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Chickpea in Nontraditional Areas: Evidence from Andhra Pradesh

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Introduction

Although chickpea is not traditionally a prominent pulse crop in areas with a hot and dry climate, this region contributes more than 70% of the total chickpea production in India, and has enormous potential for further expansion. The hot and dry climate poses major production-limiting biotic constraints like wilt, root rots among major diseases; and pod borer and leaf miner among insects (Ali et al. 1997). Although the biotic and abiotic constraints have remained unchanged over the years, chickpea area in the nontraditional region has increased substantially since 1990. This raises questions on its sources of area expansion, and reasons thereof. The objectives of this study were to:

- assess the growth in chickpea area, production, and yield in hot and dry climate regions
- determine the sources of area expansion in chickpea, and
- examine the role of policy and technology (improved varieties) in area shift in favor of chickpea.

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The study postulated two hypotheses: (i) postrainy fallow and marginal lands released substantial areas for chickpea cultivation, and (ii) the availability of improved technology (e.g., new varieties) facilitated area expansion.

Methodology

Study Area

The study confirmed the set hypotheses in Andhra Pradesh, where chickpea area has increased substantially since 1990 — from around 50,000 ha during the 1980s to a record 1,68,000 ha in 1994-95 (GOI 1995). Chickpea production has grown by more than 16% annually during the past five years.

Andhra Pradesh is located in the southern part of India which experiences severe hot and dry conditions not generally conducive for chickpea production. Chickpea is largely grown under rainfed conditions. Annual rainfall in the state is less than 1000 mm (925 mm), with about 70% of it occurring during the southwest monsoon (Jul to Sep) and 23% of it during the northeast monsoon (Oct to Dec) and winter period (Jan and Feb). Chickpea is sown from late September to late November in the state. While the September and October rains influence the acreage sown to the crop, the northwest monsoon and winter rains have a bearing on yields.

The state is divided into the Coastal, Rayalaseema, and Telangana regions. This study focuses on the Rayalaseema and Telangana regions in view of their large share under chickpea area (about 90% of the chickpea is sown here).

Data

The study used both primary and secondary data to test the hypotheses. Districtwise secondary data were collected and used to analyze trends in area, production, and yield of chickpea from 1970-71 to 1995-96.

Primary data was also collected (1995-96) to assess the adoption of improved chickpea varieties in the selected districts as information on this important aspect is seldom documented. This was done using a questionnaire enquiring about farmers' recollection of adoption patterns related to different chickpea varieties from 1991-92 to 1994-95. The same was confirmed with officials of the extension department of the Andhra Pradesh government.

A systematic sampling scheme was designed to choose the districts which sow over 10,000 ha of chickpea. The districts were Anantapur and Kurnool in Rayalaseema region and Medak in Telangana region, which cover almost 80% of the total chickpea area of about 1,35,000 ha in the two regions, and about 65% in Andhra Pradesh.

A three-stage stratified sampling method was employed to select chickpea growers from these districts. In the first stage, mandals were chosen and divided into three strata according to the intensity of chickpea cultivation: the top 33% of the chickpea-growing mandals were designated as high-intensity areas; the next 33% as medium-intensity areas; and the remaining as low-intensity areas. One mandal was randomly picked from each stratum from each district. Only one mandal was selected from Anantapur district from the high-intensity stratum as the area under chickpea was too low in the other two strata. In all, seven mandals were selected from three districts.

In the second stage, three villages were randomly selected from each mandal. Finally, in the third stage, 10 chickpea-growing farmers from each mandal were randomly chosen, making a total of 210 chickpea farmers which comprised the study sample.

Analytical Approach

To evaluate chickpea performance in area, production, and yield, their compound growth rates were estimated between 1970-71 and 1995-96. To study decadewise performance, a span of 25 years was divided into three periods: (i) 1970-71 to 1979-80, (ii) 1980-81 to 1989-90; and (iii) 1990-91 to 1995-96.

Sources of Chickpea Area Expansion. To examine the sources of area expansion of chickpea, temporal changes in cropping patterns during the postrainy season between 1989-90 and 1995-96 were studied. Similarly, information was estimated on the extent of postrainy fallow which is neither compiled nor reported. To estimate the area under postrainy fallow, the following procedure was used: The crops were split into two groups: rainy season and postrainy season. When a crop was in the field during both the seasons (e.g., sugarcane, cotton, pigeonpea), it was included in both the seasons. The total area under these crops during the two seasons was calculated by adding individual crop areas.

The total area under all the crops (both seasons) was subtracted from the gross cropped area, giving the area of all other crops (e.g., vegetables, spices, other grains) which were not included in the first step.

Since there was no information on the seasonality of these crops, it was arbitrarily assumed that half of the area was sown during the rainy season and the other half during the postrainy season. These other crops usually cover less than 5% of the gross cropped area in a district.

The postrainy season area under the main crops was added to half the area of all the other crops to estimate the total area under postrainy season crops.

The area calculated in the previous step was subtracted from the net cropped area to estimate the postrainy fallow.

Extent of Improved Chickpea Varieties. To understand how improved chickpea varieties were spreading in the selected districts, their adoption patterns between 1991-92 and 1994-95 were estimated on the basis of an on-farm survey.

Chickpea Area Response Model. An area response model was estimated to identify factors which determine allocation of chickpea area. The model used was as follows:

$$AREA_{cp} = f\,(AREA^{-1}_{cp},\ Y^{-1}_{cp},\ Y^{-1}_{cc},\ P^{-1}_{cp},\ P^{-1}_{cc}, CV_{cp},\ CV_{cc},\ HYV_{cp},\ IR,\ RF_{s},\ t),\ pP,\ CC,\ P,\ Icp$$

where,

$AREA_{cp}$ = chickpea area in period t

$AREA^{-1}_{cp}$ = chickpea area in t-1 period

Y^{-1}_{cp} = yield of chickpea in t-1 period

Y^{-1}_{cc} = yield of the competing crop in t-1 period

P^{-1}_{cp} = farm harvest prices of chickpea in t-1 period

P^{-I}_{cp} = farm harvest prices of the competing crop in t-1 period

CV_{cp} = coefficient of variation in chickpea yield (based on moving 3 years)

CV_{cc} = coefficient of variation of competing crop yield (based on moving 3 years)

HYV_{cp} = dummy used for the availability of improved varieties from 1991 onward

IR = irrigated area in period t

RF_s = rainfall in September-October
t = time trend.

Technology-related information in this model is represented by chickpea yield, CV in chickpea yield, and area under improved chickpea varieties. Similarly, the prices of chickpea and competing crops are proxy for price policy.

Results and Discussion

The area under chickpea was about 70,000 ha in the early 1970s but substantially declined to 51,000 ha in the early 1980s, and crossed 1,00,000 ha in the early 1990s (Table 1). However, in an unprecedented trend, chickpea area fell until 1980-81 and stabilized around 50,000 ha during the early 1980s. Chickpea area almost doubled in 1995-96 compared to that in 1980-81. Chickpea production too followed a similar pattern.

Annual compound growth rates in area, production, and yield of chickpea were computed for different periods (Table 2). The compound growth rate of chickpea production declined at an annual rate of 2.31% during 1970-80 due to a drop in its area and yield. Chickpea production increased at an annual rate of 5.75% in 1980-90; most of it came from yield increments (about 60%) and area expansion (about 40%). During 1981-90, chickpea regained the area that was lost during the 1970s. Chickpea production increased sharply during 1991-96 (an unprecedented annual compound growth rate of 16.05%). Interestingly, the entire growth in production was contributed by area expansion. The area under chickpea during 1991-96 increased at an annual rate of about 20%. Ironically, yield levels during this period showed a decline; the annual compound growth rate was -3.20%.

The analyses of growth rates in area and yield during 1991-96 indicated that chickpea cultivation was spreading in marginal environments. Growth in

Table 1. Chickpea area and production in Andhra Pradesh.

Year[1]	Area ('000 ha)	Production ('000 t)	Yield (kg ha^{-1})
1970	78.87	22.86	290
1980	55.81	16.35	293
1990	60.14	37.50	624
1995	105.68	36.37	723

[1] Triennium average ending 1970, 1980, 1990, and 1995.

Table 2. Annual compound growth rates (%) of production, area, and yield of chickpea, Andhra Pradesh.

Period	Production	Area	Yield
1970-80	-2.31	-1.12	-1.12
1981-90	5.75	2.28	3.39
1991-96	16.05	19.88	-3.20

yield was declining despite substantial increases in area. This happens when gain in chickpea area comes from marginal land where yield is much lower than that from normal land. Obviously, the lower yield levels from marginal land bring down average yields.

Spatial Variation in Chickpea Growth

Districtwise annual compound growth rates in area, production and yield of chickpea were computed (Table 3). So were districtwise temporal changes in chickpea area (Table 4). About 40% of the districts in Andhra Pradesh showed a decline in chickpea area during 1971-80. These districts covered about 36.3 thousand hectares during 1971-75, accounting for about half the total chickpea area and production in the state. With a few exceptions, the decline in chickpea area continued during 1981-90 with more districts joining the group. During 1981-90, about 70% of all the districts showed negative growth rates in chickpea area, accounting for about 80% of the chickpea area and nearly 75% of the total chickpea production in the state. Interestingly, there was a reversal in trend during 1991-96 when all the districts, except Krishna and Srikakulam, showed positive growth rates in chickpea area. Krishna and Srikakulam districts covered a negligible area (less than 100 ha) under chickpea.

During 1981-90, chickpea production declined because of a fall in area and yield. This indicates that chickpea area was released from better-endowed regions for other competing crops, and that it was largely confined to the more marginal lands. Such a phenomenon was evident from declining yields. Chickpea production increased in all the districts between 1990-91 and 1995-96, area expansion being the source of this growth. Area expansion surpassed negative yield effect in six districts — Adilabad, Anantapur, Cuddapah, Khammam, Kurnool, and Visakhapatnam — for a positive and high growth in chickpea production. Together, these districts covered about 66% of the total chickpea area in the state. Area

Table 3. Districtwise annual compound growth rates (%) of chickpea production, area, and yield, Andhra Pradesh.

	1970-79			1980-89			1990-95		
District	Production	Area	Yield	Production	Area	Yield	Production	Area	Yield
Adilabad	-0.17	-3.65	3.61	-14.53	-6.08	-9.00	32.98	11.53	19.21
Anantapur	6.87	0.13	6.73	17.35	21.17	-3.15	24.55	36.88	-9.00
Cuddapah	5.66	3.77	1.82	21.59	27.39	-4.56	15.59	18.88	-2.77
Guntur	2.08	1.53	0.54	-5.49	-4.19	-1.35	44.31	45.09	-0.54
Hyderabad	0.02	-1.93	1.99	-14.36	-3.55	-11.21	25.96	10.46	14.02
Karimnagar	-2.38	-7.52	5.56	-18.71	-12.43	-7.17	31.52	2.88	27.84
Khammam	7.06	1.32	5.67	-19.85	-25.40	7.44	0.00	19.90	-16.59
Krishna	0.93	1.17	-0.24	-14.76	-14.20	-0.65	22.47	-18.35	50.00
Kurnool	5.10	5.12	-0.02	26.54	16.99	8.16	7.21	18.95	-9.87
Mahabubnagar	0.62	-3.66	4.45	-7.15	-2.29	-4.98	51.77	20.22	26.24
Medak	-7.31	0.45	-7.73	6.23	-0.41	6.67	21.16	11.36	8.80
Nalgonda	3.26	4.47	-1.16	-20.98	-17.97	-3.67	67.30	27.02	31.71
Nellore	0.00	8.16	-7.55	20.43	24.72	-3.44	68.58	62.47	3.76
Nizamabad	-15.70	-4.06	-1.14	13.44	-4.88	19.26	12.82	7.65	4.80
Srikakulam	20.76	24.93	-3.34	3.19	-9.56	14.10	0.00	8.71	9.54
Visakhapatnam	-11.78	-8.73	-3.35	11.05	8.05	2.77	4.88	32.29	-20.72
Warangal	-2.39	-3.39	1.04	-7.21	-4.93	-2.39	11.77	3.15	8.36

expansion along with declining growth rates in yield show that chickpea's importance in marginal lands is growing.

Sources of Area Expansion

About 48,000 hectares of new area were brought under chickpea cultivation between 1990-91 and 1995-96, which may have come from either crop substitution or utilization of fallow and marginal lands or both. Though, it is not possible to obtain such information from district-level data, some indications come from a shift in cropping pattern and the extent of fallow land (Table 5). Utilization of fallow and marginal lands is expected to be the most important source of area expansion in chickpea.

Table 4. Districtwise chickpea area ('000 ha) during different periods, Andhra Pradesh.

District	1971-75	1981-85	1991-95
Adilabad	5.14	3.00	2.24
Anantapur	2.28	2.64	16.07
Cuddapah	0.90	1.10	7.44
Guntur	5.30	4.70	6.56
Hyderabad	7.70	4.80	4.24
Karimnagar	5.30	1.88	0.96
Khammam	0.86	0.56	0.09
Krishna	1.04	0.38	0.03
Kurnool	5.40	6.38	35.21
Mahabubnagar	4.06	2.64	3.10
Medak	15.82	12.98	14.81
Nalgonda	1.56	1.40	0.76
Nellore	0.12	0.36	2.43
Nizamabad	11.90	6.48	3.64
Srikakulam	0.06	0.38	0.03
Visakhapatnam	0.12	0.16	0.06
Warangal	2.08	1.00	0.91

Crop Substitution

An important source of chickpea area expansion is area released from competitive crops. It has been observed that the area under postrainy-season sorghum and tobacco has been declining (Table 5). Area released from these crops will be shared (though not equally) with other competing crops. The area under postrainy-season sorghum declined in three selected districts and that of tobacco in Anantapur and Kurnool. Some area under postrainy-season sorghum may be substituted with chickpea. Crop substitution may be due to crop competition, made possible by the higher profitability of chickpea compared to postrainy-season sorghum.

Fallow Lands. Another significant source of chickpea area expansion is its cultivation in fallow lands. Most of the crop land in rainfed areas is kept fallow during the postrainy season due to the nonavailability of irrigation water and

Table 5. Sources of chickpea expansion in select districts of Andhra Pradesh.

District	Status of crop area		Status of fallow area
	Sorghum	Tobacco	
Anantapur	Declining	Declining	Declining
Kurnool	Declining	Declining	Declining
Medak	Declining	-	Declining
Andhra Pradesh	Declining	Declining	Declining

other resources, and the low production potential of the soil (marginal lands). Over time, a decrease in the area under postrainy fallow in selected districts has been observed (Table 6). In Kurnool, it declined by 74,000 ha between triennium averages ending 1990-91 and 1994-95. The corresponding figures were 50,000 ha for Anantapur and 32,000 ha for Medak districts. On the other hand, chickpea area in these districts increased. It is believed that a large part of the area of postrainy fallow was used for chickpea cultivation. Between triennium averages ending 1990-91 and 1994-95, chickpea area in Kurnool district increased by 16,000 ha, which was about 22% of the postrainy fallow area which declined during the same period. Similarly, chickpea area between triennium averages ending 1990-91 and 1994-95 increased by 13,000 ha in Anantapur district, which was 26% of the fallow area that declined. In Medak district, chickpea area increased by 5,000 ha, 16% of the decreasing postrainy fallow area between triennium averages ending 1990-91 and 1994-95.

Table 6. Trends in postrainy fallow area ('000 ha) in select districts of Andhra Pradesh.

Year	Anantapur	Kurnool	Medak	Andhra Pradesh
1989	862	570	265	6437
1990	822	562	254	6237
1991	797	511	245	6195
1992	814	514	236	6472
1993	784	534	239	5246
1994	727	401	229	4864
1995	819	486	202	5113

Reasons for Area Expansion

There are two important reasons for expanding chickpea area in the hot and dry climates: rapid increase in chickpea prices and the availability of improved chickpea varieties.

Role of Price

The average farm harvest price of chickpea in the select districts increased by 60% between 1989-90 and 1995-96 (Table 7). On the other hand, the farm harvest price of postrainy-season sorghum during the same period increased by only 45%. The temporal changes in absolute prices between chickpea and postrainy-season sorghum were statistically significant at 1% probability level. Higher prices influenced chickpea area in two ways: chickpea became more competitive compared to postrainy-season sorghum, inducing farmers to release postrainy-season sorghum area for chickpea. Secondly, the low yield levels made chickpea profitable at higher prices. It was estimated that the minimum yield of chickpea required to cover total cost (Rs 700 kg ha^{-1} in 1989-90) fell to 400 kg ha^{-1} due to rise in output prices. This made it possible for farmers to cultivate chickpea on marginal soils with low production potential.

Table 7. Changes in farm harvest prices (Rs t^{-1}) of chickpea and postrainy-season sorghum in Andhra Pradesh.

	Average price of chickpea			Average price of postrainy-season sorghum		
District	1988-90	1993-95	Change (%)	1988-90	1993-95	Change (%)
Anantapur	627	1100	75	220	360	63
Kurnool	680	1030	51	225	340	51
Medak	655	1005	53	255	320	25

Role of Improved Chickpea Varieties

Another very important reason for expansion in chickpea area was the availability of new, improved chickpea varieties. Since 1990, three improved chickpea varieties — ICCC 37, ICCV 2, and ICCC 10 — have been released for cultivation in Andhra Pradesh. These were developed by ICRISAT in collaboration with the national program, such as the Andhra Pradesh Agricultural University (APAU). It was observed that ICCC 37 and ICCV 2 were becoming popular in Andhra Pradesh due to desirable traits such as the ability to overcome major constraints like crop mortality due to terminal drought and low crop yields due to wilt disease. ICCC 37 is a high-yielding variety that matures in 90-100 days, and is resistant to wilt and tolerant to dry root rot (Kumar et al. 1985).

Similarly, ICCV 2 is an extra-short duration variety that matures in 85 days. It is a *kabuli* type resistant to fusarium wilt. It is adapted to normal and late sowing, escapes drought, and its green pods are preferred as vegetable. Early-maturing varieties score in the sense that they avoid terminal drought in comparison to local varieties (e.g., Annigeri) which mature in about 140 days. In 1989, the Government of Andhra Pradesh released ICCC 37 and ICCV 2 for general cultivation.

Adoption of Improved Chickpea Varieties

Based on the on-farm survey, the area under improved varieties was estimated in select districts of Andhra Pradesh (Table 8). About 30% of the sample farmers had sown improved chickpea varieties in 1994-95. Among these, the popularity of ICCC 37 grew in Medak and Anantapur districts, while ICCV 2 was more popular in Kurnool district. Interestingly, the local high-yielding variety, Annigeri was still the ruling variety in Anantapur and Kurnool districts, covering about 32% and 68% of the chickpea area, respectively.

In Medak district, ICCC 37 adoption reached more than 50% of total chickpea area in 1993-94 and dropped marginally to 48% in 1994-95. In Anantapur district, the area under ICCC 37 was nearly 20% in 1994-95. ICCV 2 experienced consistent increase in adoption, reaching 22% in 1994-95. These varieties were slowly replacing the traditionally-grown ones. At the aggregate level, their share increased from 8% in 1991-92 to 26% in 1994-95. Annigeri and other local varieties were largely replaced by these two varieties in Kurnool and Medak districts. In Anantapur district, both ICCC 37 and Annigeri predominated.

The varying adoption preferences imply that farmers in these regions attach varying levels of importance to the new varieties. For instance in Kurnool district, ICCV 2 was preferred for its ability to escape drought as chickpea here is largely grown in the uplands where moisture recedes rapidly (Kumar et al. 1985). Terminal drought was not the major problem in Anantapur and Medak districts; therefore farmers preferred the high-yielding and wilt-resistant

ICCC 37. In Anantapur district, chickpea was generally grown under a favorable moisture environment, e.g. tank beds. In Medak district, rainfall distribution is such that the crop gets sufficient moisture for vegetative growth and flowering.

The high-yielding trait of the new chickpea varieties and their early maturity induced farmers to sow them in hitherto postrainy fallow lands, and also in marginal areas. Results reveal that the new varieties are spreading very fast in the hot and dry climate. Such a trend will certainly increase farm income. Also, the utilization of fallow land helps control soil erosion and conserve soil moisture.

Table 8. Adoption of improved chickpea varieties in Andhra Pradesh (percentage of total chickpea area).

District	Cultivar	1991-92	1992-93	1993-94	1994-95
Anantapur	Annigeri	24.20	23.15	19.45	32.35
	ICCC 37	5.70	5.15	12.15	19.40
	Local	70.10	71.70	68.40	48.25
Kurnool	Annigeri	86.20	77.40	81.90	67.50
	ICCC 37	0.22	0.20	0.15	0.90
	ICCV 2	4.90	8.40	8.90	22.25
	Other improved	0.60	6.20	0.95	2.00
	Local	8.08	7.80	8.10	7.35
Medak	Annigeri	15.20	7.80	8.10	7.35
	ICCC 37	38.30	49.00	51.45	48.1
	Local	46.50	39.10	33.75	38.05
Andhra Pradesh	Annigeri	74.50	66.20	70.10	57.60
	ICCC 37	4.25	5.50	6.40	8.60
	ICCV 2	4.05	6.85	7.30	17.35
	Other improved	0.60	5.05	0.75	1.55
	Local	16.60	16.40	15.45	15.20

Factors Influencing Area Expansion

Regression analysis was done to identify factors influencing area expansion in chickpea (Table 9). The linear regression equations were found to be best-fit in comparison to log-log and quadratic equations. The variables included in the model explained 93-99% of the variation in determining chickpea area.

Table 9. Results of the regression analysis on factors influencing area expansion of chickpea in Andhra Pradesh.

Variables	Anantapur	Kurnool	Medak
Intercept	137.5403	122.2052	35.1811
Lagged chickpea area	-	-	-0.4499**
			(0.1285)
Chickpea yield	0.0064***	-0.0038	0.0248**
	(0.003)[1]	(0.0071)	(0.0248)
Sorghum yield	-0.0029*	-0.0045	-0.0194***
	(0.0021)	(0.0074)	(0.0028)
Chickpea price	0.0293***	0.0615***	0.0264***
	(0.0071)	(0.0113)	(0.0036)
Sorghum price	0.0276	-0.0047	-0.0273***
	(0.0236)	(0.226)	-0.0042
Chickpea yield risk	0.0067	-0.0528	0.0562*
	(0.0298)	(0.0990)	(0.0201)
Sorghum yield risk	0.1419***	0.2302**	-0.6012***
	(0.0515)	(0.0945)	(0.0676)
Irrigated area	-0.6309*	-0.6260	0.1498*
	(0.4360)	(1.0691)	(0.0801)
Postrainy fallow	-0.1162**	-0.0942	-0.0329
	(0.0518)	(0.0518)	(0.0805)
Presowing rainfall	-0.0061*	-0.0047	0.0132***
	(0.0044)	(0.0109)	(0.0025)
Chickpea HYVs	-4.4211*	20.0504***	5.2733***
	(3.1130)	(7.2910)	(0.7509)
Time	-2.3556***	-3.8707**	-1.5247*
	(0.7965)	(1.7832)	(0.9031)
R^2	0.9343	0.9345	0.9909
Adjusted R^2	0.8826	0.8830	0.9547

[1] Figures in parentheses are the standard errors of the estimated coefficients.

*** Significant at 1% probability level.

** Significant at 5% probability level.

* Significant at 10% probability level.

In Anantapur district, chickpea yield, its price, and postrainy-season sorghum yield instability (represented by CV in yield) positively and significantly influenced chickpea area allocation. On the other hand, the regression coefficients of postrainy-season sorghum yield, irrigated area, and postrainy-season rainfall were negative and significant, indicating that any increase in these variables would *ceteris paribus* result in a decline in chickpea area.

In Kurnool district, chickpea prices, postrainy-season sorghum yield, and the availability of improved chickpea varieties showed a positive response to chickpea area allocation. In Medak district, chickpea yield, its prices, irrigated area, postrainy- season rainfall, and availability of improved chickpea varieties positively and significantly determined chickpea area. The negative regression coefficients of yield, yield risk, and prices of postrainy-season sorghum suggest that any increase in their magnitude would release chickpea area for other crop(s) in Medak district.

It is interesting to note that there was a negative relationship between allocation of area to chickpea and the extent of postrainy fallow in the select districts. This meant that any decline in postrainy fallow would increase chickpea area, *ceteris paribus*. The regression coefficient was significant at 10% probability level in Anantapur district and nonsignificant in Kurnool and Medak. Time trend also showed a negative sign, which implied that chickpea area would have declined if the variables included in the model had remained constant. This shows that in the absence of relatively favorable prices and yield of chickpea compared to competing crop (postrainy-season sorghum), the decline in fallow area would have resulted in decline in chickpea area.

This analysis clearly implies that a supportive policy (favorable prices) and technological change (improved high-yielding and short-duration varieties) are necessary for expansion in chickpea area in regions experiencing hot and dry climate.

Conclusions

Chickpea area has rapidly increased from 1990-91 onwards in regions experiencing a hot and dry climate, and invariably in nontraditional chickpea-growing regions. A large part of the expansion in chickpea area comes from the area released by either postrainy-season sorghum or postrainy-season fallow or both. This was possible due to higher output prices and the availability of improved chickpea varieties that were high yielding, of short duration and disease resistant in comparison to local varieties.

It was found that the area under improved chickpea varieties increased rapidly in the hot and dry regions. Farmers preferred the early-maturing, short-duration chickpea variety ICCV 2 in areas where soil moisture recedes rapidly, and the high-yielding and wilt-resistant variety ICCC 37 in a more favorable moisture regime. Farmers' preferences for specific varieties and adoption patterns are largely influenced by the targeting of improved varieties to suit agroclimatic conditions.

The analysis confirmed that technological breakthrough (yield enhancement, quality improvement, and risk minimization) and policy support (higher prices) are necessary for expanding the area under chickpea in nontraditional areas. A large area under postrainy-season sorghum and postrainy fallow was released for chickpea due to the availability of improved high-yielding varieties and higher output prices. The new scenario (i.e., favorable prices and availability of improved varieties) has witnessed a silent chickpea revolution in nontraditional regions. This must be sustained by ensuring the availability of appropriate seeds of improved varieties.

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