in the sample from control villages. The dependency of households on agriculture continued even during the early adoption survey.

Table 5.2 Changes in land ownership by gender

Category	Baseline Pooled		Early Adoption Pooled		Changes in Sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Female	17	2	14	10	-3	+8
Male	163	88	166	80	+3	-8

5.1.2 Shifts in Cropping Pattern

Table 5.3 Changes in cropping pattern on sample farms of Kurnool district (ha)

Crop	Baseline		Early adoption	
	Adopted	Control	Adopted	Control
Rainy season				
Sorghum	68	36	46	20
Paddy	7	22	2	21
Maize	0	0	6	0
Post-rainy season				
Chickpea	324	91	351	123
Sunflower	226	37	135	14
Groundnut	2	2	1	0
Tobacco (Natu)	13	1	30	3
Black gram	0	0	3	2
Chilies	0	0	2	0
Cotton	0	0	5	0
Mango	0	0	0	2
Total	640	189	581	185

The cropped area decreased by 10 per cent in the adopted villages and by 2 per cent in the control villages (Table 5.3) in Kurnool district. It happened largely due to seasonal/climatic conditions. The area under chickpea increased by 8.3 per cent in the adopted villages and by 35.2 per cent in the control villages. In the adopted villages, the proportion of chickpea area to the total cropped area increased from 51.8 per cent in baseline survey to 60.4 per cent in early adoption survey, while it increased from about 48.1 per cent in 2006-07 to 66.5 per cent in 2009-10 in the control villages. The area under sunflower, which was considerable in the baseline survey period, decreased considerablyin the early adoption survey as it was substituted by chickpea due to better returns from it.

Table 5.4 Changes in cropping pattern on sample farms of Prakasam district (ha)

Crop	Baseline (2006-07)		Early adoption (2009-10)	
	Adopted	Control	Adopted	Control
Rainy season				
Paddy	4	0	4	3
Green gram	0	0	3	0
Black gram	0	0	2	2
Post-rainy season				
Chickpea	355	171	337	235
Tobacco (Natu)	21	4	144	43
Tobacco (Vargina)	13	27	0	0
Chilies	0	0	0	3
Total	393	202	481	282

The increase in cropped area between baseline and early adoption survey periods was even sharper in Prakasam district than in Kurnool district. The cropped area increased by 22.4 per cent in the adopted villages and by 39.6 per cent in the control villages (Table 5.4). Area under chickpea fell by 5 per cent in the sample from adopted villages of Prakasam district. It was due to a substantial increase in the area under tobacco (Natu). But, it increased by 37.4 per cent on the sample farms from control villages of Prakasam district.

5.1.3 Changes in composition of chickpea varieties

Table 5.5 Varietal compositions of chickpea in Kurnool district, 2009-10

Variety	Adopted		Control		Both	
	Area under different varieties(ha)	Number of Farmers	Area under different varieties(ha)	Number of Farmers	Area under different varieties (ha)	Number of Farmers
Annegeri	48	12	-	-	48	12
JG-11	301	77	123	45	424	122
JAKI-9218	2	1	-	-	2	1
TOTAL	351	90	123	45	474	135

In Kurnool district, only 12 out of 90 farmers in the sample from adopted villages persisted with Annigeri, while the remaining has switched to the improved varieties (Table 5.5). 86.3 per cent of chickpea area was covered by improved varieties in the adopted villages. In the control villages, all the chickpea area was under JG-11 in 2009-10.

Table 5.6 Varietal compositions of chickpea in Prakasam district, 2009-10

Variety	Adopted		Control		Both	
	Area under different varieties (ha)	Number of farmers	Area under different varieties (ha)	Number of farmers	Area under different varieties (ha)	Number of Farmers
Annigeri	8	5	7	6	15	11
JG-11	62	20	46	15	108	35
KAK-2	267	65	182	24	449	89
TOTAL	337	90	235	45	572	135

Only 6 per cent of sample farmers in adopted villages and 13 per cent of sample farmers in control villages still persisted with Annigeri in Prakasam district during early adoption survey (Table 5.6). In terms of area, only 2 per cent in adopted villages and 3 per cent in control villages was under traditional variety, Annigeri. JG-11, an improved *desi* variety covered 18.4 per cent in adopted villages and 19.6 per cent area in control villages. KAK-2, the ruling *Kabuli* variety, occupied the bulk of chickpea area in Prakasam district, covering 79.2 per cent in adopted villages and 77.4 per cent of chickpea area in control villages. Although both desi and kabuli

varieties are grown in Prakasam district, the sample villages were drawn from areas where kabuli varieties are pre-dominant. Farmers in the sample villages have preferred *Kabuli* variety because of the attractive price it is fetching in the market. Else where, there are pockets where desi varieties are grown mostly by the farmers.

5.1.4 Economics of chickpea in early adoption studies

Table 5.7 Change in chickpea yield on sample farms of Kurnool and Prakasam districts between baseline and early adoption surveys

Variety	Baseline yield (kg/ha)		Early Adoption (kg/ha)	
	Kurnool	Prakasam	Kurnool	Prakasam
Annigeri	1015	1072	1235	1420
JG-11	1356	1241	1869	1877
KAK-2	1112	1317	0	1912
JAKI9218	-	-	1766	-

The yields of chickpea showed an upward trend between baseline and early adoption survey periods (Table 5.7). Even the traditional variety, Annigeri, yielded 21.7 per cent higher in Kurnool district and 32.5 higher in Prakasam district. The yield of JG-11, improved *desi* variety, increased by 37.8 per cent in Kurnool district while 51.2 per cent in Prakasam district. Sample farmers in Kurnool district did not grow *Kabuli* varieties in 2009-10. The yield of KAK-2, improved *Kabuli* variety, increased by 45.2 per cent on sample farms of Prakasam district. It is significant that farmers in Kurnool district are able to obtain higher yields with *desi* varieties, JG-11 and JAKI-9218, while sample farmers in Prakasam district are successful in registering high yields with KAK-2, the *Kabuli* variety.

Table 5.8 Cost of cultivation of chickpea in Kurnool and Prakasam districts during early adoption survey

Particulars	Cost of Cultivation (Rs. per ha)		
	Kurnool	Prakasam	Overall
Labour cost	17485	17760	17622
Material cost	4905	5832	5369
Total cost of cultivation	22390	23592	22991
Cost of production per 100 kg	1232	1245	1238
Grain yield	1818	1895	1857
Gross returns	50904	58745	54825
Net returns	28514	35153	31834
Benefit cost ratio	2.27	2.49	2.39

The cost of cultivation of chickpea was higher in Prakasam district than in Kurnool district by 5.4 per cent during 2009-10 (Table 5.8). The productivity of chickpea was also higher in Prakasam district by 4.2 per cent. The gross returns from chickpea were higher by 15.4 per cent in

Prakasam district, because of higher price fetched by the *Kabuli* varieties. The benefit-cost ratio was also marginally higher in case of Prakasam district than in Kurnool sample.

5.1.5 Unit cost reduction due to improved cultivars/technology

Table 5.9 Cost of production of chickpea in baseline and early adoption surveys

Item	Kurnool	Prakasam	Pooled
Weighted average cost of production in baseline (2006-07) Rs per 100 kg	1552	1619	1586
Weighted average cost of production in early adoption (2009-10) Rs per 100 kg	1275	1253	1264
Reduction in cost of production	277	366	322
Percentage reduction in unit cost of production	18	23	20

Due to increased yields of chickpea in early adoption survey, the weighted average cost of production per 100 kg decreased from Rs. 1552 to Rs. 1275 in the sample villages of Kurnool district (Table 5.9). It represented an 18 per cent reduction in the real cost of production of chickpea due to adoption of improved varieties and better crop management techniques. The reduction in the unit cost of production of chickpea was even higher at 23 per cent in Prakasam district, as the weighted average cost of production per 100 kg decreased from Rs. 1619 to Rs.1253. The reduction in unit cost of production would even be higher if the cost in 2009-10 is adjusted for inflation. Such a reduction in the unit cost of production has motivated the sample farmers to invest more and realize higher returns on investment.

5.1.6 Impact on farmers' income

In 2006-07, the weighted average area under chickpea in Kurnool district was 3.1 ha, out of which 1.4 ha was under Annigeri (Table 5.10). The weighted average net return from Annigeri was Rs. 6681 per ha. They earned a net return of Rs. 9353 per farm from Annigeri. The weighted average net return from improved varieties was Rs. 9253 per ha. From an area of 1.7 ha under improved varieties, they earned a total net return of Rs. 15730 per farm. The total net returns from chickpea were Rs. 25083 per farm in 2006-07.

In 2009-10, the average area under chickpea increased to 3.51 ha. Out of that, only 0.36 ha was under Annigeri, giving a return of Rs. 5069 (Net return per ha was Rs. 14080). The weighted average net return from improved varieties was Rs. 28514/ha. The net return earned from improved varieties was Rs. 89819.The total net return earned from chickpea by a sample farmer in Kurnool district added up to Rs. 94,888. The net return earned by a farmer increased from Rs. 25083 in 2006-07 to Rs. 94,888 in 2009-10, recording an increase of Rs.69,805. It was partly because of improved yields (by 53 per cent) and due to increased prices (by 23 per cent). The income increased much faster than the cost of cultivation due to which net returns increased sharply.It represented a 52 per cent increase over the net income from crops (Rs. 134, 531)

recorded in Kurnool district during the base line year of 2006-07. However, it must be noted that the increase in net return would be much lower if it is adjusted for inflation. The study on improved chickpea cultivars adoption conducted in Gujarat state by Shiyani (1998)revealed that, the popular local cultivar Dahood yellow is significantly substituted by the improved cultivars likes ICCV-2 and ICCV-10 around 70%, which resulted in yield gain by 35-50%, reduced cost of production considerably and increased labour productivity and net returns by 70-85% over local cultivars.

Table 5.10 Impact of chickpea technology on farmers' income in Andhra Pradesh sample

Impact Indicator	Kurnool		Prakasam	
	Baseline	Early Adoption	Baseline	Early Adoption
Area under chickpea (ha/farm)	3.10	3.51	3.90	4.24
Area under Annigeri (ha/farm)	1.40	0.36	0.96	0.11
Net income from Annigeri (Rs./ha)	6681	14080	6697	18250
Net income from Annigeri (Rs./farm)	9353	5069	6429	2008
Area under improved varieties (ha/farm)	1.70	3.15	2.94	4.13
Net income from improved varieties (Rs./ha)	9253	28514	10173	35153
Net Income from improved varieties (Rs./farm)	15730	89819	29909	145182
Total Net income from chickpea (Rs./farm)	25083	94888	36338	147190
Increase in net income (percent)	-	278	-	305
Increase in yield (percent)	-	55	-	83
Increase in price (percent)	-	23	-	37
Increased income as a share of net crop income	-	52	-	66

In Prakasam district, the average chickpea area of a sample farmer was 3.9 ha. Even in the base line period, only 24.6 per cent area or 0.96 ha was under Annigeri. The net income per ha from Annigeri in Prakasam district during 2006-07 was Rs. 6697. The net return earned from Annigeri was Rs. 6429 per farm. The net return from improved varieties of chickpea was Rs. 10173 per ha. From 2.94 ha under improved varieties, an average sample farmer has earned Rs. 29909. The total net return of a sample farmer from chickpea in 2006-07 was Rs. 36338. In 2009-10, the average area of chickpea on the sample farms of Prakasam district increased to 4.24 ha. Only 2.6 per cent area or 0.11 ha remained with Annigeri. The net income from Annigeri in 2009-10 was Rs.18250/ha. The net income derived from Annigeri was Rs. 2008 per farm. The net income from improved varieties of chickpea in 2009-10 was Rs. 35153/ha. From 4.13 ha, a sample farmer earned a net profit of Rs. 145,182 from the improved varieties of chickpea. The total net returns of a chickpea farmer were Rs. 147,190. The net income earned by sample farmer in Prakasamdistrict increased from Rs. 36,338in baseline year to Rs. 147,190 in early adoption survey year, registering an increase of Rs. 110,852. It represented a 66 per cent increase over the net income from crops (Rs. 168, 865) reported in the baseline year. Such a big increase was possible because of yield increase (by 83 per cent) as well as price increase by 37 per cent.

Because the farmers in Prakasam district grew *Kabuli* varieties, such a big increase in price was noted. Since the yield and price increases were much higher relative to increase in cost of cultivation, the net returns increased phenomenally. But it must be noted that the increase in net return gets moderated if it is adjusted for inflation.

5.1.7 Constraints in adoption of improved cultivars

The adoption levels are already high. Farmers find chickpea to be a profitable crop and are increasing area under it by leasing in more land and mechanising the field operations. Yet, the farmers face some constraints with the availability of quality seeds of high yielding varieties. They are also facing problems with the availability of labour during critical operations. A common problem encountered is a fall in the market prices of chickpea during the harvest season. Many of them are storing chickpea in cold storages till the market prices improve. Supply of seed on subsidy by the Government is dissuading them from storing the chickpea seeds of improved varieties grown by them. This program is making farmers dependent on the Government for the supply of chickpea seed. Although government departments are also procuring and supplying seeds of improved varieties on subsidy, it does not happen always. Private seed companies are not in the picture as the improved varieties are of open pollinated type. Emphasis on seed village program with the preferred varieties of chickpea will further hasten the diffusion of new varieties.

5.2 Karnataka

5.2.1 Changes in demographic characteristics

The same sample of farmers used in the baseline survey in 2007-08 was retained for the adoption survey as well. No information was collected regarding the socio-economic and demographic characteristics of farmers during the early adoption survey conducted in June, 2010, because the time gap between baseline and early adoption survey was only three years and no perceptible changes can be expected in socio-economic and demographic characteristics in such a short period.

5.2.2 Shifts in cropping pattern

Table 5.11 Changes in cropping pattern of Karnataka sample

Season and Crop	Dharwad		Gulbarga	
	Baseline (06-07)	Early adoption (09-10)	Baseline (06-07)	Early adoption (09-10)
Rainy season area (ha)	369	361	285	287
Post rainy season area (ha)	313	344	195	209
Total cropped area (ha)	682	705	480	496
Area under chickpea (ha)	247	255	191	194

Chickpea area as percent of post rainy season area (%)	79	74	98	93
Chickpea area as percent of total cropped area (%)	36	36	40	39

In Dharwad and Gulbarga districts of Karnataka, both the rainy and post- rainy seasons are more or less equally important for cropping. Between 2006-07 and 2009-10 seasons, the cropped areas changed only marginally (Table 5.11). In Dharwad district, the cropped area decreased by 8 ha in the rainy season, while that in post-rainy season increased by 31 ha between 2006-07 and 2009-10. The important rainy season crops in both the years were maize, onion, green gram and sorghum. Chickpea accounted for 79 per cent of post-rainy season cropped area in 2006-07, but it dropped marginally to 74 per cent in 2009-10. Wheat and sorghum were the other crops grown in the post-rainy season. The cropped area increased slightly in both the seasons between 2006-07 and 2009-10 in Gulbarga sample. In Gulbarga sample; pigeon pea, sorghum, green gram and sun flower were the important crops grown in rainy season. Chickpea covered 98 per cent of post-rainy season cropped area in 2006-07, but it dropped slightly to 93 per cent in 2009-10. It was because the area under safflower increased due to remunerative prices. Wheat and sorghum were grown in both the years in small areas. While the area under chickpea marginally increased in absolute terms in both the districts during the post-rainy season, its share dropped slightly in relative terms because of area increase under other minor post-rainy season crops. Chickpea accounted for 36 per cent of the gross cropped area on the sample farms of Dharwad district in both the surveys, while its share in gross cropped area marginally dropped from 40 per cent in 2006-07 to 39 per cent in 2009-10 in Gulbarga district.

5.12 Changes in composition of chickpea varieties on Karnataka sample farms

Variety	Dharwad (%)		Gulbarga (%)	
	Baseline (06-07)	Early Adoption (09-10)	Baseline (06-07)	Early Adoption (09-10)
Annigeri	91	41	94	42
BGD-103	0	18	0	18
JG-11	0	23	0	22
JAKI-9218	0	12	0	0
Bhima	2	2	0	0
KAK-2	5	2	2	5
MNK-1	0	0	0	10
Others	2	2	4	3
Total	100	100	100	100

Over the three years period between the baseline and early adoption surveys, considerable changes occurred in the composition of chickpea varieties in both Dharwad and Gulbarga districts (Table 5.12). During the baseline survey year (2006-07), Annigeri was the ruling variety, with a 91 per cent share in chickpea area of the pooled sample of Dharwad district and 94 per cent share of the same in Gulbarga district. KAK-2, Bhima and other varieties had small areas

under them in both the districts. In 2009-10, the share of Annigeri dropped to 41 per cent in Dharwad sample area under chickpea and it was followed by JG-11 in 23 per cent area, BGD-103 in 18 per cent area and JAKI- 9218 in 12 per cent area. Bhima, KAK-2 and others had minor shares of 2 per cent each. In Gulbarga district also, the share of Annigeri dropped to 42 per cent in the chickpea area of the pooled sample. JG-11 (22 per cent) and BGD-103 (18 per cent) were the improved *desi* varieties becoming popular in the area. The *Kabuli* varieties, MNK-1 and KAK-2 were grown in 10 and 5 per cent of chickpea area respectively, while the remaining 3 per cent area was covered by other varieties.

Table 5.13 Chickpea yields by variety on Karnataka sample farms (kg/ha)

Variety	Dharwad		Gulbarga	
	Baseline (06-07)	Early Adoption (09-10)	Baseline (06-07)	Early Adoption (09-10)
Annigeri	1024	1030	1148	1097
BGD-103	-	1374	-	1405
Bhima	686	1113	686	1136
JAKI-9218	-	1250	-	1333
JG-11	-	1314	-	1398
MNK-1	-	889	-	1227
KAK-2	-	1095	-	1175
Local	1009	-	955	748
Kabuli (Non descript)	993	1019	1000	1084

The yields recorded by different chickpea varieties on the sample (pooled) farms of Dharwad and Gulbarga districts in 2006-07(baseline) and 2009-10 (early adoption) surveys are presented in Table 5.13. In 2006-07, Annigeri yielded marginally better than local and non-descript *Kabuli* varieties in both Dharwad and Gulbarga districts, while Bhima fared the worst. In 2009-10, BGD-103 excelled over all other varieties in both the districts. JG-11 and JAKI-9218, other improved *desi* varieties, closely followed it Bhima also fared better than Annigeri in both the districts. Among the *Kabuli* varieties, KAK-2 gave higher yield than MNK-1 in Dharwad district, while the opposite was the case in Gulbarga district. Local and non-descript *Kabuli* yielded less than other improved varieties in the respective group.

5.2.4 Economics of chickpea in early adoption studies

The perceptions of sample farmers on the expected gross returns from different crops are summarized in Table 5.14. Among the rainy season crops, sorghum was perceived to be giving highest gross returns in Dharwad district in 2006-07, followed by maize, onion, cotton, black gram, sun flower and green gram. But, in 2009-10, gross returns from sorghum were perceived to be much lower than those from onion, maize, cotton, black gram, sun flower and green gram. Some of the crops received irrigation support in Dharwad sample and, hence, are not comparable with the crops which did not receive such support. In Gulbarga district, onion was perceived to be giving higher returns than sorghum,black gram, sun flower, pigeon pea and

green gram in 2006-07. In 2009-10, maize was believed to be giving highest returns, followed by onion, pigeon pea, black gram, sun flower, green gram and sorghum. In Dharwad district, chickpea was perceived to be giving higher returns than others during both the surveys. Wheat gave the lowest returns in both the surveys. In 2009-10, sorghum and safflower gave better returns than wheat in Dharwad district. In Gulbarga district, chickpea was perceived to have given better returns than wheat in 2006-07. However, in 2009-10, wheat led chickpea in gross returns and these two crops were followed by sorghum and safflower. Since these are perceived gross returns, nothing can be inferred on their net returns in the absence of information on cost of cultivation.

Table 5.14 Changes in gross returns (Rs/ha)

Crop	Dharwad		Gulbarga	
	Baseline (06-07)	Early Adoption (09-10)	Baseline (06-07)	Early Adoption (09-10)
Rainy Season				
Maize	40249	37183	-	81924
Onion	38138	39958	74100	51253
Cotton	23513	24587	-	-
Sorghum	49588	10717	25251	11679
Pigeon pea	-	-	21554	33018
Black gram	19859	21657	24660	25530
Green gram	12593	13427	16042	20594
Sun flower	19575	19504	24338	23819
Post Rainy Season				
Chickpea	20086	22873	25703	32082
Sorghum	-	14431	-	20866
Safflower	-	13811	-	14137
Wheat	10991	13261	24700	33896

Table 5.15 Profitability of chickpea on Karnataka sample farms (Rs/ha)

Costs and Returns	Dharwad		Gulbarga	
	Baseline (06-07)	Early Adoption (09-10)	Baseline (06-07)	Early Adoption (09-10)
Fixed Cost	3721	4054	3603	4711
Variable Cost	12463	13473	12330	13527
Total Cost	16184	17527	15933	18238
Yield (Kg/ha)	1024	1152	1102	1277
Gross Return	25194	33125	25058	36739
Net Return	9010	15598	9125	18501
Benefit Cost Ratio	1.56	1.89	1.57	2.01

The comparative economics of Annigeri in 2006-07 and improved varieties in 2009-10 on the sample farms (Pooled) in both the districts are given in Table 5.15. The total cost of cultivation of

chickpea increased rather slowly in both the districts between 2006-07 and 2009-10. But the yield of chickpea increased by 12.5% in Dharwad district and by 15.9% in Gulbarga district due to shift from Annigeri to improved varieties in the three years period. The gross returns increased by 32% in Dharwad district and by 47% in Gulbarga district due to increase in chickpea prices, besides the yield increases. The net returns have increased by 73% in Dharwad district and by 103% in Gulbarga district over the three years period. As a result, the benefit-cost ratio from chickpea increased from 1.56 to 1.89 in Dharwad district and from 1.57 to 2.01 in Gulbarga district.

5.2.5 Unit cost reduction due to improved cultivars/technology

Table 5.16 Change in unit cost of production on Karnataka sample farms

Yield and cost of production	Dharwad		Gulbarga	
	Baseline (06-07)	Early Adoption (09-10)	Baseline (06-07)	Early Adoption (09-10)
Fixed Cost (Rs./ha)	3721	4054	3603	4711
Variable Cost (Rs./ha)	12463	13473	12330	13527
Total Cost (Rs./ha)	16184	17527	15933	18238
Yield of Chickpea (Kg/ha)	1023	1152	1102	1277
Cost of Chickpea production (Rs./ 100 kg)	1582	1521	1446	1428
Reduction in unit cost of production (percent)	-	4	-	1

The computationsof unit cost of production of chickpea in the two districts, Dharwad and Gulbarga, are presented in Table 5.16. In 2006-07, the unit cost of production was 1582 per 100 kg in Dharwad district. Since the yield increased faster than the cost of cultivation, the unit cost of production of chickpea fell to Rs. 1521 per 100 kg in nominal terms. It signified a 4 per cent reduction in the cost of production due to the effect of improved technology. In real terms, the reduction in unit cost of production would be much sharper if the cost of production in 2009-10 is adjusted for inflation. In Gulbarga district, the unit cost of production of chickpea in 2006-07 was Rs.1446 per 100 kg. In 2009-10, it decreased to Rs. 1428 per 100 kg in nominal terms. This represented a reduction of 1 per cent in unit cost. Certainly, the reduction in cost of production will be much higher, if cost of production in 2009-10 is adjusted for inflation.

5.2.6 Impact of technology on farmers' income

The impact of chickpea technology on farmers' income is worked out and presented in Table 5.17. Out of 1.83 ha area under chickpea per farm in Dharwad district during 2006-07, 1.67 ha was under Annigeri variety alone. The net returns from a hectare of Annigeri were Rs.9010 and the returns from 1.67 ha under Annigeri were Rs. 15047. The area under improved varieties was only 0.16 ha and the net returns from improved varieties were only Rs.10500per ha. The net

returns from improved varieties of chickpea amounted to only Rs.1680, raising the total returns from chickpea to Rs. 16727 per farm in 2006-07.

In 2009-10, the area under chickpea increased slightly to 1.89 ha. The average area under Annigeri was 0.78 ha and the net returns from chickpea were Rs. 11, 357 (the net returns from one ha of Annigeri variety of chickpea were Rs. 14560). The area under improved varieties of chickpea was 1.11 ha. As the returns from one ha of improved varieties of chickpea increased to Rs. 15,598, the returns from improved varieties of chickpea were Rs. 17,313. The total returns from chickpea on the sample farms (pooled) added up to Rs. 28671 per farm. Thus, the average net returns from chickpea on sample farms increased from Rs.16,727 to Rs.28,671, which represented an increase of 71 per cent over the period of three years. This substantial increase was possible because of a 15% increase in the yield of chickpea and a 13% increase in the price of chickpea. The increased net income of Rs. 11,944 represents a 28.7% increase in the annual net income of a sample farm (Rs. 41, 667) from crops. The increase in net return would get much moderated if adjustment is made for inflation.

In Gulbarga district, the area under chickpea on sample farms was 1.42 ha, out of which 1.34 ha area was under Annigeri variety alone.As the net returns from a hectare of Annigeri were Rs. 9125 per ha, the total net returns earned by a sample farm were Rs.12, 228. The net return from 0.08 ha of chickpea under improved varieties was Rs.854, as the profit from one ha of improved varieties was Rs.10, 680 per ha. Thus, the total net returns from chickpea cultivation in 2006-07 were only Rs.13, 082 per sample farm. In 2009-10, the area under Annigeri dropped to 0.61 ha. As the income from one ha of Annigeri increased to Rs 15, 673, the income from Annigeri variety of chickpea reached Rs. 9561. The income per ha from improved varieties was much higher at Rs. 20, 900, the net returns from 0.83 ha under improved varieties were Rs.17,347. The total net returns from chickpea added up to Rs.26,908 per sample farm in 2009-10. There was an increase of Rs. 13,826 in the net returns from chickpea over the three years period. Such an impressive increase in income by 94.6 per cent was possible because of a 16 per cent increase in the yield and a 25 per cent increase in the price of chickpea. The increased income from chickpea on sample farms represented a 49% increase in the net income from crops (Rs. 28, 000) recorded in the baseline survey year of 2006-07. But, in real terms, the increase in net return may be much smaller if the returns are adjusted for inflation.

Table 5.17 Impact of Chickpea technology on farmers' income in Karnataka sample

Impact Indicator	Dharwad		Gulbarga	
	Baseline	Early Adoption	Baseline	Early Adoption
Area under Chickpea (ha/farm)	1.83	1.89	1.42	1.44
Area under Annigeri (ha/farm)	1.67	0.78	1.34	0.61
Net income from Annigeri (Rs./ha)	9010	14560	9125	15673
Net income from Annigeri (Rs./farm)	15047	11357	12228	9561
Area under improved varieties	0.16	1.11	0.08	0.83

(ha/farm)				
Net income from improved varieties (Rs./ha)	10500	15598	10680	20900
Net Income from improved varieties (Rs./farm)	1680	17314	854	17347
Total Net income from Chickpea (Rs./farm)	16727	28671	13082	26908
Increase in net income (percent)	-	71	-	95
Increase in yield (percent)	-	15	-	16
Increase in price (percent)	-	13	-	25
Increased income as a share of net crop income	-	29	-	49

5.2.7 Constraints faced by farmers

The constraints faced by the sample farms of Dharwad and Gulbarga districts relate to the availability of quality seeds of preferred varieties. Farmers were supplied small quantities of seeds of varieties preferred by the farmers in FPVS trials. However, these small quantities of 2 to 3 kg per farmer were inadequate and the farmers had to depend on the market for their balance requirements of seed. Other constraints like shortage of labour in the peak season period, shortage of credit, inadequate marketing facilities are also deterring the farmers from adopting improved cultivars in full measure.

Various research studies (Teshale *et al*. 2006; Aw-Hassan *et al.* 2003; Bishaw *et al*. 2008; Abate *et al*. 2011; Rubyogo *et al*. 2007; Ali and Gupta, 2012; Mazid *et al.* 2009; Bumb *et al.* 2011)concluded that despite a large number of released varieties in grain legume crops their impact has yet not fully realized by resource-poor farmers. It is due to several technical, institutional, regulatory and policy constraints in the legume seed industry andinadequate supply of quality seeds.

Chapter 6
Synthesis and Lessons learnt

6.1 Study synthesis

Chickpea has experienced tremendous changes in its spread and production in India over the last five decades. Its production dipped when it was substituted by more profitable crops in Northern states with cooler climate and long growing season. But the shortfall in production increased its relative price and spurred its production in the non-traditional areas. The research system has responded to the challenge by evolving short duration and high yielding varieties with adaptability to warmer climate. The chickpea crop substituted less profitable crops in Central and Southern states and gained area. Study conducted by Joshi et al., 1998 in major chickpea growing states in India confirmed that research efforts significantly expanded the chickpea area and production in a hot and dry climate because the new varieties were adapted to the environment. Several on–farm benefits such as yield gain, decline in unit cost of production, enhanced employment opportunities and labour productivity, positive implication on gender related issues and price premium due to qualitywere derived by farmers as a result of adopting improved chickpea varieties (ICCV1, ICCV2, ICCV10 and ICCC37). Way back in 2002-03, the Acharya N G Ranga Agricultural University (ANGRAU) has conducted farmer participatory varietal trials with 32 improved cultivars. It triggered an interest among the farmers in the new varieties and, in a way, facilitated their initial adoption in Andhra Pradesh. Similar efforts were also initiated by University of Agricultural Sciences (UAS), Dharwad, but the suggested improved varieties could not break the strangle hold of Annigeri in Karnataka.

International Crops Research Institute for Semi-arid Tropics (ICRISAT) and its research partners have been evolving a number of *desi* and *Kabuli* varieties suitable to the new growing areas. As the farmers saw an opportunity to earn profits allocated better lands to it and adopted improved agronomic practices to suit the new varieties. It has been a sustained effort on the part of farmers to gradually improve the yields of chickpea by evolving an optimum mix of right varieties, suitable soils and climate, better agronomy, mechanization and storage-cum-marketing strategies to survive the competition and make a living. It is a saga of gradual shift of the crop from its normal ecology to another and a recovery of area and productivity to achieve higher production levels to meet the market demand created by growing population and increasing incomes.

The Tropical Legumes-II project funded by Bill and Melinda Gates Foundation (BMGF) helped ICRISAT and its research partners to test some of the promising varieties of the research stations on the farmers' fields in some selected villages of Andhra Pradesh and Karnataka through the Farmer Participatory Varietal Selection (FPVS) trials and organize the production and distribution of varieties preferred by the farmers to cause a quick spread and impact on the yields and incomes of the farmers in a short slice of time period. In Andhra Pradesh, which is an all together

a new area for chickpea, there has been a quick churning of varieties and cropping systems to hit on the optimum blend of soils, agronomy and varieties. Chickpea has taken deep roots as an alternative to tobacco which is being discouraged by the governments and other post-rainy season crops like sun flower, corianderetc. No varieties were entrenched as ruling varieties. The Regional Agricultural Research Stations (RARS) Lam and Nandyalof ANGRAU collaborated with ICRISAT and released a few varieties like Sweta and Kranti. Even Annigeri was tried as one of the alternatives. Farmers were quick in trying new varieties like KAK-2 and JG-11 by remaining in touch with the ICRISAT research stations and Krishi Vigyan Kendra's. The research stations were also keeping in touch with the farmers and selected villages to test their varieties and technologies.

When TL-II project was launched, some of these progressive villages were picked up as intervention and control villages. Due to this reason, farmers were already using the improved varieties in the baseline survey year of 2006-07. The same varieties were tried in the FPVS trials along with some other new varieties. JG-11 was preferred by the farmers in the FPVS conducted in both Kurnool and Prakasam districts. It also yielded better than the other *desi* and *Kabuli* varieties tested in the mother trials conducted in 2007-08 and 2008-09. The research system recommended for the multiplication and supply of JG-11 and the Andhra Pradesh State Seed Development Corporation (APSSDC), National Seed Corporation (NSC) and State Farms Corporation of India (SFCI) organized the seed production of JG-11 and put it in the seed supply chain. Farmers from both adopted and control villages of Kurnool district adopted it largely by 2009-10, the year of early adoption survey. In the adopted and control villages of Prakasam district, farmers used more of *Kabuli* varieties because of substantial difference in the market price over that of *desi* varieties. The marginal yield advantage in favor of *desi* varieties like JG-11 was swamped by the price difference of Rs. 500 to 600 per 100kg in favor of the *Kabuli* varieties. KAK-2 remained the favorite in the adopted and control villages. Farmers are also growing other extra-bold seeded *Kabuli* varieties that were not introduced by the research system but were promoted by trade because of the attractive price they are fetching. While the adopted and control villages of Kurnool district are reflecting the trend in the Kurnool district where JG-11 is getting entrenched as the ruling variety. JG-11 is a popular variety in Prakasam district also, if seed sales are taken as an indication. But, the adopted and control villages are not reflecting this trend and are cultivating KAK-2 and other *Kabuli* varieties, besides JG-11. What is significant is that the farmers in the sample villages of both Kurnool and Prakasam district have adopted improved varieties and other technologies fully and the impact of technology was seen in terms of improved yields and higher net returns.

In Karnataka, Annigeri was a long entrenched variety of the region for nearly four decades. It was evolved in Karnataka and became popular quickly and remained the favorite of farmers even in 2006-07, when baseline survey was conducted. But the FPVs trials conducted in 2007-08 in Dharwad and Gulbarga districts asserted the supremacy of new varieties like JG-11, BGD-103, JAKI-9218 among the *desi* varieties. KAK-2 and MNK-1 proved their superiority among the *Kabuli* varieties in Dharwad and Gulbarga districts respectively. Farmers also selected JG-11 and BGD-103 as the top two varieties preferred for their agronomic and market characteristics. In TL-II

project also the researchers also supplied small quantities of the chickpea seeds of farmer preferred varieties to the sample farmers in adopted and control villages of Dharwad and Gulbarga districts. But there was no large scale effort to organize the seed production and distribution of preferred varieties by the State Seed Corporation in Karnataka. As a result, these varieties did not enter the seed supply chain in a big way. Non-commercial (Grisley 1993) and commercial (Byerlee and White, 1997) approaches and Participatory Variety Selection (PVS) coupled with local seed production by farming community has been suggested as one of the approaches to improve grain legume seed delivery by various studies (Sperling and Scheidegger, 1995; Almekinders et al. 2007; Nasirumbi*et al*. 2008; Abate, 2012).

In the early adoption survey in Karnataka, it turned out that the adoption of new varieties was only partial. Annigeri was still cultivated in about 43 per cent area. Farmers are trying a number of improved varieties like JG-11, BGD-103, JAKI-9218, KAK-2 and MNK-1 and have not zeroed on one or two preferred varieties because of lack of seed supply. Yet, the farmers did benefit by the partial adoption of varieties as evidenced by the enhanced yields and increased net returns. If backed up by seed production and distribution, the preferred new varieties would make further dent on Annigeri and contribute to the welfare of the farmers.Apart from that, the other driving forces for the adoption of the improved cultivars are farmers'access to information and awareness of improved legume varieties and crop management technologies, access to credit and markets and development of decentralized seed production systems coupled with strong partnership relation between farmers, institutions and public and private sector.

6.2 Lessons learnt and Implications for Phase-II

Some useful lessons are learnt in the implementation of phase-I of Tropical Legumes-II project. The first lesson is with respect to selection of villages itself. The normal tendency is to select villages which are familiar to the researchers; which have irrigation facilities to protect the trial plots; and which are known to be progressive. By selecting such villages purposively, the baseline levels of adoption, yields and returns are likely to be higher than the district averages. When baseline yields are higher, it is difficult to achieve a bigger impact in terms of enhanced yields, adoption levels and higher returns over the base line levels. Hence, it is better if villages are chosen randomly when the adoption levels, yields and incomes are likely to conform to the district average levels. Another issue is with the selection of control villages in close proximity to intervention/adopted villages.When the control villages are closer to intervention villages, the diffusion impact will be stronger and there may not be any difference between the adopted and control villages towards the end of the project.

The Farmer Participatory Varietal Selection (FPVS) trials should test a large number of promising varieties that have a potential to do well in a given area. A common tendency noted is the promotion of own varieties of a breeder or a research station over other varieties bred by others or at other research stations. The researchers should have a broader vision and solely aim at improving the yields and profits of the farmers. The research managers should ensure that the

best possible entries are included in the trials. The recommendation is that about 6-8 varieties should be included in the FPVS trials, because it will be un-wieldy to have more varieties beyond that number. The varieties tried in the FPVS are drawn from Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh.

Besides the physical yields, the prices should also be considered to give the farmers those varieties which can improve the profits of the farmers. Efforts should be made to involve a few hundreds of farmers for the Farmer Participatory Varietal Selection (FPVS) exercise. Two visits should be organized for the same set of farmers at vegetative/flowering stage and maturity/harvest stage to record their preferences among the varieties under trial. The results of FPVS trials should be publicized among the farmers aggressively. If there are any differences in the rankings of varieties based on yield levels and farmer preferred traits, they should be highlighted. Finally, the varieties selected in the FPVS process should be taken up for seed production and distribution. If there are any seed subsidy programs, it should be ensured that the varieties preferred by the farmers figure in the subsidy schemes to ensure their spread.

If possible, data may be collected on the costs and returns of the varieties in the trials so that they can be compared and assessed for relative profitability. Although there are limitations in analyzing the data collected from small plots, the analysis can be indicative if not, definitive. In the final reckoning of the farmers, it is not merely the physical yields, but the net returns that matter for the farmers. Attractive net returns are the best bets for adoption and impact creation. Some of these valuable lessons could be used for enhancing the planning and execution of the second phase program of Tropical Legumes-II project.

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