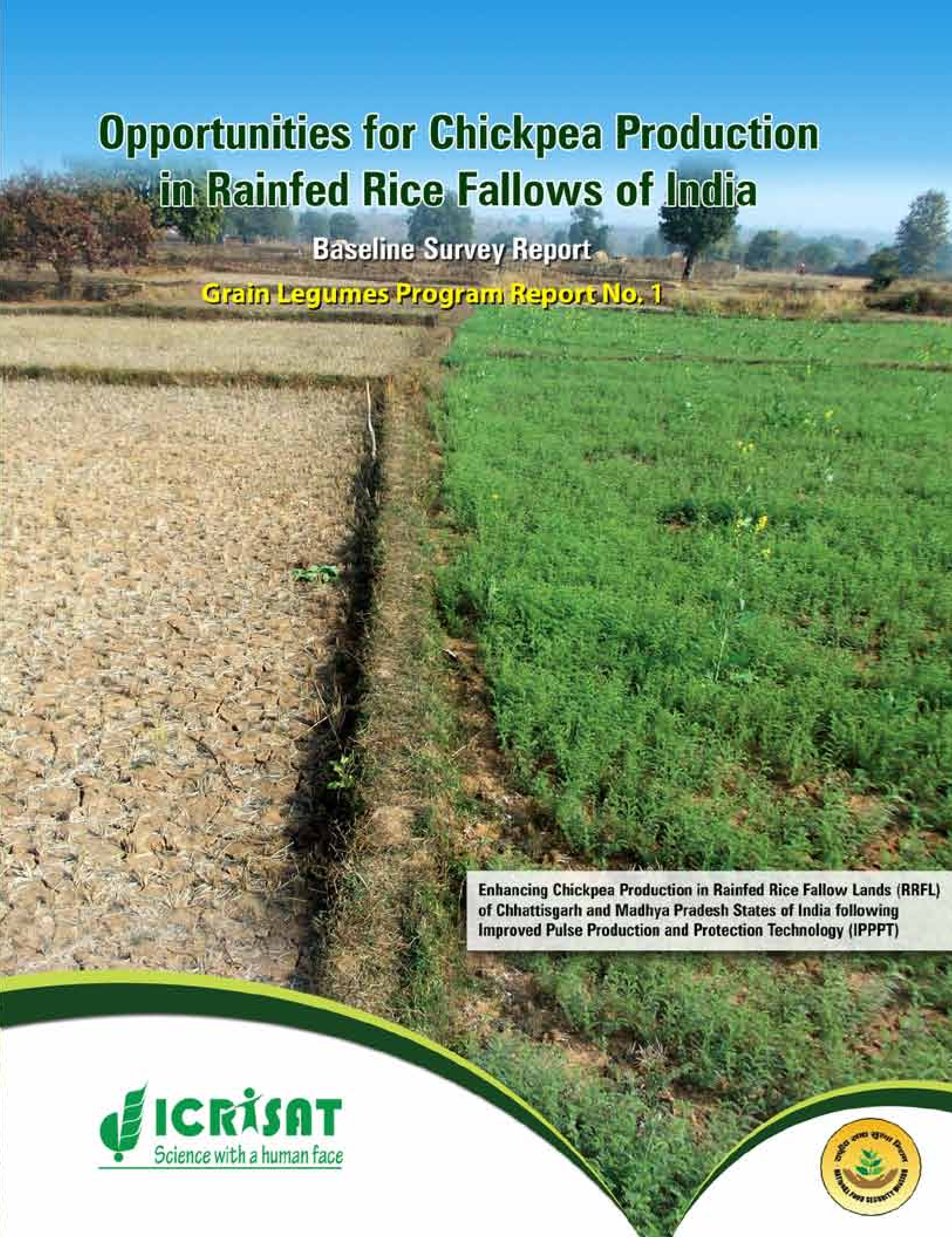
Opportunities for Chickpea Production in Rainfed Rice Fallows of India

Baseline Survey Report

Grain Legumes Program Report No. 1



Enhancing Chickpea Production in Rainfed Rice Fallow Lands (RRFL) of Chhattisgarh and Madhya Pradesh States of India following Improved Pulse Production and Protection Technology (IPPPT)

ICRISAT
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Abstract

The feasibility study on growing chickpea as an economically beneficial crop in the rainfed rice-fallow land (RRFL) of eight selected districts of Madhya Pradesh and Chattisgarh states of India identified several favourable and limiting factors as indicated by hundreds of farmers who were interviewed for this study. These two states hold about 40% of the total 40 million ha RRFL in India and have great potential of introducing chickpea as a rabi crop in the RRFL. The productivity and production of chickpea can be significantly enhanced using the improved pulse production and protection technology (IPPPT) and overcoming some of the major technical, socioeconomic and policy constraints. The major constraints identified include: abiotic stress – drought caused by low and erratic rainfall; biotic stress due to insect-pest and disease attacks; poor crop management practices; lack of awareness of IPPPT – timely availability of quality seed of reasonable price improved cultivars, management methods of pest and diseases; financial credit facilities; poor linkage to market and government support price policies. Creating awareness among farmers of IPPPT and helping overcoming the major constraints through formal and informal support by special projects will go a long way in increasing chickpea production and improving the well-being of resource-poor farmers in RRFL of these states.

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Under NFSM-Pulses supported project

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International Crops Research Institute for the Semi-Arid Tropics
Patancheru 502 324, Andhra Pradesh, India

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Foreword

India is the largest chickpea growing country in the world, accounting for more than 70% of the global production. As the most important pulse crop in India, chickpea plays a significant role in the food and nutrition security of its people. It is the cheapest source of protein and is an inseparable part of the daily diets of every Indian.

In spite of being the world's largest producer, India has to import about 1.5 million tons of chickpea every year to meet its domestic requirements. It is unlikely that the area under chickpea production will ever increase in the irrigated regions of the country. However, there is enormous potential for expanding chickpea production in approximately 12 m ha of rainfed rice fallow lands (RRFL) in central and eastern India. Of this potential 12 m ha, 7.6 m ha of chickpea-growing RRFL areas are in the states of Chhattisgarh and Madhya Pradesh.

In these two states, farmers either leave RRFL without growing a second crop, or grow local, low-yielding varieties of chickpea. Rainfall during the *kharif* season (rainy) in the country's RRFL region is usually more than enough to grow rice. In feasibility studies conducted by ICRISAT and its partners in Chhattisgarh and Madhya Pradesh, *rabi* (postrainy section) cropping of chickpea in RRFL has clearly shown that short-duration, wilt-resistant improved varieties of chickpea ICCV 2, JG 11, JG 315, Vaibhav and others can be expanded following the Improved Pulse Production and Protection Technology (IPPPT).

Efforts must therefore be strengthened to enable farmers in RRFL regions of the states of Chhattisgarh and Madhya Pradesh to have access to newly-developed high yielding varieties and improved management practices for chickpea. Farmers have shown interest in the cultivation of these improved chickpea varieties with IPPPT in rice fallows with adequate residual moisture as a second crop due to their adaptability and profitability in comparison to other crops.

The authors have done a commendable job of compiling information pertaining to the introduction and expansion of chickpea in RRFL in a simple and comprehensive manner. I am confident that this report will serve as an important reference to researchers, extension workers and farmers on the constraints and opportunities for chickpea cultivation in RRFL, and a useful guide to policy makers in providing policy support to chickpea introduction in India's RRFL as well as in similar environments in other SAT regions of the world.

William D Dar
Director General, ICRISAT

Executive Summary

The study explored opportunities and constraints of chickpea production by introducing it as a second crop in rainfed rice-fallow lands (RRFL) of Madhya Pradesh and Chattisgarh states of India. About 12 million ha of rainfed rice lands in India remains uncultivated in the postrainy season (*rabi*), of which 40% lies in Madhya Pradesh and Chhattisgarh. The RRFL offers significant opportunities for the intensification of agricultural production in these states. Chickpea is one of the important pulses that can be successfully grown in RRFL on residual moisture, and can escape terminal drought. It provides sufficient scope for augmenting employment opportunities and income of the farming community. Inadequate irrigation facilities coupled with low residual soil moisture is the main limiting factor to utilization of RRFL for crop production in *rabi*. Drought alone may reduce crop yield by 50%. A quantum jump in productivity can be achieved by applying life-saving irrigation especially in *rabi* pulses grown on residual moisture. Extraction and use of ground and surface water for irrigation is difficult and costly. Private investment in irrigation has its limitations because most of the farmers are resource-poor and practice subsistence farming. The creation of public irrigation infrastructure also requires huge investment and social cost. The lack of basic infrastructure to promote agriculture is another important constraint. Value addition in agriculture is low due to lack of primary agro-processing facilities and agricultural markets in the villages. Agricultural markets are generally far from the villages. The average distance of the markets from the selected villages varied from 10 to 27 km in Chhattisgarh and 10 to 24 km in Madhya Pradesh. The price of chickpea is another important determinant. About 85 to 98% of the farmers cited the low price of chickpea as an important reason for their reluctance to cultivate the crop. Farmers often are constrained to take any price that is being offered to them because they lack sufficient surplus to influence the market. Moreover, the prices in the local markets keep fluctuating and even remain below the statuary prices due to lack of marketing facilities, such as procurement by the Government agencies, cooperatives etc. Low demand in the local markets is another important reason for the low adoption of chickpea or other *rabi* pulses for production in RRFL. It exists due to the difference between the consumption and production preferences for the pulses in the selected regions. Other pulses are often grown due to the low opportunity costs of the fallow lands.

The level, quality and information flow are some of the important determinants of agricultural production and marketing. Rainfed farming is subject to great risks and uncertainties. However, a majority of farmers lacked pertinent information on various aspects of production and marketing. For seeking advisory and extension services, farmers used to travel at least 16 to 36 km in Chhattisgarh and 12 to 29 km in Madhya Pradesh.

The RRFL of Chhattisgarh and Madhya Pradesh consists of a range of soil types varying from dominant shallow sandy-loam (Entisols) or Mattassi, to heavy textured deep vertisols soils (Kanhar-Dorsa or Kali Matti). Deep vertisols (Kanhar-Dorsa) soil types are more suitable for profitable chickpea cultivation in RRFL. Deep vertisol soils provide a better environment for the root zone and retain moisture for a longer period. However, the problem of low organic matter and humus in the soils of RRFL is common.

The village seed sector, by and large, depends on traditional seeds that have low genetic potential. Self produced seeds of chickpea are commonly used for further production. The seed replacement rates of the non-participating farmers are as low as 6.3% to 13.6%. Non-availability of short-duration varieties of *kharif* rice as well as of chickpea is another serious problem. Most of the existing rice varieties are of long duration (about 130-150 days). This delays the recommended sowing of chickpea from mid-October to early-November after rice harvesting. Late sowing of chickpea often leads to poor seed germination, poor crop stand and suffering from terminal drought.

Farmers expect an R&D system to provide certain plausible solutions to safeguard their interests by providing some short-duration high-yielding varities of rice and chickpea specifically developed to promote *rabi* cropping in RRFL and to escape terminal drought. Non availability of resource-conserving machineries and implements to farmers limits their work efficiency and income. Farmers cannot afford to buy zero-till machines for sowing of seeds of different crops and other farm machines that perform multiple tasks of inter cultivation and sowing.

Most of the cultivated chickpea varieties suffer heavy losses due to attack by insect pests, diseases, animals and birds. Insects such as *Helicoverpa* (pod borer) and leaf miner cause substantial economic losses in standing chickpea crops, whereas seed beetles and bruchids inflict huge storage losses. Dry root rot, Fusarium wilt, and collar rot are some of the important diseases prevalent in RRFL. Heavy incidence of Fusarium wilt and dry root rot was reported by many farmers in both the states. Short duration chickpea varieties with multiple resistance to important insects and diseases may be helpful in the expansion of chickpea in RRFL. In addition, there is a need to develop some economical and effective management practices to minimize the losses due to insect-pests and diseases. Wild animals, such as *neelgai* (blue bull) and monkeys have emerged as potential threats in the region and cause heavy economic losses. Hunting of these animals is banned under the provisions of India's wildlife protection act. Appropriate policy reforms and institutional support are essential to tackle these problems. To some extent this problem can be addressed by increasing area under the crop, as has been done by the soybean growers to manage the grazing problem. Collective or community farming may be one of the options to bring in more area under chickpea cultivation in the RRFL of Chhattisgarh and Madhya Pradesh. Further, rehabilitation of natural habitats of these animals and massive forestation programs would mitigate these losses.

The most serious problem is non-availability of quality seeds in desired quantity (Bantilan and Parthasarathy 1998) at appropriate time at reasonable cost. More than 90% farmers viewed this as the prime reasons for a large area that remain fallow in *rabi*. Also, non-availability of seed of improved varieties compels the farmers to buy the locally available seed of low-yielding traditional varieties. This affects the seed replacement rate and leads to increased incidence of some seed-borne diseases and reoccurrences of insect-pests in the region. Strengthening village seed system is imperative. Increasing the supply of seed will require integrating farmers in the seed supply chain. Large scale seed production on the farmers' fields will increase the availability of improved seeds and also bring down the prices of the seeds in the region. Private sector R&D organizations and marketing firms can also find huge opportunities in the production and marketing of improved varieties of chickpea seeds by supporting farmers to grow chickpea in the RRFL. Despite low use of fertilizers in chickpea, farmers face difficulties in the acquisition of fertilizers at reasonable prices. There is need to maintain and monitor the supply of other inputs such as pesticides and fertilizers.

Rice-chickpea rotation yields net returns worth Rs. 14,125 ha^{-1} in Chhattisgarh and Rs 9,985 ha^{-1} in Madhya Pradesh. The benefit/cost ratio in rice-chickpea rotation is 1.75 in Chhattisgarh to 2.10 in Madhya Pradesh. The existing local varieties, cultivated in RRFLs of Chhattisgarh and

Madhya Pradesh can provide an additional return of Rs 9,300 ha^{-1}. Chickpea production in RRFL generates an average employment of approximately 48 man days ha^{-1}. Farmers need assured market linkages for their produce. Establishment of several farmers' societies, cooperatives and *mandis* among the clusters of villages would provide this linkage. Strengthening of the public procurement system can also play a vital role, while the private sector can harness the opportunity by establishing pulse processing units and integrating the pulse producers. The production risk in chickpea production could be mitigated by extending crop insurance coverage and buy back guarantees.

Production of chickpea in RRFL is economically viable and technically feasible. Chickpea productivity and production in RRFL can be significantly enhanced using the Improved Pulse Production and Protection Technology (IPPPT). This offers one of the most feasible options for improving the economic status of the poor farmers in the region. It can be produced at low cost with greater economic benefits. Extended project support for another 2-3 years is essential to establish the faith of the farmers in realizing the benefit of IPPPT in chickpea production in the regions.

1. Introduction

Though, India has successfully sailed through the turbulent phase of hunger and famine of 1950s and 1960s by adopting yield-enhancing bio-chemical technologies, overcoming hunger and malnutrition remains one of the major developmental challenges of the country. India ranks 67 in the Global Hunger Index (GHI) (Grebmer et al. 2010). The GHI incorporates three interlinked hunger-related indicators – the proportion of undernourished in the total population, the prevalence of underweight in children and the mortality rate of child due to malnutrition in the world. India houses a large number of the world's undernourished children. In 2005-06, about 44% of children under the age of five were underweight and the proportion of stunted children in the same age group was 48% (WHO 2010). These numbers apparently indicate that 42% of the world's underweight children and 31% of the stunted children reside in India (UNICEF 2009). Widespread protein deficiency is one of the most worrisome problems. The current intake of protein in India is only 57g day^{-1} $person^{-1}$, which is expected to decline further as per the existing trends. Both the central and state governments are aware of the severity of malnutrition. They are targeting their efforts and investments to ensure food and nutritional security by improving food supplies to vulnerable groups through a variety of social welfare schemes such as subsidized grain supply under the Public Distribution System (PDS), provision of mid-day meals in schools, and the like.

However, supply-side constraints pose a serious threat to ensuring consistent food supplies, especially of high-protein pulses. Agricultural land is fixed and the scope to bring additional area under cultivation is limited because of increasing demand for land for non-agricultural activities. The only opportunities to increase food grain production are by increasing cropping intensity and/or growing more than one crop in a year on the same piece of land. The rainfed rice-fallow lands (RRFL) offers some scope to address the twin problems of food and nutrition insecurities (Joshi et al. 2002). About 12 million ha of rainfed rice land remains uncultivated in the postrainy season (*rabi*). It has been mentioned that if the existing rice-fallow lands were brought under cultivation, it may usher another green revolution in the predominantly rice-fallow states, benefiting millions of small landholders (Joshi et al. 2002). However, a number of technical, institutional, socioeconomic and ecological factors limit growing of a second crop after rice in RRFL. Many of the available rainfed production technologies have either not been transferred appropriately or failed to cater to the needs of the farmers. Financial institutions are reluctant to finance rainfed agriculture. These factors affect the cropping systems, but lack of irrigation is the main limiting factor to RRFL productivity of r*abi* crops. Extraction and use of ground and surface water for irrigation is difficult and costly. Creation of public irrigation infrastructure involves a huge investment and social cost. Private investment in irrigation has its own limitations.

Introduction of crops that can escape terminal drought is one of the plausible options to harness the potential opportunities in RRFL. Pulses are water-efficient crops and are known for their drought tolerance. These complement cereals in both production and consumption. Pulses improve soil fertility, require less water in comparison to cereals, and improve moisture-holding capacity of the soils. The nutritional benefits of pulses are enormous. Most pulses contain 18-25% protein and comprise one of the cheapest sources of protein.

Pulses are a regular diet in India. Unfortunately per capita availability of pulses has been declining continuously, from 62g in 1990 to 55g in 2008/09. Most of the times their demand had exceeded the domestic production and the additional demand was met through imports. In the last five years, India on an average has imported about 2 million tons of pulses a year. On the other hand, growth in production was not encouraging between 1990 and 2008; total pulses production grew at an annual rate of 0.6% from 12.02 million tons to 14.2 million tons. The demand for pulses is expected to grow further. Kadakia and Jacob (2009) estimated that in order to overcome protein deficiency through pulses alone India will require 38 million tons of pulses in 2017-18; and to produce this quantity domestically it would be essential to either double its area at current yield levels or double the productivity keeping the acreage constant. The area under pulses is unlikely to increase in the irrigated areas. Thus, the focus should be on improving yields and increasing area wherever possible, such as RRFL.

Chickpea is one of the most important pulses that can be successfully grown in RRFL on residual moisture and escape terminal drought. Evidence indicates that pulses can be grown in a cost-efficient manner because of their low input requirements (Joshi et al. 2002). It would also augment employment opportunities and income of the farming community.

This study focuses on an analysis of opportunities and constraints of chickpea production in RRFL in the states of Chhattisgarh and Madhya Pradesh, which together share 40% of the total rice-fallow lands of India. The specific objectives of the study are to: (i) identify technical and socioeconomic constraints to chickpea production in RRFL and (ii) explore opportunities for intensification of chickpea production in RRFL.

Distribution of Rainfed Rice Fallow Lands (RRFL)

Approximately 12 million ha of the 40 million ha rice area cultivated during the rainy season (*kharif*) remains uncultivated in the *rabi*. Of the total rice fallow area, close to 40% lies in the states of Madhya Pradesh and Chhattisgarh (Table 1, Figure 1), with former having a larger share. In absolute terms, these states control 4.7 million ha of RRFL, which is about half of the country's total chickpea area. The extent of *rabi* rice-fallow area in these states, based on satellite image data, is as high as 82% in Chhattisgarh and 87% in Madhya Pradesh. Together, the RRFL in these two states accounts for about 84% of the total *kharif* rice area. It implies that only 16% of the *kharif* rice area is utilized for cultivation of *rabi* crops and the rest of the land remains fallow.

It is a common practice for farmers to either leave the rice area vacant in the *rabi* after harvest of rice or to cultivate traditional low-yielding varieties of chickpea without paying heed to its potential use. Rainfall during the *kharif* in the RRFL of the country is usually more than enough to grow rice. Hence, there is tremendous opportunity for cultivation of a second crop on available soil moisture after harvest of rice (with a few agronomical manipulations). Lack of irrigation facilities is the main impediment to production of another crop in the RRFL.

Chickpea is one of the crops that have better tolerance to moisture stress. Recent feasibility studies conducted by ICRISAT and its partners in ICAR and State Department of Agriculture (DoA) on the *rabi* cropping of chickpea in RRFL at a few selected locations in Chhattisgarh and Madhya Pradesh, have clearly shown that short-duration wilt-resistant improved varieties of chickpea can be successfully expanded following Improved Pulse Production and Protection Technology (IPPPT).

Table 1. State-wise estimates of rainfed rice fallow area in India (1999-2000).

State	Kharif-Rice Area ('000 ha)	Rabi-Fallow (RRFL) ('000 ha)	RRFL as % of Kharif-Rice Area	% of RRFL in India
Chhattisgarh	3,584	2,936	81.92	25.0
Madhya Pradesh	2,012	1,753	87.12	14.7
Bihar	5,974	2,196	36.8	18.9
West Bengal	4,617	1,719	37.2	14.8
Assam	2,234	539	24.1	4.6
Uttar Pradesh	6,255	353	5.6	3.0
Others	15,508	2,463	15.9	21.0
Total	40,184	11,652	29.0	100.0

Source: *Subarao et al. 2001*.

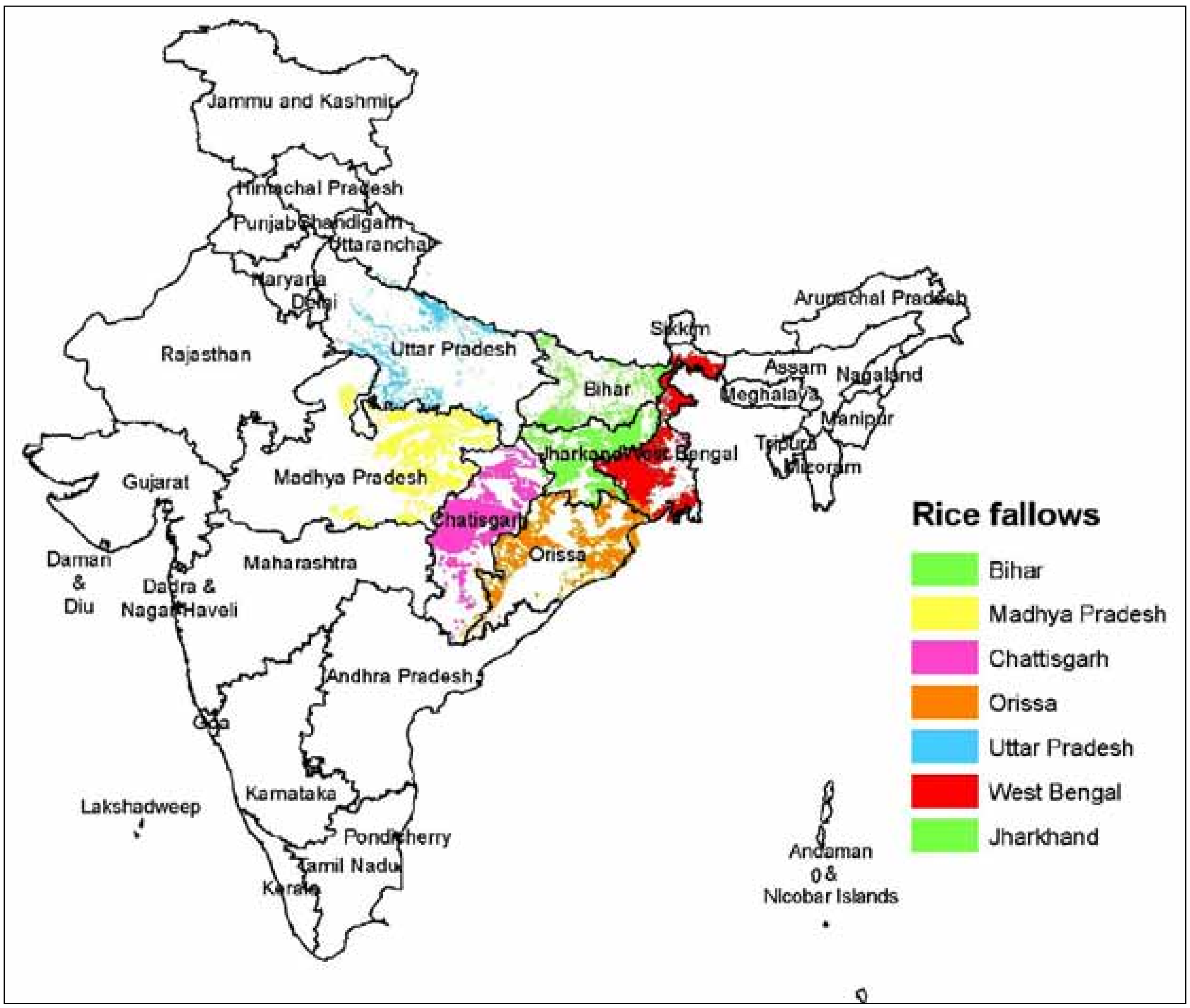


Figure 1. Potential rainfed rice fallows where pulse cultivation could be introduced in central and eastern India.

2. Methodology

2.1 Locale

The study was conducted in the selected villages of the pilot districts in the states of Chhattisgarh and Madhya Pradesh in India. These two states have 28 RRFL districts, of which 8 are in Chhattisgarh and 20 in Madhya Pradesh (Table 2).

Table 2. Estimated rainfed rice-fallow area based on satellite image analysis and selected project districts/blocks/villages in Chhattisgarh and Madhya Pradesh.

State	Rice-fallow area (000 ha)	Rice fallow districts (no.)	Selected RRFL districts for IPPPT	Number of selected blocks	Number of selected villages
Chhattisgarh	2936	8	Durg, Kabirdham, Raipur and Rajnandgaon	5	23
Madhya Pradesh	1753	20	Rewa, Satna, Jabalpur and Damoh	9	41
Total	4689	28	8	14	64

The selected pilot districts in Chhattisgarh were Durg, Kabirdham, Raipur and Rajnandgaon Rewa, Satna, Jabalpur and Damoh in Madhya Pradesh (Figure 2) and elicit information on different production parameters and socioeconomic indicators pertaining to chickpea production in RRFL. Selection of the pilot districts and the villages was based primarily on the basis of the on-going trials in the area.

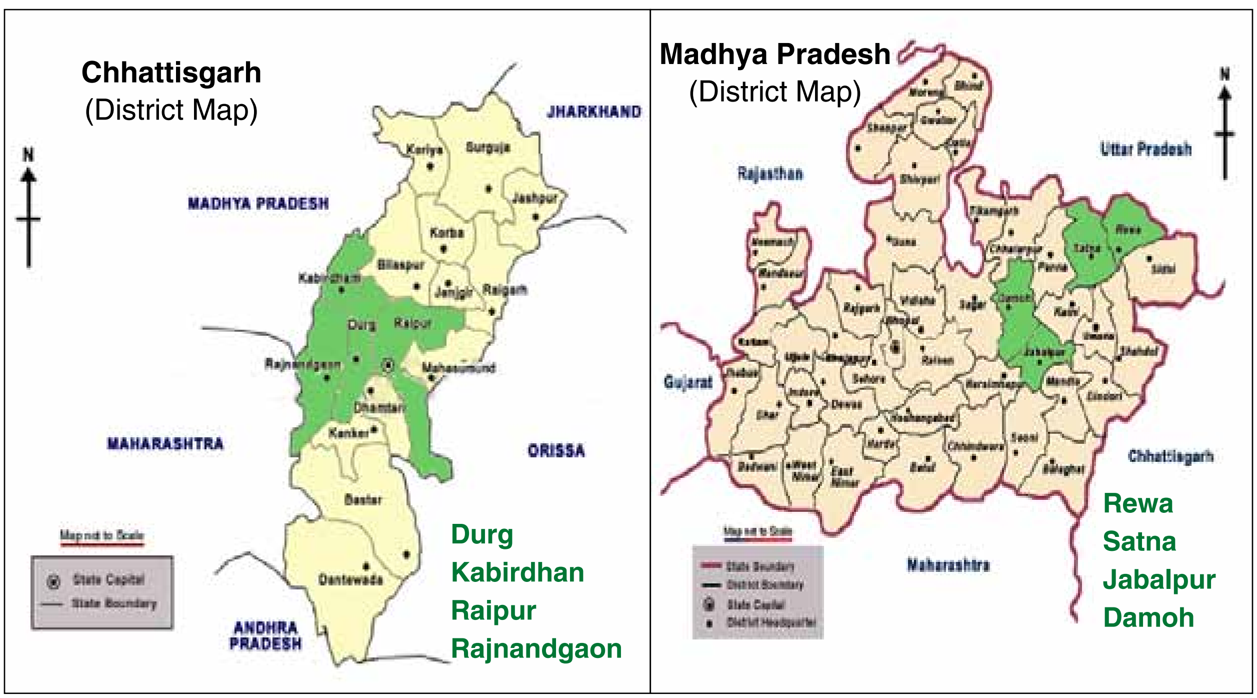


Figure 2. Pilot districts of Chhattisgarh and Madhya Pradesh for promotion and expansion of IPPPT in RRFL.

2.2 Sample

The study was conducted in 64 villages (Appendix 1), 23 in Chhattisgarh and 41 in Madhya Pradesh, where participatory research trials were undertaken by ICRISAT and its partners to enhance chickpea production in RRFL by introducing IPPPT. Requisite data were elicited from the selected participating and non-participating farmers with the help of especially designed baseline data record sheets 1-4 (Appendix 2) focusing on pertinent information required to identify opportunities and constraints regarding chickpea production in the selected RRFL districts. A total of 174 IPPPT farmers and 106 non-IPPPT farmers from the selected villages in Chhattisgarh and Madhya Pradesh were randomly selected, interviewed and the information obtained was recorded in the baseline data record sheets (Figure 3). The number of selected farmers in each state was in proportion to the number of districts in these states. The final sample contained 51 participating farmers and 38 non-participating farmers from 24 villages in 4 pilot districts of Chhattisgarh, and 123 participating farmers and 68 non-participating farmers from 40 villages in 4 pilot districts of Madhya Pradesh. Additionally, several group meetings were also conducted in each of the project villages in both the states.

Figure 3. Participatory rural appraisal-baseline data collection.

2.3 Data

Information on perceptions about the constraints and opportunities of chickpea production in RRFL were obtained from the selected farmers by conducting field survey in the selected villages of the two states. The selected farmers were interviewed and the elicited information was recorded in the specially designed baseline data record-sheets. The information pertaining to constraints to chickpea production including agro-ecology, crop management, infrastructure, marketing, production and price risk, institutional supports and farm resources along with possibilities of chickpea production in RRFL were obtained. Farmers' perception about input

Figure 4. Farmers orientaion.

and advisory services, local demand for pulses, their willingness to continue with chickpea in RRFL and willingness of non-IPPPT farmers to grow chickpea were sought (Figure 4). Besides, secondary data related to pulse production, demand, supply, trade and prices were also collected and presented to supplement the results of the study.

In order to validate the information, Participatory Rural Appraisal (PRA) was also undertaken in these districts of Chhattisgarh and Madhya Pradesh. The study, therefore, is a blend of information obtained by both the methods.

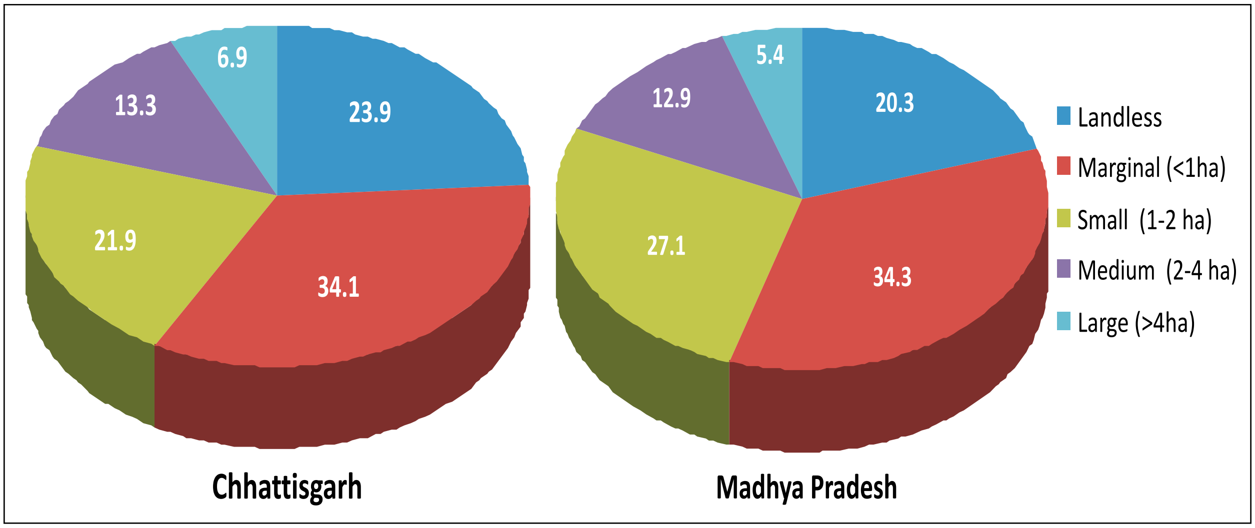
2.4 Data analysis

The information on perceptions of IPPPT farmers and non-IPPPT farmers related to opportunities and constraints of chickpea production in RRFL were carefully scrutinized, and it was found that there was no significant difference between the perceptions of the two respondent groups. It was, therefore, considered appropriate to pool the information. However, some separate results were also presented to show the impact of the IPPPT as and when required.

2.5 Village profiles and household characteristics

Distribution of households based on analysis of sample data obtained from the selected villages in Chhattisgarh and Madhya Pradesh is illustrated in Figure 5. About 23% households in Chhattisgarh and 20% in Madhya Pradesh were landless, implying that about 78-80% households in the selected villages of these two states were farm households who had agricultural lands for crop production.

Among farm households (farmers), the proportion of marginal and small households was more in Madhya Pradesh than in Chhattisgarh (Table 3). About 34.3% and 27.1% households in Madhya Pradesh were marginal and small households, respectively. Chhattisgarh had 34.1% marginal



Source: *ICRISAT Field Survey 2010.*

Figure 5. Distribution of households in selected villages in Chhattisgarh and Madhya Pradesh.

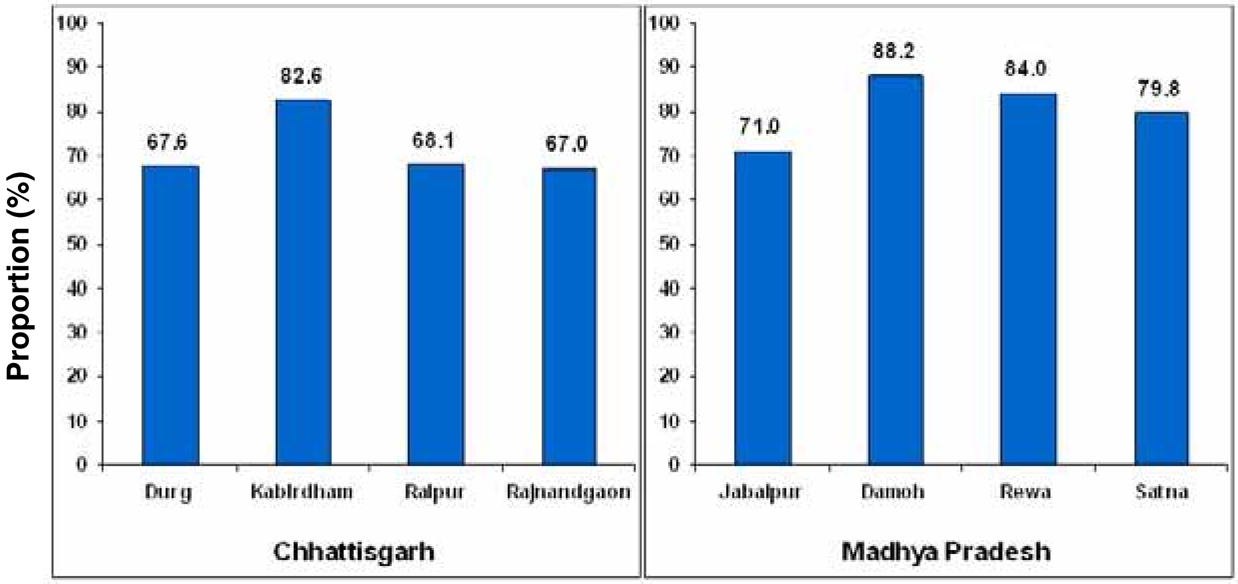
households and 21.9% small households. It is worth noting that the proportions of medium and large farm households in selected villages were more in Chhattisgarh than in Madhya Pradesh. Chhattisgarh had 13.3% and 6.9% medium and large households whereas their proportions were only 12.9% and 5.4%, respectively in Madhya Pradesh.

Table 3. Percentage of different categories of households/farmers in the sample villages of the selected RRFL districts in Chhattisgarh and Madhya Pradesh.

Selected districts/ state	Landless	Marginal (<1ha)	Small (1-2 ha)	Medium (2-4 ha)	Large (>4ha)	Total
Damoh	18.4	51.7	20.3	5.8	3.8	100
Jabalpur	12.3	30.9	28.4	21.0	7.4	100
Rewa	21.7	17.7	37.9	15.9	6.8	100
Satna	28.9	36.7	21.9	9.0	3.4	100
Madhya Pradesh	**20.3**	**34.3**	**27.1**	**12.9**	**5.4**	**100**
Durg	27.5	26.6	22.7	15.7	7.4	100
Kabirdham	22.9	24.2	27.4	15.9	9.5	100
Raipur	22.5	49.2	15.9	8.9	3.5	100
Rajnandgaon	22.6	36.3	21.5	12.7	7.0	100
Chhattisgarh	**23.9**	**34.1**	**21.9**	**13.3**	**6.9**	**100**

Source: *ICRISAT Field Survey 2009-2010 and 2010-11.*

Figure 6 presents proportion of marginal and small farm households in selected districts of Madhya Pradesh and Chhattisgarh. It is obvious that among the farm households the proportions of marginal and small householders dominated in all the districts. In the selected villages of Madhya Pradesh, the proportion of marginal and small farm households varied between 71% in Jabalpur district and 88% in Damoh district.



Source: *ICRISAT Field Survey 2009-2010 and 2010-11.*

Figure 6. Proportion (%) of marginal and small farm households in selected districts in Chhattisgarh and Madhya Pradesh.

The proportion of marginal and small farm households in the selected villages of Chhattisgarh was found in the range of 67% in Rajnandgaon district to 82.6% in Kabirdham district. These facts clearly indicate that small holding agriculture is the key characteristics of these villages. Obviously, a majority of farmers were poor with low-risk bearing ability. Due to low production and high domestic consumption the resource-poor marginal and small farm households fail to generate adequate marketable surplus to have sufficient bargaining power in the markets.

These villages have very poor irrigation coverage (Table 4). The average irrigation in the selected villages of Madhya Pradesh was limited to about 43% of the total cropped area with just 22% in Rewa to 70% in Jabalpur districts. Similarly, the average irrigated area of the selected villages in Chhattisgarh was 42% with villages of Raipur district having more than 51% irrigation while these in Kabirdham district had only 26%.

A number of villages in the pilot districts of Madhya Pradesh and Chhattisgarh have been covered by canal irrigation. But during the PRA, it was reported that the canals did not receive adequate water from their tributaries and thus failed to cater the irrigation requirements of the farmers in several villages. Some of the villages also had state (public) tube wells, but these have their own limitations. Sinking of private tube wells involve huge initial costs. Many of the farmers cannot afford these, and therefore, the level of irrigation is unlikely to increase much in these villages.

Rice is the principal crop cultivated in the *kharif* in all selected villages of the pilot districts in Madhya Pradesh and Chhattisgarh (Table 4). The *kharif* rice area accounts for about 66 to 82% of the cropped area. Farmers cultivate rice during the *kharif* and leave a large chunk of that area fallow in the *rabi* (Figure 7). The average area of RRFL in the selected villages of Madhya Pradesh accounted for about 62% (range 42.9-71.6%), while it was 55% (range 40.6 -68.8%) in Chhattisgarh.

Table 4. Extent of rice-fallow area and irrigated area in the target districts of Chhattisgarh and Madhya Pradesh.

District/state	Kharif rice area as % of cultivated area	Kharif rice area cultivated in postrainy season (%)	Total RRFL (%)	Cropped area irrigated (%)
Durg	76.9	53.6	46.4	47.5
Kabirdham	80.1	31.2	68.8	26.4
Raipur	78.4	59.4	40.6	51.4
Rajnandgaon	81.7	45.7	54.3	48.4
Chhattisgarh	**79.9**	**44.9**	**55.1**	**42.2**
Damoh	71.3	28.4	71.6	41.2
Jabalpur	74.3	57.1	42.9	70.3
Rewa	65.7	41.0	59.0	21.8
Satna	74.1	49.1	50.9	41.9
Madhya Pradesh	**71.0**	**38.2**	**61.8**	**42.7**

Source: *ICRISAT Field Survey 2009-2010 and 2010-11.*

Availability and access to certain critical rural infrastructure is imperative to provide impetus to the whole gamut of agricultural and rural development. Infrastructure plays a catalytic role in the process of transformation of subsistence agriculture into a viable livelihood option. Thus access to convenient and fast transport facilities, efficient information and communication systems, primary education, provision of health services for people and animals and critical agricultural inputs is essential to raise the status of the farmers. The majority of the selected villages in the pilot districts of Chhattisgarh and Madhya Pradesh lack basic infrastructure to promote agriculture (Table 5). Value addition in agriculture is also not happening due to lack of primary agro-processing facilities and agricultural markets in the villages.

Figure 7. Rainfed rice fallow lands.

Table 5. Districts (proportion %) with access to important infrastructure facilities in Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Infrastructure	Durg	Kabirdham	Raipur	Rajnandgaon	Damoh	Jabalpur	Rewa	Satna
Road connectivity	100	90	100	83	86	91	100	89
Railway connectivity	0	0	0	0	14	0	0	11
Post office	0	10	0	17	29	18	29	22
Institutional credit	0	0	0	0	29	9	0	22
Primary School	100	100	100	100	100	90	100	100
Presence of NGOs	0	0	0	50	0	0	0	0
Health center	0	40	33	17	14	9	29	44
Animal health center	0	10	0	0	21	9	14	33
Watershed program	0	10	0	0	7	9	0	11
Agricultural input shops	0	0	20	0	14	0	0	33
Agro- processing units	0	0	0	0	7	0	0	0

Source: ICRISAT Field Survey 2009-2010 and 2010-11.

Agricultural markets are located far away from the villages; the average distance between the market and the village varied from 10 to 27 km in Chhattisgarh and 10 to 24 km in Madhya Pradesh (Table 6). Farmers of the selected villages in Chhattisgarh travel 16 to 36 km to seek advisory and extension services. Similarly, in Madhya Pradesh, farmers travel 12 to 29 km to seek these services. Average distance of the selected villages from the nearest urban center varies from 16 to 24 km in Chhattisgarh and 12 to 24 km in Madhya Pradesh. However, it is a matter of some relief that the villages now have road connectivity and primary schools.

Table 6. Average distance (km) of the selected villages in districts from the nearest center of important amenities.

	Chhattisgarh				Madhya Pradesh			
Particulars	Durg	Kabirdham	Raipur	Rajnandgaon	Damoh	Jabalpur	Rewa	Satna
Urban centre	23.0	23.7	23.0	15.5	11.5	12.7	11.9	23.7
Agricultural market	26.5	23.9	10.3	15.5	11.5	15.6	10.1	24.1
Agriculture extension office	26.5	18.8	36.3	15.3	20.0	15.1	11.9	29.4

Source: ICRISAT Field Survey 2009-2010 and 2010-11.

Average size of landholding of the sample households in the selected villages in Chhattisgarh ranged from 1.6 ha in Kabirdham to 3.4 ha in Durg while in Madhya Pradesh, it ranged from 2.3 ha in Jabalpur to 5.9 ha in Satna (Table 7). It is obvious that the farmers of these states are comparatively better off in terms of size of landholding than the average Indian farmers. The average family size of the selected households in Chhattisgarh ranged from 5.8 in Rajnandgaon to 6.6 in Kabirdham, while it was 4.7 in Jabalpur to 8.4 in Satna in Madhya Pradesh. A majority of the household heads are fairly educated and relatively young. About 62 to 78 % of the household heads in Chhattisgarh and 62 to 67% household heads in Madhya Pradesh are educated. Also, it was observed that the selected households are headed by the members who are in the 40-50 year age range.

Table 7. Socioeconomic characteristics of the selected households in selected districts of Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Characteristics	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Size of land-holding (ha)	3.4	1.6	2.7	2.9	2.3	4.9	5.9	5.3
Family size (no.)	6.25	6.58	6.47	5.83	4.73	6.60	8.36	6.52
Age of household head (years)	47.6	40.3	43.5	45.6	41.4	44.6	49.7	45.5
Education of household head (%)								
Illiterate	25.8	38.2	37.2	21.4	35.2	39.5	36.3	32.8
≤ 5 years	21.8	46.5	18.3	28.4	16.7	14.7	20.1	22.4
6 ≤ 10 years	35.3	7.7	27.8	32.8	25.8	23.3	17.4	32.8
≥ 10 years	17.1	7.6	16.7	17.4	22.3	22.5	26.2	12.0

Source: ICRISAT Field Survey 2009-2010 and 2010-11.

3. Pulses in India: An Overview

Pulses are grown on about 23 million ha with an annual production of 14 million tonnes. It is obvious that since 2000-01, there has been very little change in area and production of pulses (Table 8). The productivity of pulses has also been quite low and fluctuating. There has not been much difference between the area under *rabi* and *kharif* pulses during the first half of this decade, but after that the area under *rabi* pulses has increased from 11.4 in 2004-05 million ha to 12.6 million ha in 2008-09.

Table 8. Season-wise area, production and productivity of pulses in India.

	Kharif			*Rabi*			Total		
Year	Area (million ha)	Prodn (million tons)	Yield (kg/ha)	Area (million ha)	Prodn (million tons)	Yield (kg/ha)	Area (million ha)	Prodn (million tons)	Yield (kg/ha)
2000-01	10.7	4.5	417	9.7	6.6	684	20.4	11.1	544
2001-02	10.7	4.8	453	10.9	8.5	762	21.7	13.4	609
2002-03	10	4.2	417	10.6	7	661	20.5	11.1	543
2003-04	11.7	6.2	528	11.8	8.7	745	23.4	14.9	637
2004-05	11.3	4.7	417	11.4	8.4	735	22.8	13.1	577
2005-06	10.6	4.7	439	11.8	8.5	716	22.4	13.1	585
2006-07	10.7	4.8	449	12.5	9.4	751	23.2	14.2	612
2007-08	11.5	6.4	557	12.1	8.4	709	23.6	14.8	688
2008-09	10.4	5	484	12.6	9.2	726	23.0	14.2	617

Source: Department of Agriculture and Cooperation 2009.

For the last 4-5 years, productivity of pulses has been more or less stagnant (Figures 8 and 9), which has important implications for the R&D systems. In order to make pulse production more attractive and popular, the research system should concentrate on breaking the yield barrier and develop varieties that have better adaptability to rainfed conditions and the marginal lands. Besides, there is a need to develop some affordable and effective production technologies to cater to the needs of the farmers.

During 2001-08, the area under pulses registered a compound annual growth rate of 1.9% with a corresponding growth in production at the rate of 3.4% per annum (Table 9). Chickpea and pigeonpea are the two most preferred pulses in India. During 2001-08, the chickpea area grew at an annual compound growth rate of 4.7%, whereas the same for pigeonpea was 0.9%. Growth rates in chickpea and pigeonpea production were found to be 5.5% and 3.7% per annum, respectively. As far as the over all productivity of pulses is concerned, it appears that growth in pulse productivity is mainly driven by the productivity growth of pigeonpea. However, it is important to consider that the growing season, length and ecosystem of pigeonpea are altogether different from those of chickpea. Chickpea is invariably grown under rainfed *rabi* conditions.

Table 9. Percent compound annual growth rates in area, production and yield of major pulses in India during 2001-08.

Commodity	Area	Production	Yield
Chickpea	4.7	5.51	0.77
Pigeonpea	0.91	3.66	2.74
Other pulses	0.76	1.59	0.82
Total pulses	1.91	3.42	1.65
Total food grains	0.48	2.09	2.82

Source: *Area, production and productivity of principal crops in India (various issues). Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi, India (2009).*

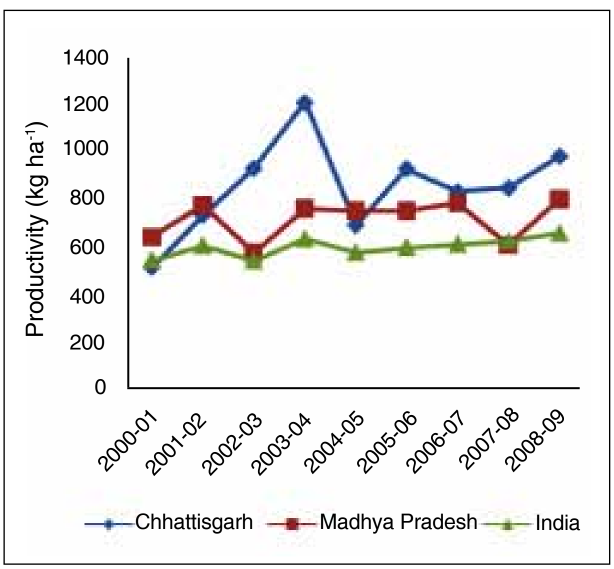


Figure 8. Trends in productivities of total pulses in Chhattisgarh, Madhya Pradesh and India.

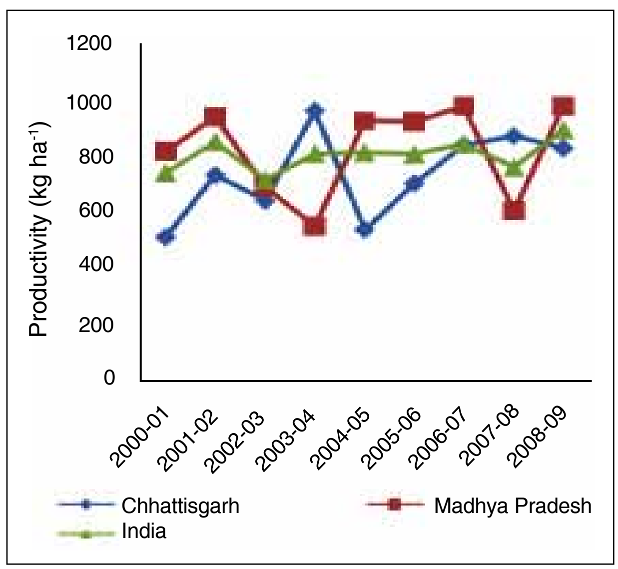


Figure 9. Trends in productivities of chickpea in Chhattisgarh, Madhya Pradesh and India.

4. Chickpea Production in RRFL of Chhattisgarh and Madhya Pradesh

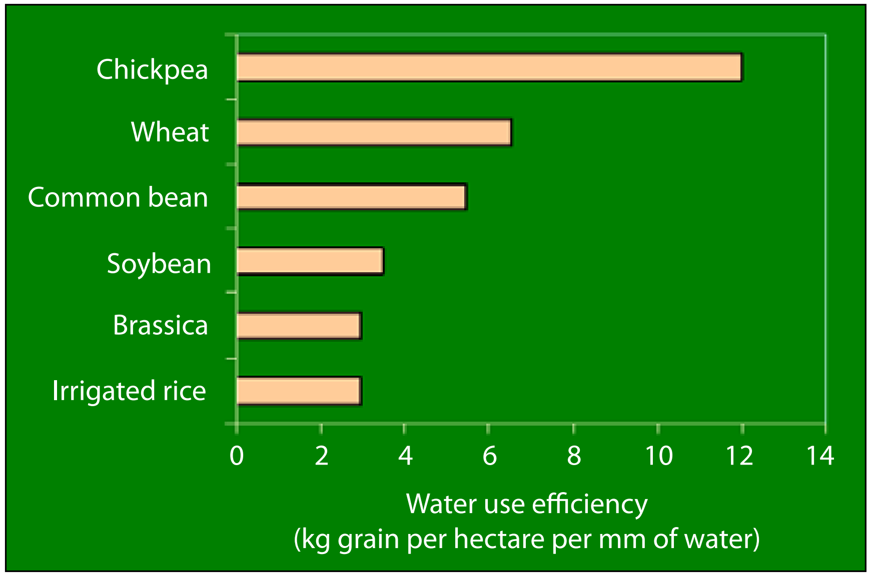


Figure 10. Water use efficiency of pulses.

Pulses provide colossal opportunities for crop diversification and intensification of cropping under rainfed production systems. Evidence indicates that pulses are the most ideal crops that can be successfully cultivated in RRFL (Satyanarayana et al. 1988; Kumar et al. 2000; Joshi et al. 2002). Of the various pulses, chickpea offers the best option for *rabi* cultivation in RRFL. It has better adaptability to moisture stress conditions and can thrive well on residual soil moisture after the harvest of rice (Figure 10). Chickpea, being a leguminous crop, makes better use of atmospheric nitrogen and fixes it in its root nodules, which in turn enriches the soil and reduces requirement of fertilizers by succeeding crops. Its root system also checks soil erosion and improves soil structure.

5. Socioeconomic features

Pulse production is comparatively less capital intensive. Thus, chickpea can easily be incorporated in the cropping system of small and medium farmers who often lack adequate resources. States with rice fallows are inhabited by poor people (Joshi et al. 2002). Chickpea production can help these states in several ways – it can increase employment, enhance income and livelihood conditions, and improve nutritional status of the households. In Chhattisgarh and Madhya Pradesh, where a massive population (about 70 to 80%) depends on agriculture, intensification of chickpea production in RRFL may yield substantial benefits.

Chhattisgarh and Madhya Pradesh occupy about 13.78 million ha and 30.75 million ha of lands that account for about 4.3% and 9.7% of the geographical area of the country, respectively. Together they share about 14% of the geographical area and 11% of the population of India (Table 10). The average population density varies between 154 (Chhatisgarh) and 196 (Madhya Pradesh) km^{-2}, which is almost two-thirds of the national average. Average size of landholding is 1.60 ha in Chhattisgarh and 2.2 ha in Madhya Pradesh, which is substantially more than that of the country's average. But about 76% of the farm households in Chhattisgarh and 65% in Madhya Pradesh are marginal and small, and hold about only 34.3% and 25.8% area against the share of 38.8% area in the country. It implies that the distribution of landholdings in these two states is more skewed in favour of medium and large farmers. What is of greater concern is the existence of about 74% of rural masses that largely depend on agriculture.

Agriculture contributes to about 20% in the GDP of Chhattisgarh and Madhya Pradesh with corresponding per capita incomes of Rs 34,483 in Chhattisgarh and Rs 21,648 Madhya Pradesh. Obviously, the per capita income in these two states is comparable to the national average. However, it is alarming that Chhattisgarh and Madhya Pradesh host about 41% and 38% of the population that lie below-the-poverty line. Creation of desired infrastructure to boost agricultural production is a daunting task and requires a huge investment over a considerably long span of time. As an interim strategy, chickpea production in RRFL offers immediate and ample scope for improving the socioeconomic status of the people in the region.

Table 10. Socioeconomic features of the Chhattisgarh and Madhya Pradesh two major rice-fallow states of India.

Description	Chhattisgarh	Madhya Pradesh	India
Share in geographical area (2001) (%)	4.33	9.67	100
Share in population (2001) (%)	2.02	8.8	100
Population density (2001) (persons km^2)	154	196	313
Rural population (2001) (%)	80.0	73.5	72.20
Literacy rate (2001) (%)	42.9	63.70	64.08
Population below poverty line based on URP-consumption (2004-05) (%)	40.9	38.3	27.5
Average size of land holding (2001) (ha)	1.60	2.22	1.33
Small and marginal farmers (2001) (%)	75.67	65.07	81.80
Per capita income (2008-09) at current price (Rs)	34483	21648	37490
Share of agriculture in GDP (2008-09) (%)	20.0	20.53	16.6

Source: Agriculture Centre for Monitoring Indian Economy, Mumbai, India; Economic Survey (2002), Ministry of Finance, Government of India.

6. Land-use and irrigation

Chhattisgarh and Madhya Pradesh share 4.5% and 10% of the total land use reporting area of the country (Table 11). About 34.5% area of Chhattisgarh is utilized for crop production of which 11.8% is used more than once for cultivation. It has achieved only 134% cropping intensity mainly due to extremely low irrigation intensity. Agriculture is a gamble of monsoon. The state receives about 1337 mm rainfall per annum but about 88% of the rainfall occurs in the monsoon. Madhya Pradesh utilizes more than 40% of its area for agricultural production. The cropping intensity is 139%, which is at par with the national average. The irrigation coverage and the average annual rainfall are also comparatively better in Madhya Pradesh than those of Chhattisgarh.

Table 11. Land use and irrigation in the Chhattisgarh and Madhya Pradesh rice-fallow states in Year 2007-08.

Particulars	Chhattisgarh	Madhya Pradesh	India
Reporting area ('000 ha)	13787	30756	305670
Net cropped area ('000 ha)	4763	14790	140860
Gross cropped area ('000 ha)	5327	20529	195830
Gross irrigated area ('000 ha)	1154	6567	87260
Cropping intensity (%)	134	139	139
Irrigation intensity (%)	23	43	45
Average annual rainfall (mm)	1337	1405	1200

Source: *Area, production and productivity of principal crops in India (various issues). Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi, India.*

However, the amount of rainfall received during *rabi* is low and erratic. Table 12 presents the percentage of irrigated area under different crops in Chhattisgarh and Madhya Pradesh for the year 2005-06. It is obvious that coverage of irrigation was limited to about 24% of the gross cropped area in Chhattisgarh and about 30% area in Madhya Pradesh. This implies that about two-thirds area of the gross cropped area in Chhattisgarh and Madhya Pradesh were rainfed.

Table 12. Percent irrigated area under various crops in the Chhattisgarh and Madhya Pradesh states in India in 2005-06.

Crops	Chhattisgarh	Madhya Pradesh	All India
Rice	30.34	13.64	55.98
Sorghum	0.32	0.12	9.03
Pearl millet	-	0.08	8.93
Maize	4.03	1.94	21.06
Wheat	62.90	78.34	89.55
Barley	1.11	44.36	68.25
Total cereals	**28.76**	**43.22**	**52.27**
Chickpea	16.23	47.50	31.10
Pigeonpea	-	1.20	4.17
Total pulses	**4.66**	**33.49**	**14.99**
Total food grains	**24.26**	**39.67**	**45.45**
Sugarcane	90.73	99.77	92.49
Groundnut	14.94	8.98	19.55
Rapeseed & mustard	7.27	50.16	72.10
Soybean	0.59	0.50	1.70
Sunflower	96.82	60.66	24.93
Total oilseeds	**5.48**	**7.67**	**28.02**
Cotton	75.40	36.43	36.05
Tobacco	89.66	73.58	40.90
Total area under all crops	**23.94**	**29.98**	**42.86**

Source: *Department of Agriculture and Cooperation, Economics and Statistics, Ministry of Agriculture Government of India," Land use Statistics at a glance" 1999-2009.*

Of the total cropped area about 29% of total cereals in Chhattisgarh and 43% in Madhya Pradesh were irrigated. For pulses only 5% of the area was irrigated in Chhattisgarh and 33.5% in Madhya Pradesh. These numbers indicate that the residual moisture in the field after the harvest of *kharif* crops plays a deciding role for the *rabi* crop production.

Rice, wheat, coarse cereals, chickpea, and oilseeds are some of the important crops that are cultivated in Chhattisgarh. Table 13 presents percentage distribution of areas under different crops in Chhattisgarh and Madhya Pradesh. Rice occupied 3.72 million ha (about 65%) in Chhattisgarh followed by 0.91 million ha of pulses and 0.32 million ha of oilseeds. Madhya Pradesh had 1.66 million ha under rice, 4.11 million ha under pulses and 6.09 million ha under oilseeds. Soybean has emerged as the main *kharif* crop in Madhya Pradesh covering 4.77 million ha and wheat is the primary *rabi* crop occupying 3.99 million ha. The area under pulses accounted for 4.11 million ha, of which the share of chickpea was 55%. Apart from these other crops such as pigeonpea (mainly on bunds), lentils, other pulses, vegetables and minor millets are also cultivated in the *kharif*. In the *rabi* wheat, mustard, field pea, and vegetables are grown in the irrigated fields. Chickpea and green gram (mungbean) are mainly grown in rainfed lands.

Table 13. Major crops grown in Chhattisgarh and Madhya Pradesh (2007-08).

	Area in million ha		
Crop	Chhattisgarh	Madhya Pradesh	India
Rice	3.72	1.66	43.81
Wheat	0.10	3.99	27.91
Coarse cereals	0.33	2.02	28.71
Pulses	0.91	4.11	23.19
Chickpea	0.21	2.46	7.49
Pigeonpea	0.05	0.32	3.56
Lentil	0.04	0.52	2.00
Oilseeds	0.32	6.09	26.51
Rapeseed & mustard	0.13	0.69	6.79
Soybean	0.01	4.76	8.33
Total cropped area	5.75	19.89	192.8

Source: Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi, India (2009).

7. Contribution to pulse production

The contributions of Chhattisgarh and Madhya Pradesh in the area and production of total pulses as well as in the chickpea area and production in the country for 2007-08 are presented in Figures 11 to 14.

These states together occupy about a quarter of the total pulse area of the country and contribute equally to the production. In chickpea, these states occupy about 39% area and contribute about 32% of the total chickpea production in the country. However, between the two states, Madhya Pradesh has the larger share of area and production. The two states together offer tremendous pulse production potential and possibilities as these provide better and viable options under rainfed conditions. With suitable production technologies and concerted R&D support, these states can leap forward as the bowl of pulses in the country.

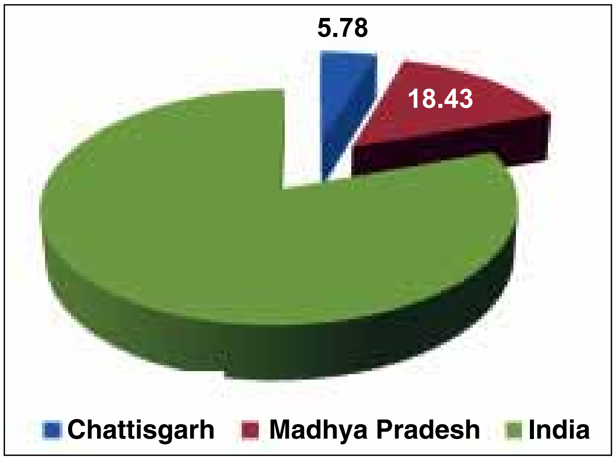


Figure 11. Share (%) of Chhattisgarh and Madhya Pradesh states in total pulse area in India in 2007-08.

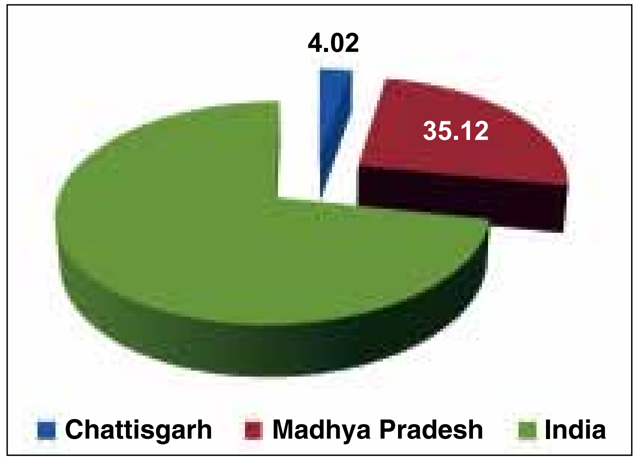


Figure 12. Share (%) of Chhattisgarh and Madhya Pradesh states in total chickpea area in India in 2007-08.

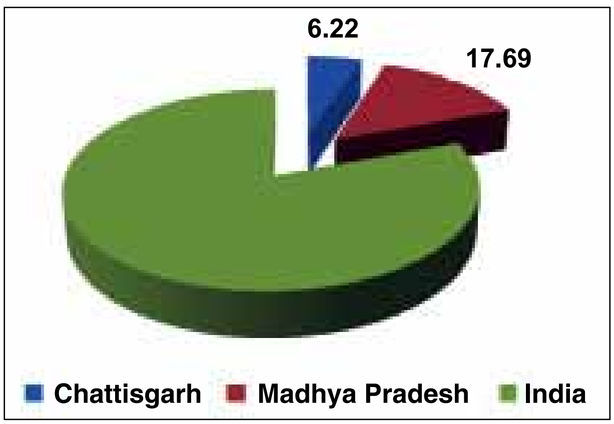


Figure 13. Share (%) of Chhattisgarh and Madhya Pradesh states in production of total pulses in India in 2007-08.

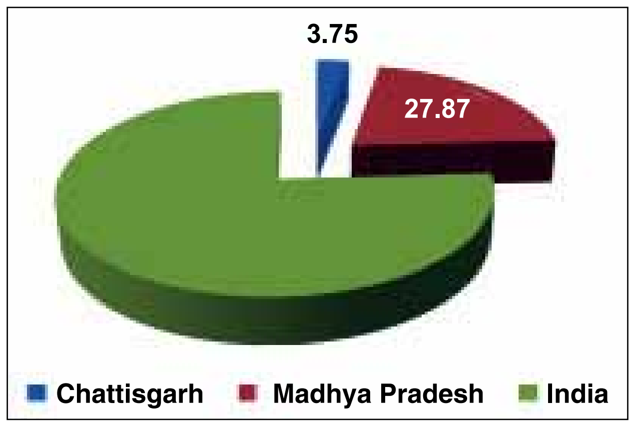


Figure 14. Share (%) of Chhattisgarh and Madhya Pradesh states in production of total chickpea in India in 2007-08.

8. Constraints to chickpea production in RRFL

There is a tremendous scope for the production of pulses in RRFL, but the potentials of pulses have not been exploited to their fullest extent. Except for Madhya Pradesh and Chhattisgarh, there has been a significant decline in the area and production of chickpea in the other RRFL states – Bihar, Orissa, and West Bengal in recent years (Joshi et al. 2002). This section identifies some of the critical constraints to expansion of area, production and productivity of chickpea in the RRFL of Chhattisgarh and Madhya Pradesh.

8.1 Technical Constraints

The production of chickpea in RRFL is affected by a number of technical constraints, which cause serious pre- and post-harvest losses in chickpea. The technical constraints are mainly abiotic and biotic in nature. The consequences of there constraints are discussed in the subsequent paragraphs.

8.1.1 Abiotic constraints

A number of abiotic factors limit the utilization of RRFL for *rabi* production (Table 14). As discussed in earlier sections, water is the most critical constraint to production in the RRFL. Adequate soil moisture is required for seed germination, crop establishment, efficient conversion of soil nutrients to induce proper crop growth and grain filling. Low moisture content in the soil after rice harvest, low and depleting water table due to exploitation of ground water for production of crops such as wheat, mustard and vegetable, and terminal drought towards flowering and harvest stages limit the crop productivity.

Table 14. Percentage of farmers reporting water and soil related abiotic constraints to *rabi* cropping in rice fallows in selected districts of Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Constraint	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Low moisture content in soil	75	70	100	67	82	57	44	50
Low water table	25	30	33	50	27	34	21	37
Terminal drought	92	84	95	87	90	81	98	93
Soil hardness after rice puddling	89	78	72	67	82	86	89	43
Low organic matter content	63	52	78	54	49	58	61	64
Soil cracking	97	90	85	83	91	87	78	84
Soil salinity	-	10	-	-	9	-	-	-
Soil type	25	30	33	50	27	14	11	7

Source: *ICRISAT Field Survey 2009-10 and 2010-11.*

Lack of irrigation coupled with low residual soil moisture in RRFL is the main factor for prevalence of fallow during the *rabi* in the RRFL. The terrain is such that during the *kharif* water tables are raised high, but as the monsoon rains cease, the water tables recede swiftly. The water table at many places is beyond accessible limits, and a tube well becomes successful only after repeated drilling at different locations or plots. This makes investment in irrigation costly. Because of high initial cost, most farmers cannot afford to sink private tube wells in their fields. Post-monsoon rainfall is uncertain and sparse. A drought-like condition during advanced stages of the *rabi* crops adversely affects the productivity and sometimes also leads to crop failure.

Drought alone may reduce seed yields by 50% in the tropics. A quantum jump in productivity can be achieved by applying life-saving irrigation, especially in *rabi* pulses grown on residual moisture.

Other problems viewed seriously by the farmers were the quality, texture and type of soils having a significant bearing on pulse production. The RRFL of Chhattisgarh and Madhya Pradesh consists of a range of soil types. The RRFL here is dominated by shallow sandy-loam soils (Entisols), locally known as *Mattassi* in Chhattisgarh, and heavy texture deep vertisols, known as *Kanhar-Dorsa* in Chhattisgarh and *Kali Matti* in Madhya Pradesh. Deep vertisol (*Kanhar-Dorsa*) soil types are more suitable for profitable chickpea cultivation in RRFL. In *Mattassi*, cultivation of chickpea or any other pulses is difficult with limited irrigation because of their poor moisture-holding capacity. Deep Vertisols create better environments for the root zone and retain moisture for a longer period. However, deep Vertisols have their own limitations.

A very high proportion of the farmers perceived the problem of soil cracking as one of the most serious constraints. Deep vertisol soils become hard and compact after puddling. Under prolonged moisture stress conditions these soils develop cracks that facilitate rapid escape of available moisture from the field and proves fatal for the standing *rabi* crops. Low organic matter content and humus in the soils of RRFL is another constraint worth noting. The number of draft animals has reduced drastically over the years. Even the rearing of milch animals for dairy production is facing difficult challenges. Cow dung is one the major sources of soil organic matter and the availability of dung is unlikely to increase in future. The other soil related constraints are development of soil salinity, particularly in some of the canal-irrigated areas. However, this problem was quite sporadic and confined to some fields of villages of Kabirdham district in Chhattisgarh and Jabalpur district in Madhya Pradesh.

8.1.2 Biotic constraints

Apart from abiotic constraints, chickpea production is hampered by a number of biotic constraints. Most of the cultivated chickpea varieties are prone to heavy losses due to attack by insect pests, diseases, animals and birds. Evidence indicates that pulses are the most susceptible to damage by insects (Deshpande and Singh 2001).

Chickpea cultivation suffers substantial production as well as post-production losses. *Helicoverpa* (pod borer) and leaf miner are the two insects of significant economic importance for the standing crop. Among insects, *Helicoverpa* causes significant economic loss (Table 15). Leaf miner is another insect that causes substantial damage to chickpea. Besides these, chickpea also suffers huge storage losses due to bruchids if stored for a long period without taking adequate preventative measures.

Table 15. Percentage of farmers reporting severe pest problems of chickpea in selected districts of Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Constraints	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Insects								
Pod borer (*Helicoverpa*)	62	82	67	70	75	71	67	83
Leaf miner	12	19	16	21	9	18	16	11
Bruchid	67	50	62	71	69	53	41	33
Diseases								
Dry root rot Wilt/collar rot	51	63	44	57	61	57	53	61
Animals & birds	25	30	98	40	48	60	79	57

Source: ICRISAT Field Survey 2009-10 and 2010-11.

Among diseases dry root rot, *Fusarium* wilt, and collar rot were reported (Table 15). Incidence of *Fusarium* wilt and dry rot was reported by a large proportion of the farmers in both the states (Figure 15A-E.). Short duration chickpea varieties with multiple resistance against critical insects such as *Helicoverpa,* and diseases such as wilt, may promote the expansion of chickpea in RRFL. In addition, it is necessary to develop economical and effective management practices to control the losses due to insect-pests (pod borer) and diseases (dry root rot and collar rot).

Figure 15A. Fusarium wilt.

Figure 15B. Collar rot.

Figure 15C. Dry root rot.

Figure 15D. Pod borer.

Figure 15E. Bruchids.

8.1.3 Animal grazing

Grazing is another potential threat to chickpea cultivation as domestic animals are often allowed to graze freely on the rice fallow lands. The lack of cultivated fodder and prevalence of several nondescript animals, free grazing is a common practice in RRFL. The farmers in the selected villages reported substantial losses in *rabi* crops caused by animal grazing. Stray animals such as *neelgai* (blue buck) and monkeys have also emerged as potential threats in the region. Destruction of standing chickpea crops by the monkeys has become one of the major threats and needs to be tackled on a priority basis. As hunting of monkeys and *neelgai* is banned under the Wildlife Protection Act; policy reforms and institutional supports are essential to tackle these problems. These problems cannot be controlled by individual efforts, and need collective action to gain attention. Due to small and fragmented landholdings, farmers grow chickpea in small patches that make it even more vulnerable. The problem of stray animals can only be addressed by increasing the area under the crop. A similar problem was faced by the soybean farmers in the recent past, which was handled effectively by large-scale cultivation of soybean. This strategy may help in the case of chickpea production as well. But there is a need to educate and convince the farmers about the feasibility and profitability of chickpea. Collective or community farming may be one of the options to bring in more and more lands under chickpea in the RRFL of Chhattisgarh and Madhya Pradesh. Further, rehabilitation of natural habitats of these animals and massive aforestation programs could mitigate these losses.

8.1.4 Crop sequence and management related constraints

Depending upon the type of soils and availability of irrigation, farmers decide their crop plan. Chickpea, wheat, mustard, lentil and lathyrus are the most preferred crops for *rabi* production. However, there is an obvious preference for chickpea everywhere in RRFL. Wheat requires more irrigation and is therefore cultivated in fields that have assured irrigation facilities. Mustard also requires irrigation. Chickpea, lentil and lathyrus are well suited to rainfed conditions, but chickpea has the best adaptability of all. Though cultivation of lathyrus is preferred by the farmers of Chhattisgarh, its detrimental effect on human health discourages its cultivation. Cultivation of lentil is preferred in Madhya Pradesh, but it is more susceptible to some of the diseases and pests. Chickpea is relatively hardy. Despite these, there are certain agronomical and growth related constraints that make chickpea crop management difficult.

The village seed sector by and large depends on traditional seeds, which unfortunately have low genetic potential. Most times self produced, stored seeds of chickpea and other pulses are used to produce these crops. The seed replacement rates of the non-participating farmers were as low as 6.3 to 13.6%. Non-availability of short-duration varieties of *kharif* rice as well as chickpea is the most critical problem (Table 16). Since cultivation of rice is subject to the extent of monsoon rains, and most of the existing rice varieties are of long duration (about 130 to 150 days) there remains a very short growing period for chickpea production. If the harvest of rice is delayed, chickpea sowing also gets delayed. The recommended sowing time for chickpea is mid-October to mid-November but it is often sown up to last week of December or well into the first fortnight of January. This leads to

Table 16. Percentage of farmers reporting cropping system related constraints to chickpea production in RRFL.

	Chhattisgarh				Madhya Pradesh			
Constraint	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Non-availability of short-duration varieties of chickpea and rice	67	70	59	73	69	87	82	77
Short growing period	90	78	95	87	91	84	96	82
Poor seed germination	25	90	67	83	73	14	33	57
Poor plant stand	12	10	33	17	18	71	22	21

Source: *ICRISAT Field Survey 2009-10 and 2010-11.*

reduced seed germination and a poor crop stand. Since the chickpea is gown on residual soil moisture after the harvest of rice, farmers perceive that better germination of chickpea occurs if sowing is done immediately after the harvest of rice. Perhaps the soil moisture, temperature and micro-environment in the field after the harvest of rice favour chickpea. Unfortunately, the sowing of chickpea is further delayed due to threshing and preparation of the field for *rabi* sowing. Most of the cultivated chickpea varieties are of long duration. These varieties often suffer the worst form of terminal drought or even witness massive failures if there is no rainfall.

The farmers look forward to short-duration, high-yielding varieties of rice and chickpea specifically developed to promote *rabi* cropping in RRFL (Figures 16-18). It would help the region to escape terminal drought and promote the livelihood status of the farmers who are constrained to leave the paddy fields vacant during *rabi*. Another remedy could be the introduction of resource-conserving technologies such as zero-tillage (seed cum fertilizer drills) and sprinkler irrigation.

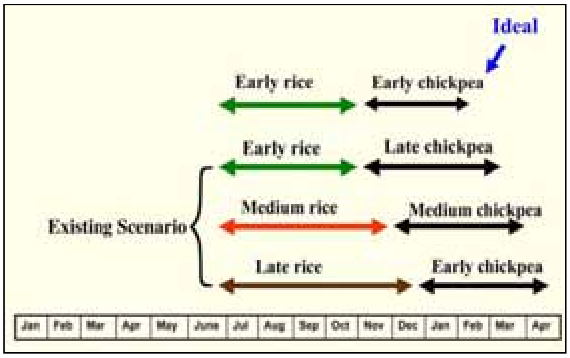


Figure 16. Rice-chickpea cropping system.

Figure 17. Early rice variety, JRH 4.

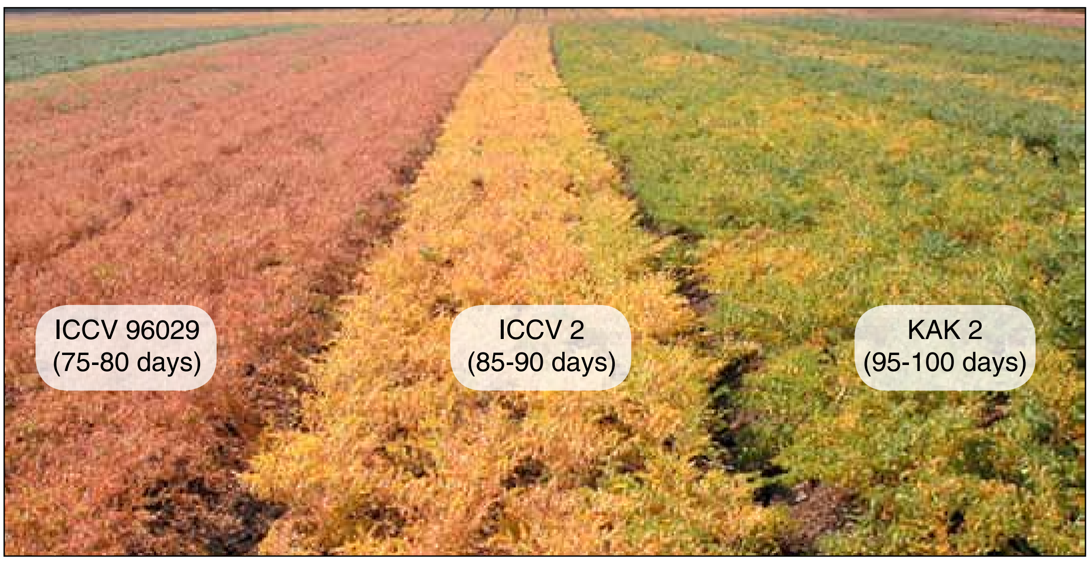


Figure 18. Short-duration chickpea varieties.

8.2 Socioeconomic constraints

The subsistence nature of farming and monsoon-based agricultural practices inflict many serious socioeconomic problems in the region. Agriculture is prone to high production and price risks. Farmers are generally poor with high dependency on agriculture. The ecology is harsh and contributes to massive poverty, depletion of natural resources, pervasive malnutrition and sparse employment opportunities. Thanks to employment generation programs such as the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) that is providing alternative employment opportunities, the migration of rural youth from the region is controlled. Despite this, farmers of the selected villages in the pilot districts of Chhattisgarh and Madhya Pradesh reported a number of socioeconomic constraints including several types of resource constraints, marketing constraints and information constraints. The following sections present some of the critical constraints pertaining to chickpea production in RRFL.

8.3 Financial, institutional and resource constraints

Although farmers are informed about the advantages of chickpea production in RRFL, non-availability of inputs and resources retards the pace of cultivation. Table 17 presents various resource constraints reported by the farmers of the selected villages in the pilot districts of Chhattisgarh and Madhya Pradesh. More than 89% of the farmers reported 'lack of capital' as the most critical constraint. A majority of farmers are constrained to follow the rice-fallow system because of lack capital that limits their ability to invest in creation of basic agricultural facilities such as irrigation and storage. Lack of funds also affects the input use patterns of the farmers and restricts the adoption of improved machinery and tools.

Lack of institutional credit for various agricultural purposes is another important constraint that has significant bearing on lives of the farmers. Banks are often apathetic towards the concerns of the farmers belonging to marginal and small categories. Cumbersome banking procedures discourage farmers from acquisition of institutional credits. This compels the farmers to take loans from informal sources. Farmers take loans to meet their operational expenses. About a half to two-thirds of the selected farmers in the selected villages of Chhattisgarh and Madhya Pradesh were in the grip of private money lenders and took loans at exorbitant rates of interest ranging from 2 to 10% a month or even more.

Table 17. Percentage of farmers reporting resource constraints to *rabi* cropping.

	Chhattisgarh				Madhya Pradesh			
Constraints	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Lack of capital to invest in irrigation, farm machinery and tools	94	97	89	91	99	95	92	99
Lack of funds to purchase inputs	88	93	91	95	86	89	92	90
Lack of institutional credit	66	70	66	75	70	62	77	69
High interest of the private money lenders	44	51	47	58	50	55	50	66
Scarcity of human labor	40	36	50	48	55	60	53	67
Unavailability of resource conserving tools and machinery	88	90	78	87	77	66	58	80

Source: *ICRISAT Field Survey 2009-10 and 2010-11.*

Labor scarcity is another critical problem. About 80 - 90% of the farmers in Chhattisgarh and Madhya Pradesh complained about unavailability of human labor and high wage rates. Many of them even blamed MGNREGA for the shortage of labor in agriculture. A common perception is that due to the guaranteed 100 days employment and high wages, laborers prefer to work for MGNREGA. This problem might be solved by linking MGNREGA to farming. Like laborers, farmers could also be registered to have their on-farm activities conducted under the employment guarantee programs on a part-payment basis. This could generate more employment opportunities and also help the farmers with the supply of human labor at subsidized wages.

8.4 Marketing constraints

Agricultural marketing is a complex proposition. The spectrum of prices for most agricultural produce is also unique. It is an outcome of demand and supply during transactions between various intermediaries at different levels in the marketing system. It depends upon marketing arrangements that facilitate interaction between different stakeholders and play an important role in determination of prices at various stages of the chain from farm gate to the ultimate user. The complex nature of agricultural markets and marketing channels generate several marketing constraints. Many of these problems are difficult for farmers to cope with. This section investigates the marketing constraints that impede the promotion of pulses with particular reference to chickpea in RRFL (Table 18).

Table 18. Percentage of farmers reporting marketing constraints in selected districts of Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Constraint	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Low local demand for chickpea	35	28	20	33	27	37	30	34
Low price of chickpea in local markets	98	93	95	90	85	90	89	94
Lack of marketing facilities	50	67	56	47	36	44	52	61
Price instability in local/ informal markets	17	20	27	13	19	23	11	26
Non-availability of pesticides	9	20	16	23	19	12	8	11
High price of seed	47	30	33	24	36	42	78	50
High price of pesticides	40	19	31	29	22	39	44	36

Source: *ICRISAT Field Survey 2009-10 and 2010-11.*

About 85-98% farmers in the selected villages of Chhattisgarh and Madhya Pradesh blamed the low price of chickpea as an important reason for their reluctance to cultivate the crop. The farmers are often not in a position to influence the markets and are constrained to take any price that is being offered to them by the local buyers. Moreover, the prices in the local markets keep fluctuating and even remain below the statutory prices due to lack of marketing facilities, such as procurement by Government agencies, cooperatives and the like.

Low demand in the local markets is another important reason for the low adoption of chickpea and other *rabi* pulses for production in RRFL. The range of farmers reporting low demand for chickpea in the local markets varied from 20% at Raipur in Chhattisgarh to 37% at Rewa in Madhya Pradesh. The demand for chickpea in the local markets is low due to the difference between the consumption and production preferences for the pulses in the selected regions. The farmers in the region prefer pigeonpea for self consumption. Chickpea and other *rabi* pulses are often sold in the markets and are grown due to low opportunity costs of the fallow lands. Besides, most of the farmers have very small marketable surpluses and also lack access to formal agricultural markets. Due to their very small marketable surplus they usually prefer to sell their produce in the local markets or even in the village itself to avoid transportation and transaction costs.

8.5 Lack of awareness and information on improved pulse production technologies

The role of information is phenomenal. The level, quality and flow of information are some the determinants of agricultural production and marketing. Rainfed farming in particular is subject to great risks and uncertainties. Lack of information pertinent to improved pulse production technologies and marketing was reported as one of the important constraints to enhance sustainable pulse production particularly chickpea by a substantial proportion of farmers in the selected villages of Chhattisgarh and Madhya Pradesh (Table 19).

Table 19. Percentage of farmers reporting lack of information on improved production practices and marketing of chickpea in Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Area of information gap	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Sowing techniques	55	44	37	33	36	54	33	48
Moisture conservation techniques	45	90	67	83	55	86	44	57
Control of insects and pests	65	92	37	62	40	59	42	59
Disease control measures	86	96	87	92	73	71	78	64
Market and prices	67	83	65	72	64	87	60	73

Source: ICRISAT Field Survey 2009-10 and 2010-11.

Sowing in *rabi* fallow lands depends on the level of residual moisture after the harvest of *kharif* rice. With the help of improved sowing techniques, better germination and crop stand can be obtained. Improved sowing techniques such as seed priming (Figure 19A) and other resource-conserving techniques [(zero tillage, line sowing, etc., (Figure 19B)] not only help conserve moisture but also reduce the delay in sowing. Farmers can take advantage of chickpea production by adopting improved pulse production practices. However, it was found that about one-third to more than a half of the farmers in the selected villages were either completely ignorant or had very little information about these techniques.

Figure 19A. Zero-till cum fertilizer seed drill.

Figure 19B. Seed priming.

Farmers also lack information on plant protection measures. Due to inadequate knowledge about the insect pest control measures and disease management, farmers suffer huge losses. A number of cultivated traditional varieties of chickpea are prone to damage by insects like *Helicoverpa* and leaf miner. *Helicoverpa* causes substantial damage as most of the available insecticides are ineffective against it. Protection techniques such as integrated pest management (IPM) could be helpful in the control and management of *Helicoverpa* and other insect pests, but a considerable proportion of farmers did not have adequate information about such measures. Occurrence of diseases in chickpea is also common. Diseases such as *Fusarium* wilt, collar rot and dry root rot cause severe (up to 40%) damage to the standing chickpea crop grown in RRFL. These problems can be effectively reduced by the treatment of seed before sowing, replacing seeds at regular intervals and sowing of disease-resistant varieties. Unfortunately, about two-thirds or even more of the farmers refused to access any information on marketing and prices from any authentic sources. Overall, Kabirdham district in Chhattisgarh and Rewa in Madhya Pradesh appear to be lacking in information compared to other selected districts.

Both formal and informal types of information sources are available to farmers (Table 20). It transpires that farmers have better access to extension personnel and agricultural scientists in Raipur and Jabalpur. It is important to note that apart from the line departments, these districts also have state agricultural universities. At other places the proportion of farmers seeking information from the extension personnel and university scientists varied in the range of 38% in Rajnandgaon to 52% in Durg of Chhattisgarh. In Madhya Pradesh, about 33% farmers in Satna to 48% in Damoh obtained information from extension personnel and university scientists. The analysis indicates that only 27% farmers of the selected villages of Madhya Pradesh and 23% farmers of Chhattisgarh have ever visited the state agricultural universities and/or Krishi Vigyan Kendras (KVKs, farmers associations)/neighboring extension offices.

Table 20. Percentage of farmers reporting major sources of information on rainfed *rabi* cropping in Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Source of Information	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Extension personnel/ Scientist	52	47	70	38	76	44	33	48
Input dealers	69	90	67	83	55	86	54	57
Radio	25	92	22	67	36	14	22	59
Magazines/ newspapers	30	56	67	32	47	21	28	35
Fellow farmers	77	83	65	72	64	87	60	73

Source: ICRISAT Field Survey 2009-10 and 2010-11.

Magazines and newspapers are also important sources of information, though it was interesting to discover that a very high proportion of farmers rather seek information from fellow farmers and input dealers. This is probably because the farmers and the input dealers in the regions may be trained on different aspects of production, plant protection and agricultural marketing and can thus provide more complete information.

8.6 Input constraints

Production is transformation of input into output by adopting suitable production/ transformation processes. It includes a set of functions ranging from acquisition of inputs, combining resources with appropriate production technologies/transformation process to output, and finally to marketing of the produce. The level of production depends on the quantity and quality of various inputs. Seed, fertilizer, pesticides, irrigation and labor are some of the important inputs that have strong bearings on production. This section probes the constraints related to various inputs needed for chickpea production in RRFL.

Non-availability of good quality seed in desired quantities at the right time is the most serious problem in the selected regions (Table 21). More than 90% farmers in each of the selected villages viewed this problem as one of the prime reasons for the large chunks of fallow land seen in *rabi*. Lack of improved seed compels the farmers to procure locally available low potential seeds and suffer huge production losses, else leave the field fallow. This also affects the seed replacement rate and leads to occurrence of several seed borne diseases and of insect pests in the regions. It is the general practice in the villages that farmers buy/exchange seeds from fellow farmers. Hence, strengthening of the village seed system by introducing improved seeds is imperative. It will increase the availability of seeds in the village itself. Farmers expect to have seed of improved cultivars with multiple resistance against *Helicoverpa*, wilt, dry root rot and terminal drought. These problems should receive the highest priority for chickpea breeding. The high cost of seed is another constraint against the adoption of improved chickpea varieties. Large-scale seed production in the region would not only increase the availability of improved seeds but also bring down the price of chickpea seeds in the region. Private sector R&D organizations and marketing firms can also find huge opportunities in the production and marketing of improved varieties of chickpea seeds by supporting farmers in growing chickpea in the RRFL. Unfortunately none of the private seed companies are venturing in to pulse seed production and marketing in India.

Table 21. Percentage of households reporting major constraints related to important inputs in Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Constraints	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Non-availability of quality seed as and when required	94	87	92	90	95	90	91	91
Non-availability of pesticides	65	53	57	66	36	54	42	59
High cost of seed	60	50	69	57	47	52	58	45
High cost of fertilizers	35	42	47	36	64	87	60	73
Non-availability of fertilizers on time	50	48	60	55	30	56	67	32
High cost of pesticides	55	86	54	57	69	90	67	83
High cost of water saving implements	76	44	33	48	25	92	22	67
Non-availability of multi-purpose zero till cum seed drill machine	52	47	70	38	77	83	65	72

Source: ICRISAT Field Survey 2009-10 and 2010-11.

It is also important that supply of other inputs, especially insecticides and pesticides, and important fertilizers be maintained and monitored regularly. Despite low use of fertilizers for chickpea, substantial proportions of the farmers face difficulties in the acquisition of fertilizers. The farmers often buy fertilizer by paying high prices. Non-availability of resources, machinery and implements in the selected villages restricts their large-scale use. Farmers cannot afford different zero-till machines for sowing seeds of different crops. They want a multipurpose machine that can perform multiple tasks with simple manipulations. However, such machines are not available.

High risk associated with chickpea production is also a critical problem. It is clear from Table 22 that 29-81% of the farmers cite risk as the reason for slow expansion of chickpea in RRFL.

Table 22. Proportion (%) of farmers perceiving high risk in chickpea production in RRFL of Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Risk	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Chickpea								
Yield	67	70	64	81	73	70	66	85
Price	47	33	56	44	50	53	37	29

Source: *ICRISAT Field Survey 2009-10 and 2010-11.*

9. Opportunities for chickpea production in RRFL

The RRFL offers enormous opportunities for intensification of pulse production in India. Pulses have several unique characteristics, which make them one of the most eligible crops for production in RRFL. Among pulses, chickpea has a better prospect due to better adaptability to the harsh weather conditions, soils, and moisture stress. Besides, it has a great economic and nutritional value. The analysis of data reveals that chickpea production in rice-fallow areas of Madhya Pradesh and Chhattisgarh has opened several new avenues to the farmers in terms of increased farm income and employment. There are certain conditions that favour chickpea production in RRFL in these states that are discussed below.

9.1 Untapped production potential

The traditional varieties of chickpea often have very low production potentials and are also vulnerable to a number of biotic and abiotic constraints. These constraints inflict a huge gap between the average attainable yield and the average yield of the traditional chickpea varieties in RRFL. Average attainable yield is just the average yield of the improved chickpea varieties cultivated by the farmers in the village.

Table 23 presents the gaps between the average actual on-farm yields of improved chickpea varieties and the average yield of local varieties grown in the selected villages of Chhattisgarh and Madhya Pradesh. These yield gaps indicate the quantum of untapped production potentials in these selected regions. It is obvious that there is tremendous scope for increasing chickpea production by bridging these yield gaps in different regions. It is obvious that on an average chickpea yield in both Chhattisgarh and Madhya Pradesh can be almost doubled just by replacing all the local chickpea varieties with improved varieties in the regions. In absolute terms, there would be an increase in the yield of chickpea to the tune of 4.71 q ha^{-1} and 6.49 q ha^{-1} in the RRFL of Chhattisgarh and Madhya Pradesh, respectively.

Table 23. Yield gap in chickpea grown in RRFL by the farmers in the selected districts of Chhattisgarh and Madhya Pradesh.

	Average Yield (Kg ha^{-1})		Yield Gap (Improved Vs Local)	
District/State	Improved varieties	Local varieties	(Kg ha^{-1})	%
Durg	772	494	278	56
Kabirdham	803	347	457	132
Raipur	915	450	465	103
Rajnandgaon	865	474	391	83
Chhattisgarh	**858**	**430**	**471**	**110**
Damoh	1142	525	617	118
Jabalpur	1215	581	734	126
Rewa	1289	784	605	77
Satna	1272	874	627	72
Madhya Pradesh	**1289**	**680**	**649**	**96**

Source: *ICRISAT Field Survey 2009-10 and 2010-11.*

9.2 Economic feasibility

Production of chickpea in RRFL is economically viable and technically feasible. It tenders one of the most feasible options for improving the economic status of the poor farmers in the region. It can be produced at lesser costs with greater economic benefits (Table 24).

Table 24. Economics of rice-based cropping systems in the selected villages/districts of Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Crop Rotation	Gross Return (Rs)	Variable cost (Rs)	Net Return (Rs)	B/C Ratio	Gross Return (Rs)	Gross Cost (Rs)	Net Return (Rs)	B/C Ratio
Rice-fallow	15750	11836	3914	1.33	12340	10754	1586	1.15
Rice-wheat	31064	24712	6352	1.26	34973	24335	10638	1.44
Rice-chickpea	32914	18789	14125	1.75	38126	18141	19985	2.10
Rice-lentil	39950	25971	13979	1.50	-	-	-	-

Source: *ICRISAT Field Survey 2009-10 and 2010-11.*

Chickpea fits in rotation with the *kharif* rice and it can be successfully produced on less puddled heavy vertisol soils with residual soil moisture after the rice harvest. In comparison to rice followed by fallow in *rabi*, or rice followed by wheat, rice-chickpea rotation yields net returns of Rs 14,125 ha^{-1} in Chhattisgarh and Rs 19,985 ha^{-1} in Madhya Pradesh. Apparently, compared to rice-fallow, cultivation of improved chickpea varieties generates additional benefits of Rs 10,211 ha^{-1} in Chhattisgarh and Rs 18,399 ha^{-1} in Madhya Pradesh. The benefit/cost ratio in paddy-chickpea rotation is 1.75 in Chhattisgarh to 2.10 in Madhya Pradesh. Even the existing local varieties cultivated in RRFLs of Chhattisgarh and Madhya Pradesh yield an average additional return of Rs 9,300 ha^{-1}. The large additional benefits coming from the production of chickpea make it one of the most profitable crops for production in the RRFLs (Figure 20). What is needed is to take initiatives for educating the farmers about the economic and technical aspects of chickpea production and also provide them better technical guidance and market linkage.

Figure 20. Profitable chickpea production in RRFL.

9.3 Enabling policy environment

The policy environment in the country is also in favour of intensification of pulse production. The Government of India is committed to provide food to all by “right to food security” in the near future. Programs such as the National Food Security Mission (NFSM) are involved in accomplishing the goals of enhancing the availability and accessibility of food. Considering the importance of pulses in food security, the NFSM was launched during the Eleventh Five-Year Plan (2008-12). The NFSM targets important food grains like rice, wheat and pulses. The mission aims at increasing pulse production by 2 million tons by bringing more area under pulses and raising their productivity as well. The mission targets 17 million ha under pulses in 171 identified districts. By 2011-12, it will attempt to include an additional 4.05 million ha under cultivation through the utilisation of rice fallows and inter-cropping with wider-spaced crops.

The NFSM ambitiously targets an additional 2 million tons of production by 2011-12. It encourages the adoption of improved and established crop production and protection technologies. It also supports creation of agricultural infrastructure with the objective of ensuring higher productivity and bridging yield gaps. These enabling policy environments provide substantial opportunities to the farmers of the regions to take advantage of the support provided under these programs, and serve to help themselves as well as the nation.

The National Pulse Development Project (NPDP) is in full swing since the beginning of the Eighth Plan (1985-86) to enhance the adoption of improved pulse production technologies. It is a centrally sponsored scheme, which is being formulated, implemented, coordinated and monitored by the Directorate of Pulse Development. Since 1990, the pulse sector has also been brought under the canopy of the Technology Mission on Oil seeds and Pulses (TMOP) to instigate pulse production in the country. During the Tenth Five-Year Plan an Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize (ISOPOM) was proposed and implemented after merging the centrally sponsored schemes on oilseeds, pulses, palm oil and maize with an objective to make the program more integrated and financially sound (Ministry of Agriculture and Cooperation 2004). The ISOPOM emphasis was on seed production, distribution and adoption of improved technologies. With all these programs, the policies and integrated research and extension efforts to make better utilisation of fallow areas under pulses have increased significantly in rice fallows in some parts of the country (Ali and Kumar 2009). But evidence shows that the benefits of these efforts have been limited to localised areas with irrigation facilities (Reddy 2009).

9.4 Opportunities for employment generation

Production of chickpea in the fallow land after the harvest of *kharif* rice generates additional employment opportunities of about 47 -51 man-days ha^{-1} in Chhattisgarh and to 47-55 man-days ha^{-1} in Madhya Pradesh (Figure 21).

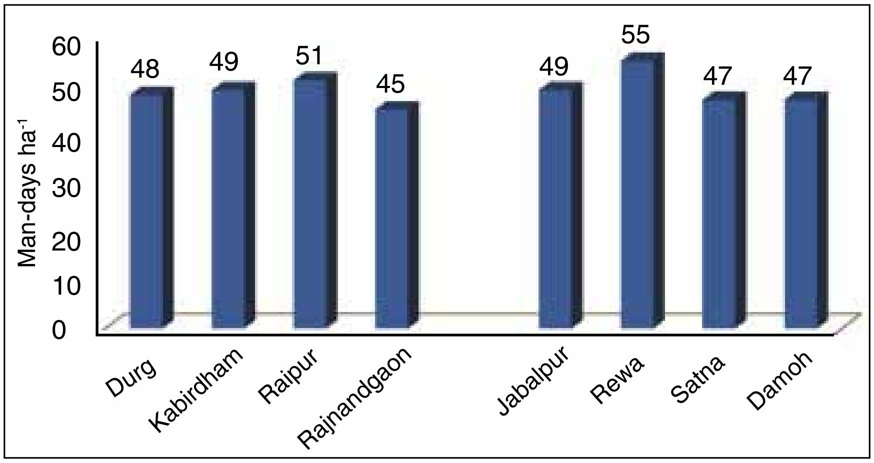


Figure 21. Employment generation due to chickpea production in RRFLs in the selected project districts in Chhattisgarh and Madhya Pradesh.

The average employment generated due to the chickpea production in the region accounted for about 48 man-days ha^{-1}. The season, after the harvest of rice in the selected regions, is a lean period for on-farm employment. This results in substantial migration of human labor from the villages to the nearby towns or to the metropolitan cities in the country, or a shift to available non-farm employment opportunities in the region. Chickpea production can create significant opportunities for on-farm employment in the rural areas in the selected region. It will help the farm to retain the labor force on the farm, which will also solve the problems of scarcity of agricultural labor in the area.

9.5 Pressing consumption requirements

Pulses are the most affordable sources of protein, particularly for the huge vegetarian population, a significant proportion of which is undernourished and poor. Pulses complement cereals in both production and consumption. Despite their importance, the per capita availability of pulses has reduced significantly from about 60 g day^{-1} in 1950-51 to 30 g day^{-1} in 2001 (Figure 22). One of the critical reasons behind the declining availability of pulses in India is the shift in area of pulses from favoured regions to marginal lands. Indiscriminate production of rice and wheat in favoured regions pushed the production of pulses to the margins. This situation is likely to reverse in the near future. It is, however, encouraging that after 2001 there has been a marginal increase in the per capita per day availability of chickpea, which also leads to a corresponding increase in availability of total pulses, and the only hope for enhancing the pulse production in the country lies in marginal areas such as the RRFL.

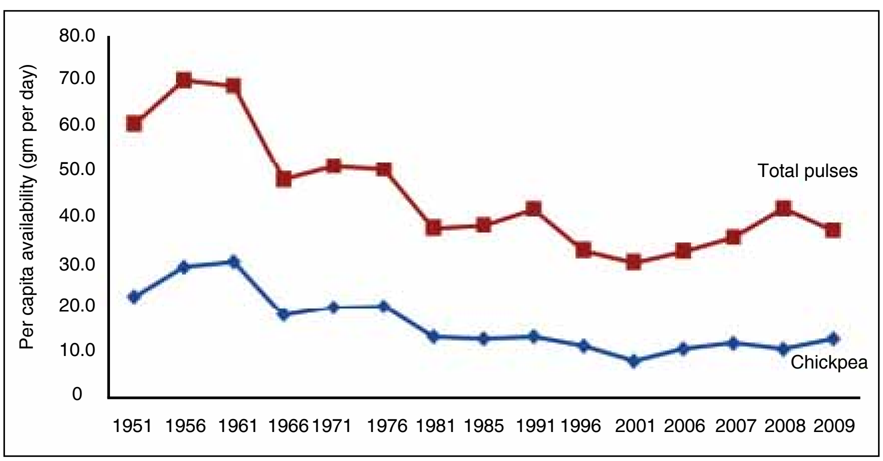


Figure 22. Per capita net availability of chickpea and total pulses in India.

About 17.5 million tons of pulses are consumed annually in India, but the domestic production is unable to meet this demand (Table 25). The NFSM has set a target to increase pulse production by 2 million tons by 2012. It is therefore imperative that all possible measures be taken to augment the pulse production in the country. Introduction and intensification of pulse production in RRFL would help India to achieve this target and chickpea can play a lead role under the given circumstances.

Table 25. Consumption and production of pulses in India 2001-2009.

Year	Total consumption (million tons)	Total pulse production (million tons)
2000-01	11.2	11.1
2001-02	15.4	13.4
2002-03	13.0	11.1
2003-04	16.5	14.9
2004-05	14.2	13.1
2005-06	14.3	13.1
2006-07	17.5	14.2
2007-08	17.4	14.8
2008-09	16.4	14.2

Source: Department of Agriculture and Cooperation 2009.

9.6 Import substitution

In order to supplement domestic production, India imports about 2 to 4 million tons of pulses to meet the gap in annual demand for pulse consumption (Figure 23). India also exports pulses such as green gram and black gram in small quantities (between 0.1 and 0.4 million tons annually) to fulfil the commitments of WTO. Expansion of *rabi* rice-fallow area under chickpea would reduce the import dependency of the country and also check siphoning of the valuable foreign reserves.

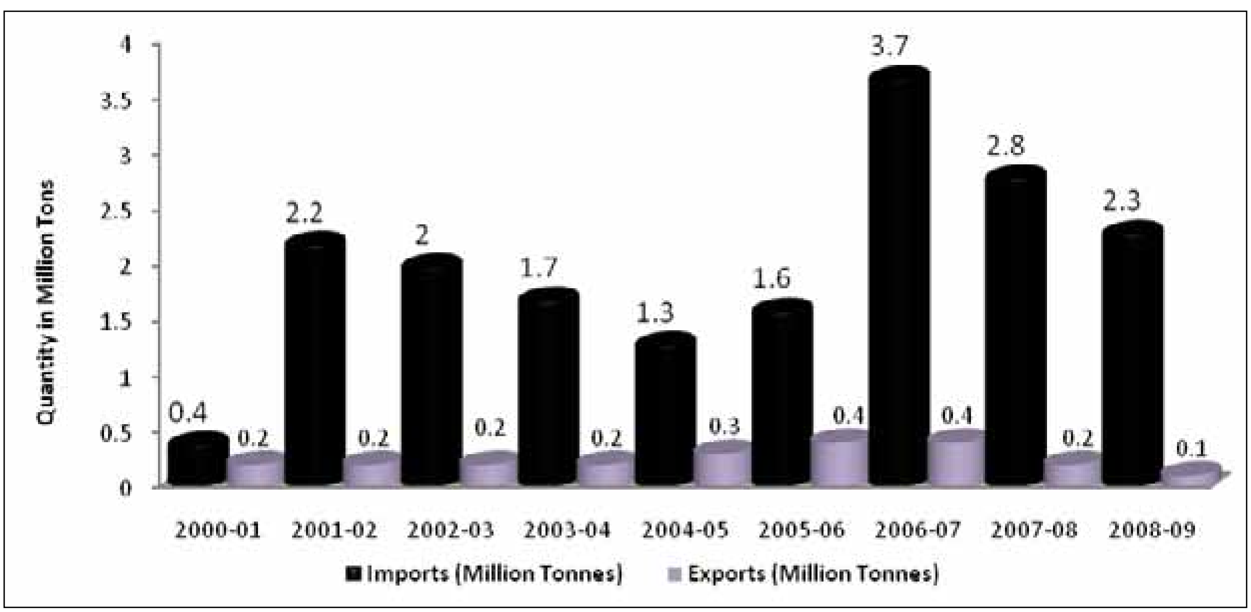


Figure 23. Trends in import and export of pulses in India.

9.7 Farmers' willingness to grow chickpea

The best encouragement for intensification of chickpea can be seen in the willingness of the majority of farmers to grow the crop in the *rabi* on their rice-fallow lands (Table 26). The farmers of the selected regions were confident about the benefits of chickpea production (Figure 24). The proportion farmers satisfied with the performance of IPPPT demonstrations at different locations was found to be ranging from 88 to 98%. The most encouraging and hopeful factor that favours the future of chickpea in RRFL is the willingness of large proportions of farmers to continuously opt for chickpea production in RRFL. In addition, 30 to 100% non-participating farmers expressed their willingness to grow chickpea.

Table 26. Percentage of participating and non-participating farmers in the selected districts of Chhattisgarh and Madhya Pradesh willing to grow chickpea in RRFL with IPPPT.

	Chhattisgarh				Madhya Pradesh			
	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Participating households								
Satisfied with IPPPT	88	92	95	87	98	93	95	90
Willing to grow chickpea	100	100	99	98	98	100	100	96
Non-participating households								
Willing to grow chickpea	92	87	66	89	100	90	83	91

Source: ICRISAT Field Survey 2009-10 and 2010-11.

However, certain enabling conditions are essential to motivate farmers to grow chickpea in RRFL (Table 27). Majority of the farmers require assured provisions for the availability of quality chickpea seeds of short duration (70 to 80 days) along with short duration rice varieties (up to 120 days) to facilitate rice-chickpea rotation in RRFL (Figure 17-18). Most of the cultivated rice varieties are of long duration resulting in delayed sowing of chickpea. Besides, farmers want to buy water-saving irrigation equipment and tillage equipment, but their financial condition does not allow them do so. It is therefore imperative that adequate provisions be made to provide this equipment either on subsidy or through easy and affordable credits for this purpose.

Figure 24. The farmers of the RRFL are willing and happy to grow chickpea.

Table 27. Requirements of participating farmers (%) willing to grow chickpea in RRFL of Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Requirement	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Seed availability	85	66	75	91	88	90	84	95
Short-duration chickpea varieties	100	100	100	100	100	100	100	100
Short-duration rice varieties	45	68	50	53	70	40	59	56
Insect and pest control measures	75	88	61	87	90	86	90	92
Water saving irrigation equipment	98	93	84	92	88	94	89	93
Tillage equipment	66	59	72	68	77	80	72	84
Assured market	98	94	87	95	84	92	97	90
Remunerative prices	72	85	65	84	66	91	78	83
Credit facilities	50	47	54	45	49	51	63	75
Crop insurance	100	100	100	100	100	100	100	100
Extended project support for 2-3 years to stabilize the technology	80	66	73	85	56	77	60	68

Source: *ICRISAT Field Survey 2009-10 and 2010-11.*

Moreover, farmers need assured market linkages for their produce. This objective can be achieved by creating farmer societies and cooperatives, or by establishing an additional number of *mandis* in the villages or at least in the clusters of villages. Strengthening of the public procurement system can also play a vital role. The private sector can also harness the opportunity by establishing pulse processing units and integrating the pulse producers in the market chain.

As chickpea production is highly vulnerable to production risks, farmers expect assured policy interventions such as crop insurance coverage and buy back guarantees. Finally, the farmers opined that the project support extended for additional 2-3 years would be usefulin establishing the faith of the farmers in the chickpea production with IPPPT. Because of late sowing, the performance of the chickpea in many of the villages had not been satisfactory. If the project is continued for the next 2-3 years it will help the adopters as well as the non-participating farmers to consolidate their trust in the benefits of IPPPT and the production of chickpea.

The expectations of non-participating farmers are by and large the same as those of participating farmers (Table 28). They also want assured availability of quality seed as per their requirements. They expect subsidies to various inputs as they often fall short of essential funds. Besides, they require insurance against production risks and an assured market with buy back guarantees at remunerative prices.

Table 28. Requirements of non-participating farmers (%) willing to grow chickpea in selected RRFL districts of Chhattisgarh and Madhya Pradesh.

	Chhattisgarh				Madhya Pradesh			
Requirement	Durg	Kabirdham	Raipur	Rajnandgaon	Jabalpur	Rewa	Satna	Damoh
Availability of improved seed	92	83	94	91	98	92	99	95
Subsidized inputs	79	82	89	88	62	85	74	91
Technical support	56	64	52	70	63	73	55	57
Insurance against risk	98	91	99	90	95	97	96	93
Buy back arrangements	99	89	99	90	78	100	94	97
Remunerative prices	60	87	45	96	54	78	62	83

Source: ICRISAT Field Survey 2009-10 and 2010-11.

10. Conclusions and implications

The RRFL offers an enormous scope for pulse production in the country. The area of RRFLs accounts for about 12 million ha. Pulses provide colossal opportunities for crop diversification and intensifying cropping under rainfed production systems. Evidence indicates that pulses are the most ideal crops that can be successfully cultivated in RRFL. Pulse production is generally less capital intensive and so is the chickpea production. Chickpea can easily be integrated into the cropping systems of smallholder and medium farmers who often have lower economic backgrounds.

This study has explored the baseline information pertaining to chickpea production in RRFLs of Chhattisgarh and Madhya Pradesh as per the improved pulse production and protection technology (IPPPT) being introduced by ICRISAT. The study has shown that the region has enormous potential and possibilities for chickpea production in RRFL. To identify the strengths, weaknesses, opportunities and threats a SWOT (strengths, weaknesses, possible opportunities and threats) analysis was done. Highlights of the SWOT analysis are discussed in the subsequent paragraphs.

The major strength of the region is the existence of large *rabi* fallow lands that virtually has zero opportunity cost. Labor is also abundant and cheap, and remains grossly underutilized during the *rabi*. Besides, chickpea has better adaptability to marginal lands. Yields of chickpea in Chhattisgarh and Madhya Pradesh are also higher than the national average. The region has an abundance of Vertisol, which favour chickpea production. The monsoon is generally good in these states, and that helps chickpea cultivation on the residual moisture after *kharif* rice.

Unavailability of quality seed, poor accessibility to markets, practice of cultivation of long duration rice varieties, lack of short-duration chickpea varieties, weak extension system, drought-like situations at the time of crop maturity and uncertain rainfall are some of the obstacles to chickpea production in RRFL. Besides, the farmers lack water-saving/harvesting technologies and improved tools and implements required for crop establishment.

Constraints such as the low local demand for chickpea and inefficient markets and poor seed delivery systems are the other weaknesses of the region. Majority of sales and purchases take place in unorganized informal markets that are unable to safeguard the interests of smallholder and marginal producers who lack sufficient bargaining power due to the generation of low marketable surplus. Private dealers dominate the seed/ input market and there is no guarantee of quality and authenticity of the inputs. Besides, instability of pulse prices and high price of improved seeds constrain the chickpea production in RRFL.

The Government of India is committed to introduce the 'Food Security Act (FSA)' in the near future, and the success of FSA will depend on augmentation of agricultural production by raising agricultural productivity and/ or cropping intensities of mono-cropped, rainfed and marginal lands, apart from other measures. Pulses complement cereals in both production and consumption. These improve soil fertility; require less water in comparison to cereals and control diseases and pests in rotation with cereals. Besides, pulses are relatively cheaper sources of protein. Despite their importance, the per capita availability of pulses has reduced significantly (from about 60 g day^{-1} in 1950-51 to 32.6g day^{-1} in 2006). This indicates scope for legume production in which chickpea plays a significant role.

The analysis of data reveals that chickpea production in rice-fallow areas of Madhya Pradesh and Chhattisgarh has opened several new avenues to the farmers in terms of increased farm income and employment. Thus a large proportion of the farmers are willing to grow chickpea. About 82% farmers reported a persistent increase in area of chickpea under rice fallow. Because of cultivation of chickpea after rice, farmers could obtain an average additional income of Rs 9300 ha^{-1}. It also generated an average additional employment of about 48 man-days ha^{-1}. About 47% farmers perceived the positive impact of chickpea cultivation on soil fertility as seen from the increased yield of subsequent rice crops.

Imbedded production and price risk is the most serious threat to chickpea production. Year to year variation in pulse production is a regular feature. Prices also show erratic behaviour. Menace of stray animals such as *neelgai* and monkeys are acute but substantial. Problems of *Helicoverpa* and wilt are the other persistent threats that need immediate attention.

11. Suggestions/Recommendations

- Extend project support to evaluate and demonstrate the early rice-early chickpea crop rotation with newly developed varieties of these crops in diverse agro-ecologies of RRFL in the states of Chhattisgarh and Madhya Pradesh.
- Need to develop seed-cum-fertilizer drills suitable for chickpea crop establishment soon after the harvest of rice.
- Increase R&D endeavour to develop short-duration chickpea cultivars with multiple resistance to major biotic and abiotic constraints such as Fusarium wilt, collar rot, dry root rot, pod borer, terminal drought, etc.
- Increase R&D efforts to develop short-duration rice varieties with resistance to diseases and pests suitable for RRFL.
- Increase on-station and on-farm R&D with short-duration rice varieties with short duration chickpea in different agro-ecological regions of Chhattisgarh and Madhya Pradesh.

- Strengthen formal seed markets and value chains to safeguard interests of farmers.
- Include advocacy of chickpea as a part of farming system.
- Develop low cost and effective insect pest/disease management technologies.
- Disseminate relevant information on different aspects of production, crop protection, soil and water conservation, markets and prices.
- Ensure sufficient regulatory and policy mechanisms to regulate role of private sector in seed and input marketing and delivery.
- Provide easily available at low interest rate institutional credit.
- Develop a better seed multiplication and distribution system: Private sector, NGOs, SHGs/ Farmers organizations and Govt. organizations can play a vital role in this area.
- Create and establish sufficient numbers of processing and value addition facilities in the region. The private sector should be encouraged to take lead in this area and integrate pulse producers in their value chain.
- Train and educate farmers and input dealers about the economic and technical aspects of chickpea production and provide them proper guidance.
- Ensure insurance against production risks and markets with buy-back guarantees at remunerative prices through public procurement system.
- Establish adequate number of *mandis* in the villages or at least in the clusters of villages.

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Appendix- 1

Selected project districts/blocks/villages in Chhattisgarh and Madhya Pradesh.

Chhattisgarh			
S.no.	District	Block	Village
1	Kabirdham	Bodla	Sili
2	Kabirdham	Bodla	Boda
3	Kabirdham	Bodla	Magarwada
4	Kabirdham	Bodla	Tarsingh
5	Kabirdham	Bodla	Baijalpur
6	Kabirdham	Bodla	Singhari
7	Kabirdham	Bodla	Amera
8	Kabirdham	Bodla	Dullapur
9	Kabirdham	Bodla	Boriya
10	Kabirdham	Kawardha	Dajauri
11	Rajnandgaon	Rajnandgaon	Kumhalori
12	Rajnandgaon	Rajnandgaon	Dhamansara
13	Rajnandgaon	Rajnandgaon	Bharregaon
14	Rajnandgaon	Dongargoan	Nathunawagaon
15	Rajnandgaon	Dongargoan	Kohka
16	Rajnandgaon	Dongargoan	Pendarvani
17	Raipur	Tilda	Kumhari
18	Raipur	Tilda	Khapridih khurd
19	Raipur	Bhatapara	Khairi
20	Durg	Dhamdha	Mohandi
21	Durg	Dhamdha	Mudpar
22	Durg	Dhamdha	Dhour
23	Durg	Dhamdha	Semariya
Madhya Pradesh			
24	Jabalpur	Kundam	Imlai
25	Jabalpur	Panager	Podi
26	Jabalpur	Patan	Gwari
27	Jabalpur	Patan	Chedi
28	Jabalpur	Patan	Baroda
29	Jabalpur	Panager	Urdua
30	Jabalpur	Panager	Kevlari
31	Jabalpur	Sihora	Gidorha
32	Jabalpur	Sihora	Ghorakohi

33	Jabalpur	Panager	Saliya
34	Jabalpur	Panager	Paroda
35	Rewa	Sirmore	Veerkham
36	Rewa	Rewa	Saanw Bhudai
37	Rewa	Rewa	Bidwa
38	Rewa	Rewa	Tikiya
39	Rewa	Rewa	Puraini
40	Rewa	Rewa	Bahuri bandh
41	Rewa	Rewa	Kokaham
42	Satna	Rampur	Bathiya
43	Satna	Rampur	Matha
44	Satna	Rampur	Satri
45	Satna	Amar Patan	Bachera
46	Satna	Amar Patan	Gora
47	Satna	Amar Patan	Magraj
48	Satna	Amar Patan	Katha
49	Satna	Amar Patan	Parsiya
50	Satna	Rampur	Saajanpur
51	Damoh	Damoh	Hinota
52	Damoh	Damoh	Bandakpur
53	Damoh	Damoh	Mudari
54	Damoh	Damoh	Halgaj
55	Damoh	Damoh	Riyana
56	Damoh	Damoh	Bamohri
57	Damoh	Damoh	Kherua
58	Damoh	Damoh	Nonepani
59	Damoh	Damoh	Hindoria
60	Damoh	Damoh	Gunji
61	Damoh	Damoh	Dhanawa
62	Damoh	Damoh	Aanu
63	Damoh	Damoh	Bhandoli
64	Damoh	Damoh	Surkhi

Appendix- 2

Baseline Data Record Sheet No. 1: Village Profile

Constraints and opportunities for chickpea in RRFL: MP and CG

Name of the village: __________, Block____________, District_________

1. Access to infrastructure, organizations, institutions:

Road connectivity: Yes=1, No=0; If no distance from the village (km) _________

Railway connectivity: Yes=1, No=0; If no distance from the village (km) _________

Post office: Yes=1, No=0; If no distance from the village (km) _________

Institutional credit facility: Yes=1, No=0; If no, distance from the village (km) _________

Distance to nearest urban centre (km) _________

Distance to nearest agricultural market (km) _________

Distance to nearest agricultural development/extension office (km) _________

School: Primary/Secondary_________

Presence of any NGO: Name_________ Activity: 1.Agriculture 2.Non-agriculture

Health centre: Yes=1, No=0; If no distance from the village (km)_________

Animal health centre: Yes=1, No=0; If no distance from the village (km)_________

Watershed program: Yes=1, No=0_________

Agricultural input shops: Yes=1, No=0 _________

Agro-processing units: Dal mill- Yes=1, No=0; Rice mill- Yes=1, No=0; Oil crusher- Yes=1, No=0.

2. Distribution of households

Number of households in the village:

Landless________, Marginal (<1ha) ________, Small (1-2ha) ________, Medium(2-4ha) Large (>4ha)________

3. Most preferred pulses grown (i) ___________ (ii) ___________ (iii) ___________

4. Most preferred pulses consumed (i) ___________ (ii) ___________ (iii) ___________

5. Chickpea specific information

Total cultivated area during rainy season (acres) _________, irrigated area_________

Total cultivated area during post-rainy season (acres) _________, irrigated area_________

Area under paddy during rainy season (acres) _________.

Rainy season paddy area cultivated in the postrainy season_________

Important crops grown on rainy season paddy harvested area:
crop______, area______; crop______, area______; crop______, area______;

Total chickpea area in the village (acre) _______, chickpea area irrigated_____

Varieties grown: JG 16 area______, JG 11 area _____, JG 130 area ______, JG 14 area ______,
JG 74 area ______, JG 63 area ______, JAKI 9218 area ______, JGK 2 area ______,
Others _______, area_______

Whether chickpea area has (i) increased (ii) decreased (iii) remained constant in the village:
Give most important reasons

1.________________________

2.________________________

3.________________________

4.________________________

5.________________________

6.________________________

7.________________________

Baseline Data Record Sheet No. 2: Group Profile

Constraints and opportunities for chickpea in RRFL: MP and CG

Instruction for the investigators: Kindly ask all the questions of the group (1-2 per village). Let the group decide preferences etc. The investigators should not suggest preferences to the farmers. The preferences should be in strong ordering only.

Date: **Year:**

Village name:……………..………..…… Block:……………..………..…… District:……………..………..……

1. **Group Number:**

   No. of participants: ________________ No. of female participants:________________

2. Consumption preference for pulses: 1___________, 2___________, 3_____________

3. Production preference for pulses: 1___________, 2___________, 3_____________

4. Is area of chickpea increasing, decreasing or constant?

Increasing ☐ Decreasing ☐ Constant ☐

5. What are the important constraints to growing chickpea (discuss and then rank).

S. no.	Constraints	Rank
1	Water logging	
2	Low moisture holding capacity	
3	Soil hardiness after rice paddling	
4	Low organic matter content	
5	Soil cracking	
6	Soil salinity	
7	Soil alkalinity	
8	Low water table	
9	Saline water	
10	Alkaline water	
11	Drought conditions towards crop harvest. Short sowing period after rice or long duration rice crop	
13	Non-availability of short duration varieties of chickpea	
14	Poor seed germination	
15	Poor plant stand	
16	Pest problems	
17	Insects Pod borer	
18	Diseases Wilt/Collar rot/Dry root rot	
19	Lack of capital to invest in irrigation	
20	Lack of funds to purchase inputs	
21	Animal grazing	
22	Lack of information on sowing techniques	
23	Lack of information on moisture conservation practices	
24	Lack of information on treatment of saline/alkaline soils	
25	Lack of information on insect control measures	
26	Lack of information on disease control measures	
27	Low local demand for chickpea	
28	Lack of marketing facilities	
29	High fluctuation in prices	
30	Non-availability of good quality seed	
31	Non-availability of pesticides	
32	High price of seed	
33	High price of pesticides	

Baseline Data Record Sheet No. 3: Individual farmer level (Participating farmers)

Constraints and opportunities for chickpea in RRFL: MP and CG

Note: Data to be recorded at an individual farmer level (select 10% or minimum 30 participating farmers)

Date: **Year:**

1. **Farmers ID:**

   District……………………..Block……………………..Village……………………..

   Name of respondent: …………………………………………………

   Male……………… Female ……………… Age ……………… Education……………

2. **Family size (Nos):**

   Adult males____________ Adult females____________ Children____________

3. **Most important sources of income (Rs/years) for the household**

Crop production	Livestock production	Agriculture labor	Non-farm labor	Service	Business	Others	Total

4. **Size of land holding (acres):**
   Owned land______, leased-in______, leased-out______.

Season	Cultivated area (Acre)	Irrigated area (Acre)	Source of irrigation
Rainy season			
Winter season			

5. Cropping pattern

Season	Crop	Area	Area irrigated	Source of irrigation
Rainy season				
Winter season				

6. Chickpea cultivation

1. During the last 10 years chickpea area has increased / decreased/ constant

   Reason for increasing/ decreasing/ constant

………………………………………………………………………………………………………

………………………………………………………………………………………………………

2. Since how long you have been growing chickpea ………………………………………………...

3. Current area under chickpea ……………………………………………….............…..............

4. Crop before chickpea in rainy season …………………………………………………………...

5. Crop after chickpea in rainy season ……………………………………………………………..

6. Soil type

   a. Entisols (*Bhhata)*…………… b. Deep vertisols (*Kanhar-Kali Matti*) ….
   c. Inceptisols (*Mattasi*) …………d. Alfisols (*Dorsa*)……..

7. Is chickpea grown every year in the same plot/ land? Yes/No

   If answer is no, please give the reason.

……………………………………………………………………………………

8. Chickpea yield during

   a. Good year……………………………………….. kg/acre
   b. Bad year…………………………………………. kg/acre
   c. Normal year……………………………………… kg/acre

7. Resource use pattern and crop yields (Information to be collected / acre)

Wage rates: human labor (Rs/day)_________; A pair of bullocks (Rs/day)_________;

Tractor (Rs/hour)____________

	Chickpea (variety_________)					Competing crop______ variety______			
	Unit	Quantity	Value (Rs)	Labor	Bullock or Machine	Quantity	Value (Rs)	Labor	Bullock /Machine
Land preparation									
Seed									
Fertilizer									
a)									
b)									
c)									
d)									
e)									
Pesticide									
Insecticide									
Weedicide									
Irrigation									
Harvesting									
Threshing									

8. Total production (Production per acre area under chickpea)

	Unit	Chickpea		Competing crop______	
		Qty	Value	Qty	Value
a) Main product					
b) By product					
b) Use of byproduct					

9. Utilization of chickpea (qty in kg) Home consumption:
as human food_________, as feed_________, saved as seed_________, marketed_________

	Chickpea		Competing crop______	
Marketed to whom	Quantity	Price received	Quantity	Price received

10. Other technology-related (Mechanization: Crop establishment using Zero-Till Seed-cum fertilizer seed drills etc.) constraints.

a. Do you use machines for chickpea crop establishment? Yes/No

If yes, name of machine ……………………………………………………………….

If no, reason for not using ………………………………………………………………

…………………………………………………………………………………………………

b. Have ever heard about using Zero-Till Seed-cum fertilizer seed drills? Yes/No

If yes, performance of machine

………

……………………………………………………………………………

If no, reason for not knowing

………

……………………………………………………………………………

c. Will you be able to bear the cost of a machine? Yes/No

If no, reason

…………………………………………………………………………………………………

…………………………………………………………………………………………………

Baseline Data Record Sheet No. 4: Individual farmer level (Non-participating farmers)

Constraints and opportunities for chickpea in RRFL: MP and CG

Note*: *Data to be recorded at an individual farmer level
(Select 5 Non-participating farmers per village)

Date: **Year:**

1. **Farmers ID:**
District………………..Block………..………..Village…………………

Name of respondent: ………………………………………………….

Male………………Female ………… Age……….. Education……………

2. **Family size (Nos):**
Adult males____________ Adult females____________ Children______________

3. **Most important sources of income (Rs. /years) for the household**

Crop production	Livestock production	Agriculture labour	Non-farm labour	Service	Business	Others	Total

4. **Size of land holding (acres):**

Owned land____________ leased-in____________ leased-out____________

Season	Cultivated area (Acre)	Irrigated area (Acre)	Source of irrigation
Rainy season			
Winter season			

5. **Cropping pattern (acres):**

Season	Area	Area irrigated	Source of irrigation
Rainy season crop			
Winter Season crop			

6. Willingness to grow chickpea (if not growing)

1. **Are you aware of the chickpea demonstrations?** 1=Yes, 2=No
2. **How frequently you have visited the demonstration site?**
   1= Every week, 2= once a fortnight 3= once a month, 4=never
3. **Are you willing to grow chickpea?** 1= Yes, 2=No
4. **What kind of inputs and information would you require to adopt rabi cropping?**
   1. Chickpea seed
   2. Information on methods of sowing
   3. Short duration variety of chickpea to escape terminal drought
   4. Short duration rice variety to facilitate timely sowing of chickpea
   5. Tillage equipment
   6. Information on insect control measures,
   7. Information on disease control measures
   8. Assured market for produce
   10. Credit for creating irrigation facilities
   11. Any other

About ICRISAT

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, and 644 million of these are the poorest of the poor. ICRISAT and its partners help empower these poor people to overcome poverty, hunger, malnutrition and a degraded environment through better and more resilient agriculture.

ICRISAT is headquartered in Hyderabad, Andhra Pradesh, India, with two regional hubs and four country offices in sub-Saharan Africa. It belongs to the Consortium of Centers supported by the Consultative Group on International Agricultural Research (CGIAR).

Contact Information

ICRISAT-Patancheru
(Headquarters)
Patancheru 502 324
Andhra Pradesh, India
Tel +91 40 30713071
Fax +91 40 30713074
icrisat@cgiar.org

ICRISAT-Liaison Office
CG Centers Block
NASC Complex
Dev Prakash Shastri Marg
New Delhi 110 012, India
Tel +91 11 32472306 to 08
Fax +91 11 25841294

ICRISAT-Nairobi
(Regional hub ESA)
PO Box 39063, Nairobi, Kenya
Tel +254 20 7224550
Fax +254 20 7224001
icrisat-nairobi@cgiar.org

ICRISAT-Bamako
(Regional hub WCA)
BP 320
Bamako, Mali
Tel +223 20 223375
Fax +223 20 228683
icrisat-w-mali@cgiar.org

ICRISAT-Niamey
BP 12404, Niamey, Niger
(Via Paris)
Tel +227 20722529, 20722725
Fax +227 20734329
icrisatsc@cgiar.org

ICRISAT-Bulawayo
Matopos Research Station
PO Box 776
Bulawayo, Zimbabwe
Tel +263 383 311 to 15
Fax +263 383 307
icrisatzw@cgiar.org

ICRISAT-Lilongwe
Chitedze Agricultural Research Station
PO Box 1096
Lilongwe, Malawi
Tel +265 1 707297/071/067/057
Fax +265 1 707298
icrisat-malawi@cgiar.org

ICRISAT-Maputo
c/o IIAM, Av. das FPLM No 2698
Caixa Postal 1906
Maputo, Mozambique
Tel +258 21 461657
Fax +258 21 461581
icrisatmoz@panintra.com

www.icrisat.org

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