SOCIOECONOMIC CONSTRAINTS AND OPPORTUNITIES IN RAINFED RABI CROPPING IN RICE FALLOW AREAS OF INDIA

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Executive Summary

About 30% of the 40 million ha area under rice production during the kharif (rainy) season in India remains fallow in the subsequent rabi (postrainy) season due to a number of biotic, abiotic, and socioeconomic constraints. As high as 82% of fallow lies in the states of Assam, Bihar, Chhatisgarh, Jharkhand, Madhya Pradesh, Orissa, and West Bengal, which is equivalent to the net sown area of Punjab, Haryana, and western Uttar Pradesh – the sheet of green revolution in the country. Introduction of rabi crops in this area may bring green revolution in this backward, poverty-ridden, and deprived region of the country. This would benefit millions of poor small landholders solely dependent on agriculture for their livelihood. This study has identified major limiting factors to the cultivation of rabi crops under rainfed conditions, and explored opportunities for their sustained production.

Lack of irrigation infrastructure is the main limiting factor for non-utilization of the rabi fallow lands. The focus of this study, however, is on rainfed cropping because an overwhelming majority of farmers in the region are poor small landholders and lack capacity to invest in creating the irrigation infrastructure. A number of crops including pulses and oilseeds can be successfully grown under rainfed conditions on fallow lands given the appropriate technology and needed technical and market related information. The major constraints to rainfed rabi cropping are: (i) faster receding residual moisture in fields after rice harvest; (ii) soil hardiness in the puddled rice fields; (iii) lack of short-duration varieties of rice that could facilitate timely sowing of rabi crops; (iv) lack of short-duration drought escaping varieties of rabi crops; and (v) uncertain rabi rainfall. To utilize residual moisture rabi crops need to be sown immediately after rice harvesting. During that short period, labor shortage too poses a limitation to cultivation of rabi crops.

Farmers lack information on soil moisture conservation technologies and sowing technologies that help germinate the seed in low moisture regime. Farmers are poor. They lack sufficient capital to purchase critical inputs such as seed, fertilizers, and pesticides. Access to institutional credit is limited. Non-availability of these inputs particularly seed also restricts growing of rabi crops. Public extension system is weak to

effectively deliver the technology, inputs, and information to the farmers. Farmers also perceive that in case the crop is sown and establishes well it is often prone to various insect pests and diseases. Grazing of crops by stray animals of the thinly distributed crop is a major limitation to cultivation of rabi crops. Low volume of produce and lack of markets may deprive the small and marginal producers to get the market prices.

Some of these constraints were quoted as the main limiting factors to soybean cultivation in the erstwhile kharif fallow areas in Madhya Pradesh. With gradual increase in area under soybean, most of these disappeared and large-scale cultivation of soybean transformed subsistence agriculture to commercial one.

Despite these constraints there is a possibility of growing rabi crops under rainfed conditions in the region. On-farm participatory research by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, India and the Department for International Development/Plant Sciences Research Programme (DFID-PSP), UK has proven the technical and economic feasibility of growing chickpea in the rice fallow areas. Large number of farmers were sensitized and were willing to undertake cultivation of chickpea during rabi season, given appropriate technologies, critical inputs and information. Ex-ante estimates suggest that utilization of even a small portion of rabi fallows is likely to generate substantial income and employment for the rural population.

There are enough opportunities to absorb the increased production provided appropriate marketing infrastructure is developed in the region. Pulses are the cheapest source of protein, and unfortunately their per capita availability has been declining due to supply-side constraints. Domestic supply of pulses is grossly inadequate to meet the rising demand, and often huge quantities of pulses are imported to meet the demand. This offers an opportunity to substitute imports of pulses by utilizing rabi fallows. Further, higher than national average yield of pulses in the rice fallow systems is an added advantage, though for certain pulses lack of local demand may be a disincentive to their production.

The rice fallow systems have been bypassed in the research and development efforts. To promote rabi cropping in these systems the options lie in technology development and its effective transfer to the farmers. Research should focus on evolving of short-duration drought escaping varieties of rabi crops, short-duration varieties of rice to facilitate timely sowing of rabi crops on the residual moisture, technologies that help seed germination in the low moisture regime, and moisture conservation technologies. Another option is to effect agronomic manipulations like early sowing of rice, if possible. Simultaneously the extension system needs to be strengthened to sensitize the farming community through demonstrations and other means of technology transfer. The seed sector should be strengthened to ensure timely supply of quality seeds to the farmers. These efforts need to be backed by institutional support such as provision of credit, crop insurance, and agricultural markets as to improve farmers’ investment capacity and risk bearing ability.

1. Introduction

Rice is the principal crop during kharif (rainy) season in India. The crop occupies an area of over 40 million ha. This area is not fully utilized for crop production in the subsequent rabi (postrainy) season; about 12 million ha remains fallow (Subbarao et al. 2001). This unutilized area offers enormous opportunities to overcome the problem of food and nutritional insecurity. Accomplishing household food security remains the primary concern though at the national level India has piled up a huge stock (about 60 million t) of foodgrains, mainly rice and wheat. Food crops such as pulses and oilseeds are critical to food security. Nutritional security is equally important; about 30% of the population suffer from malnutrition (Kumar and Joshi 1999). A majority of Indian population is vegetarian, deriving its protein requirement from pulses and other vegetarian sources. The per capita availability of pulses has been declining. India is deficit in pulses and edible oils, and imports huge quantities of these commodities to meet the domestic demand.

Poverty is pervasive; more than 26% of the population is poor and food insecure. Unemployment is acute in rural areas, and opportunities for employment in rural farm and non-farm sectors are limited. Agriculture engages about 62% of the rural labor force, and the pace of transfer of labor from agriculture to non-agricultural sector has been very slow. Absence of adequate opportunities in agriculture causes many social problems, such as illiteracy and migration to cities and agriculturally prosperous areas in search of employment. Problems of poverty, unemployment, illiteracy, migration, etc. are more acute in rice fallow systems.

The existing rice fallow area (12 million ha) is almost equivalent to the net sown area of Punjab, Haryana, and western Uttar Pradesh – the sheet of green revolution in India. Of the total rice fallow area about 82% lies in the eastern region (Assam, Bihar, Chhatisgarh, Jharkhand, Madhya Pradesh, Orissa, and West Bengal)[1]. If this area is

[1] Until recently Jharkhand was a part of Bihar, and Chhatisgarh was a part of Madhya Pradesh.

brought under cultivation, it may usher another green revolution in the country benefiting millions of poor, deprived, and small landholders. Promotion of crops such as pulses in the existing fallow area would also improve sustainability of the rice production system besides enhancing production and augmenting income. A number of agroecological and socioeconomic factors are limiting utilization of rabi fallows for crop production.

Irrigation is often mentioned as the main limiting factor in promotion of rabi cropping in rice fallow areas. The cost of creating public irrigation infrastructure (surface or groundwater), however, is enormously high and private investment in irrigation is unlikely. Introduction of short-duration drought tolerant crops and their varieties is a viable option to utilize rice fallow lands. This requires some agronomic manipulations in rice cropping schedule (early sowing), and/or introduction of short-duration varieties of rice to enable timely sowing of rabi crops. Introduction of moisture conservation techniques needs to accompany these changes. Pulses and oilseeds fit in such a scheme without much disruption of the kharif cereal production system.

There exist enormous market opportunities for pulses and oilseeds in the country. Pulses are a low cost source of protein and calories particularly for the poor who often suffer from malnutrition and diseases arising therefrom. Agricultural intensification through pulses can address the issue of nutritional deficiency. Improved supplies of pulses as well as oilseeds would benefit both producers and consumers. Producers would benefit through income and employment augmentation, and consumers through reduced prices of pulses, as the prices are expected to fall with increase in supply. The nation would save foreign exchange incurred in importing pulses and edible oils. On the production side, legumes have the added benefits for the agricultural system. Incorporation of legumes in rice-based cropping systems would be an important source of nitrogen. Besides improving soil fertility, pulses improve water-holding capacity of the soil and its organic matter content. Pulses and oilseeds can be grown in a cost-efficient manner because of their low input requirements. Opportunity cost of human labor is low, as at present labor remains idle during the rabi season. So is the case with bullock labor.

To improve the economic status of the farming community in general and the poverty- stricken small landholders in particular, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the Department for International Development/Plant Sciences Research Programme (DFID-PSP), University of Wales, UK have launched an initiative to explore the possibilities of utilizing rice fallow areas through technological and agronomic interventions. Initially, the program aims at demonstrating the technical feasibility of introducing rabi pulses (mainly chickpea) in the dominant rice fallow states of Jharkhand, Chhatisgarh, Madhya Pradesh, Orissa, and West Bengal through on-farm participatory research. Chickpea trials were conducted in farmers' fields with minimal input use under rainfed conditions during the rabi season of 2001-02. These trials will continue for next few years to sensitize and educate farmers to take up cultivation of rabi crops on the residual moisture in the fields vacated by rice. At the same time, it was considered appropriate to identify abiotic and socioeconomic constraints to rabi cropping that can be addressed through technological and policy interventions; and to explore market opportunities for rabi pulses to sustain their production in the long run. The focus of this study is on the pulses with the following specific objectives:

- To identify constraints to rainfed rabi cropping (pulses) in the rice fallow systems of selected states, and
- To explore socioeconomic opportunities for pulses.

The study is organized into six sections. Section 2 describes the methodology and data used to achieve the specified objectives. Section 3 assesses the performance of pulses in the rice fallow systems. Section 4 identifies abiotic, biotic, and socioeconomic constraints to rainfed rabi cropping. The results related to social and market opportunities for rainfed rabi cropping are presented in Section 5. The concluding remarks are made in Section 6.

2. Methodology

Study sites

The states of Chhatisgarh, Jharkhand, Madhya Pradesh, Orissa, and West Bengal lie in the eastern part of the country. Rice is the principal crop and largely grown under rainfed conditions during kharif season. It is also grown on a limited area during rabi season under irrigated conditions. These states together account for 82% of the rice fallow area in the country (Table 1). A large portion of this area lies in Madhya Pradesh (including Chhatisgarh). About half of the kharif rice area in this region remains fallow during the rabi season. The intensity, however, varies across states. In Madhya Pradesh (including Chhatisgarh) 78% of the kharif rice area remains uncultivated during the rabi season. In other states it is around 35 %.

Table 1. Estimate of rice fallow area in India, 1999-2000.

State	Rabi fallow area (million ha)	Rabi fallow area as % of kharif rice area	Distribution of rabi fallow area (%)
Bihar	2.2	37	19
Madhya Pradesh	4.4	78	38
Orissa	1.2	31	10
West Bengal	1.7	37	15
Total rice fallow states	9.5	47	82
India	11.6	38	100

Source: Subbarao et al. 2001.

Sampling

The study was conducted in all the villages where participatory research trials were undertaken. Annexure 1 provides sampling details. The trials were conducted in Bastar district of Chhatisgarh; Ranchi and Hazaribagh districts of Jharkhand; Mandla of Madhya Pradesh; Sambalpur of Orissa; and East and West Midnapur of West Bengal. Two main criteria were followed for selection of households for on-farm trials. These were: size of land holding (<2 ha), and non-availability of irrigation. A total of 32 farmers were selected from 2 villages in Chhatisgarh, 33 from 7 villages in Jharkhand, 35 from one village in Madhya Pradesh, 33 from four villages in Orissa, and 35 from 4 villages in West Bengal. All these farmers were included in the sample. Henceforth, these farmers are referred to as 'contact farmers'.

Apprehending that an analysis of information from contact farmers alone might inject bias in the results, we selected randomly almost equal number of non-contact farmers from the same villages to overcome the bias. On the whole, 322 farm households were selected. This comprised about 27% of the total farm households in the sample villages in the rice fallow states. In Madhya Pradesh, all farm households in the village were included in the sample. In Jharkhand and Orissa, the sample households comprised 17% and 10% of the farm households, respectively. In Chhatisgarh, the sample households comprised 52%, while in West Bengal these were 61% of the total households.

Data

The selected households were interviewed for their perceptions on constraints to and possibilities for rabi cropping with the aid of a questionnaire especially prepared for this study. The information pertaining to constraints to rabi cropping included agroecology, crop management, infrastructure, input and output markets, yield and price risk, technical and advisory services, and farm resources. Farmers' perceptions were also sought on the possible crops that can be grown under rainfed conditions during the rabi season, local demand for pulses, their willingness to grow rabi pulses, their awareness of the benefits of rabi pulses, etc. These were complemented with the secondary information related to pulses demand, supply, trade, and prices. Besides, information was collected on demographic features, land holding, cropping pattern and income sources of the households. From the contact farmers, information was also collected on inputs used in chickpea trials and chickpea yield to examine technical and economic feasibility of chickpea cultivation.

Whether there were any differences in the perceptions of contact and non-contact farmers related to constraints and opportunities in rabi cropping, initially separate analysis was undertaken for both the groups. The analysis indicated little, if any difference in the perceptions of the two groups, and therefore it was considered appropriate to pool the information. Wherever necessary, separate results are presented for the contact and non-contact farmers.

Village and household characteristics

Small holding agriculture is a characteristic feature of the selected villages (Fig. 1). In Madhya Pradesh and Orissa, 97% and 92% of the holdings respectively are of <2 ha in size. In other states, about 70–80% of the holdings was small (<2 ha). This indicates poor economic status of the farming community.

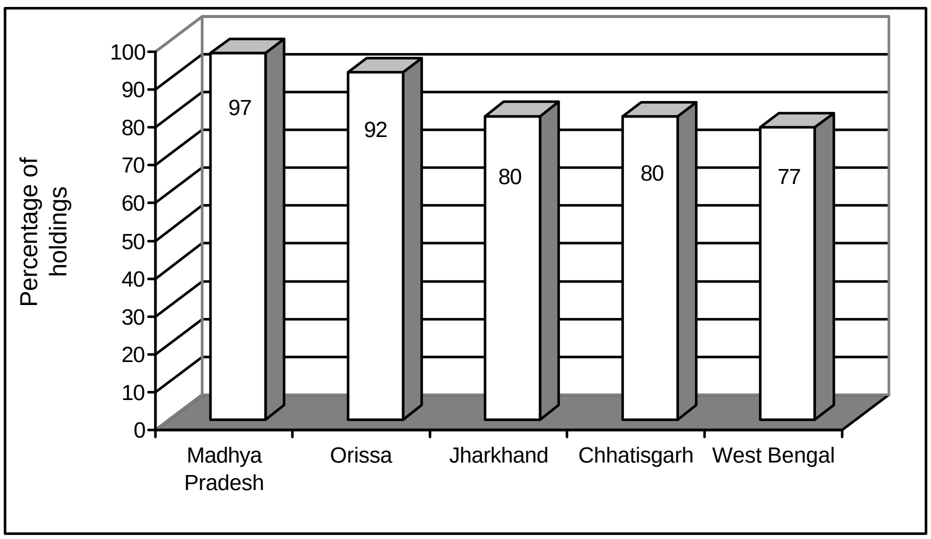

Figure 1. Proportion of marginal and small holdings (<2 ha) in the selected villages in the rice fallow states of India (Source: Field survey, 2002).

A considerable proportion of kharif rice area remains fallow in these villages (Table 2). In Orissa, West Bengal, and Chhatisgarh villages more than 90% of the kharif rice area is uncultivated during the rabi season. The extent of rabi fallow area is less in Madhya Pradesh and Jharkhand villages. In Madhya Pradesh, the rice fallow area (29%) in the selected village is much less compared to the state average of 78%. This is because the village has a watershed, which facilitates growing of rabi crops. In Jharkhand, a few farmers have access to irrigation facilities during the rabi season.

Table 2. Extent of rabi fallow area (ha) in the study villages.

State	Kharif rice area	Kharif rice fallow in rabi season	Rice fallow (%)
Chhatisgarh	327	306	94
Jharkhand	245	140	57
Madhya Pradesh	144	42	29
Orissa	275	261	95
West Bengal	243	220	91

Source: Field survey (2002).

Rice is the main kharif crop in the selected villages. In West Bengal and Orissa, more than 95% of the kharif area is under rice production. In other states, rice is grown in 70–80% of the kharif area. Other crops grown during kharif season are coarse cereals, pulses, oilseeds, and vegetables. In the rabi season, wheat, *boro* rice, mustard, and vegetables are important crops grown mainly under irrigated conditions. Farmers in Orissa, who have access to irrigation facilities grow vegetables (mainly potato). Mung bean and mustard are grown under rainfed conditions. In Jharkhand, chickpea and wheat occupy two-third of the rabi cropped area. Vegetables and mustard are other important rabi crops.

None of the villages in the selected districts of rice fallow states has infrastructure facilities needed to promote agriculture. Agricultural markets are located far away with an average distance ranging from about 4 km in West Bengal to 13 km in Orissa (Annexure 2). Similarly, the input markets and credit facilities are also located far away. Farmers have to travel much longer distance to seek advisory services from extension personnel. Accessibility of villages in Madhya Pradesh and Orissa to agricultural infrastructure is poor when compared with other states.

Average family size of the selected households ranges from 5.4 in West Bengal to 7.5 in Jharkhand (Annexure 3). Children account for about 40% of the total population. Most of the villages have primary schools. Majority of the household heads is illiterate. Only a few had attained schooling of 10 years or more.

Labor availability ranges from 2.0 persons ha^{-1} in Chhatisgarh and Orissa to 3.2 persons ha^{-1} in Jharkhand. Agriculture is the main source of employment in the selected states. Kharif rice is the main source of livelihood. Wage labor is next to agriculture, and is followed by livestock. During the rabi season employment opportunities both in farm and non-farm sectors are restricted. A few households undertake sundry jobs in the non-farm sector. A majority of the labor force remains unemployed during this period.

The village and household characteristics indicate underdevelopment of agriculture, lack of opportunities for employment in farm and non-farm sector, and poor infrastructure facilities to promote agricultural development.

3. Pulses Production in Rice Fallow Systems

Pulses are the ideal crops that can occupy the area vacated by kharif rice (Satyanarayana et al. 1988, Kumar et al. 1994). A number of factors favor this. Pulses such as chickpea, lentil, and lathyrus are hardy crops; they germinate and establish well on the residual moisture left in the rice fields. These have a deep root system, and as the plant growth advances it provides moisture and other nutrients from the lower layers of the soil to the plant. Pulses are leguminous species and fix atmospheric nitrogen in their root nodules, which partly meets the requirement of the plants, and the residual nitrogen is utilized by the subsequent crop. They also improve soil structure by adding organic matter content.

Rice fallow states are inhabited by poor people. Size of land holding is extremely small, with little access to irrigation and other critical farm inputs. Employment opportunities in and outside agriculture are restricted, yet agriculture is their main source of livelihood. Pulses production being less capital intensive, these crops can easily fit into the cropping system, and contribute towards improving income and employment opportunities. This section first presents some important socioeconomic characteristics of the rice fallow states, and then examines the performance of pulses in these states.

Socioeconomic characteristics

The states of Chhatisgarh, Bihar, Jharkhand, Madhya Pradesh, Orissa, and West Bengal account for about 82% of the total rabi fallow area in the country. Together they share 28% of the geographical area and 36% of the population (Table 3). Average population density is 432 persons km^{-2} compared to national average of 324 persons km^{-2}. But there is considerable variation in population density. In Bihar and West Bengal, it is 2–3 times higher than the national average. Madhya Pradesh and Orissa are thinly populated.

Except in West Bengal and Madhya Pradesh, urbanization is low compared to the national average of 27%. Level of urbanization in West Bengal and Madhya Pradesh is comparable to national average, while in Bihar and Orissa it is half of the national average.

Table 3. Socioeconomic features of the selected rice fallow states.

Description	Bihar	Madhya Pradesh	Orissa	West Bengal	India
Share in geographical area (2001) (%)	5.8	14.6	5.1	2.9	100
Share in population (2001) (%)	15.8	8.8	3.7	7.8	100
Population density (2001) (persons km^{-2})	880	196	236	904	324
Urban population (2001) (%)	13	25	14	28	27
Literacy rate (2001) (%)	34	50	51	60	65
Population below poverty line (2000) (%)	43	37	47	27	26
Average size of land holding (1992) (ha)	0.9	2.6	1.3	0.9	1.6
Small and marginal farmers (1992) (%)	88	60	80	91	78
Per capita income (2000-01) (ha)	6328	10907	9162	15569	10067
Share of agriculture in GDP (2000-01) (%)	27	30	26	26	23

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

More than half of the total population in the region is illiterate. Compared to the national average of 65%, Bihar has only one-third of literate population. Literacy rate in Madhya Pradesh and Orissa is about 50% while in West Bengal it is similar to the national average.

About 26% of the population in India live below the poverty line. Rice fallow region accounts for most of the poor in the country. The population below poverty line is 47% in Orissa, 43% in Bihar, and 37% in Madhya Pradesh. Incidence of poverty in West Bengal compares well with the national average.

Except in Madhya Pradesh, average size of land holding is smaller, compared to the national average of 1.57 ha. In Bihar and West Bengal it is 0.9 ha while in Orissa it is 1.34 ha. More than 80% of the holdings in the region are small (<2 ha), except Madhya Pradesh. Yet agriculture is the main source of income for the rural population; agriculture contributes 25–30% to the state domestic product in these states. Per capita income in Bihar and Orissa is below the national average. Per capita income in Madhya Pradesh is comparable to the national average. In West Bengal, it is about 1.5 times higher than the national average.

These indicators reveal low level of social and economic development of rice fallow region. West Bengal is an exception. During the last two decades, agriculture in West Bengal has undergone a transformation due to implementation of land reforms program and creation of irrigation infrastructure. Nevertheless, utilization of existing huge fallow area coupled with availability of abundant and cheap labor does promise ample scope for improving the social and economic well being of the people in the region.

Agroclimatic characteristics and cropping pattern

Rice fallow systems receive considerable amount of rainfall during the kharif season. The amount of rainfall received during rabi season is low and erratic (Table 4). Growing of rabi crops solely depends on the availability of moisture in the fields after rice harvest. The proportion of irrigated area to gross cropped area indicates that development of irrigation facilities in rice fallow states is low except in Bihar. Irrigation intensity is also lower than the national average. As a result, cropping intensity is quite low in the region, except in West Bengal.

Table 4. Land use and irrigation in the selected rice fallow states, 1997-98.

Particulars	Bihar	Madhya Pradesh	Orissa	West Bengal	India
Reporting area ('000 ha)	17330	44347	15571	8695	304895
Net cropped area('000 ha)	7356	19829	6100	5463	142352
Gross cropped area ('000 ha)	10057	25520	7953	9080	188955
Gross area irrigated (%)	46	26	28	28	39
Cropping intensity (%)	137	129	130	166	133
Irrigation intensity (%)	126	104	118	130	133

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.

Agriculture is largely cereal-based. Cereals account for a large share of gross cropped area in Bihar (80%) and West Bengal (70%) with kharif rice as the dominant crop (Table 5). In certain pockets of these states, winter rice (locally known as *boro* rice) is also grown under irrigated conditions. In Orissa and Madhya Pradesh, cereals account for about half of the gross cropped area. In Orissa, most of it is occupied by rice. In Madhya Pradesh both rice and wheat are important crops. In Bihar, rice followed by wheat occupy about 70% of the gross cropped area. Coarse cereals are important in Madhya Pradesh, Bihar, and Orissa. Pulses constitute the next important group of crops in Bihar, and Orissa with about 8–9% of the area under their cultivation. Pulses production in these states is quite diversified. Oilseeds are important in Madhya Pradesh with about 24% share in gross cropped area. Pulses account for about one-fifth of the gross cropped area, of which chickpea shares more than half of the area. Lentil and pigeonpea are other important pulses. Pulses constitute only 2.4% of the gross cropped area in West Bengal. Jute and oilseeds are also important crops.

Table 5. Area of crops (% of gross cropped area) in the selected rice fallow states, 1996-98 .

Crop	Bihar	Madhya Pradesh	Orissa	West Bengal
Cereals	80.4	48.9	51.2	69.7
Rice	50.6	19.8	49.0	65.0
Wheat	20.9	17.7	0.1	4.0
Coarse cereals	8.9	11.4	2.2	0.7
Pulses	8.7	19.8	8.0	2.4
Chickpea	1.3	10.2	0.4	0.3
Pigeonpea	0.7	1.6	1.5	0.0
Lentil	1.8	2.0	-	0.6
Other pulses	5.0	6.1	6.1	1.5
Oilseeds	2.1	24.1	4.4	5.6
Fiber crops	1.7	2.1	0.5	7.0
Other crops	7.1	5.2	35.9	15.3
Total	100.0	100.0	100.0	100.0

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.

Contribution of rice fallow systems to pulses production

In early 1960s, rice fallow states were the major contributors to total pulses production in India. The region accounted for about two-third of the pulses area in the country and contributed more than half to the total pulses production (Figs. 2 and 3). But in the late 1990s, the area share declined to 31% while the production share declined to 34%.

Madhya Pradesh has been the dominant pulse production state in the region. In early 1960s, its share in total pulses area was one-third. The area share declined sharply subsequently and stagnated at about 22%. The state contributed about 25% to total pulses production. Though the area share declined, production share almost remained constant. Bihar occupies second place after Madhya Pradesh in terms of both area and production. Its share in both area and production has declined sharply during the last four decades. The share of West Bengal in area as well as production has declined, while Orissa consolidated its position until early 1990s, but deteriorated afterwards.

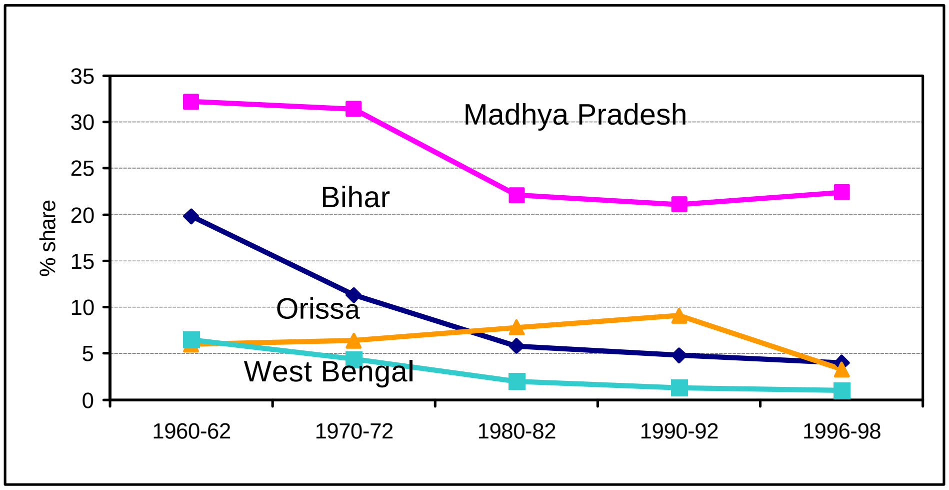

Figure 2. Share of rice fallow states in total pulses area in India.

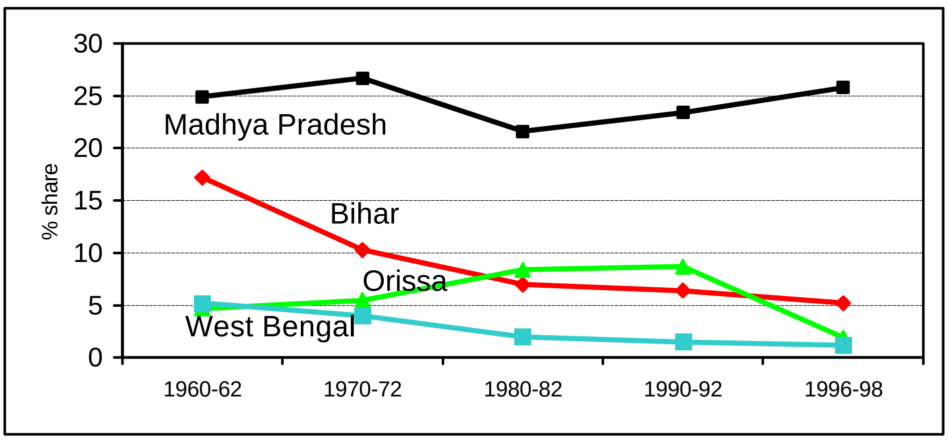

Figure 3. Contribution of rice fallow states to pulses production in India.

Production performance of pulses

Area

Area under pulses in the region has been declining, though at a slow rate (Table 6). Except during 1970s, growth in area has remained negative. The declining trend strengthened during 1990s. The performance of pulses varied across states. In Bihar, it has been consistently negative since 1960. In Madhya Pradesh, area under pulses increased during 1960s and witnessed slight decline during 1970s. It remained almost stagnant during 1980s, but increased during 1990s. In West Bengal, growth in area has been strongly negative throughout. Growth in pulses area has been positive in Orissa until 1990, but declined sharply during 1990s. With the exception of Madhya Pradesh, area under pulses in the region has declined rapidly during 1990s. At the national level, area under pulses has remained stagnant during the last two decades.

Table 6. Annual compound growth (%) in area, production, and yield of pulses in four states of India.

Year	Bihar	Madhya Pradesh	Orissa	West Bengal	Total	India
Area						
1960-70	-3.87	1.41	2.43	-2.25	-0.21	1.65
1970-80	-1.98	1.19	6.86	-3.10	1.20	4.84
1980-90	-1.59	-0.26	1.75	-3.73	-0.15	0.19
1990-98	-2.32	0.82	-11.90	-3.36	-2.03	0.05
Production						
1960-70	-3.42	2.44	3.32	-1.07	0.56	1.71
1970-80	-0.93	0.72	7.40	-3.86	1.12	2.88
1980-90	0.59	2.35	1.90	-1.20	1.79	1.53
1990-98	-1.64	2.23	-16.52	-1.92	-1.01	1.00
Yield						
1960-70	0.47	1.06	0.86	1.21	0.78	0.07
1970-80	1.07	-0.46	0.52	-0.75	-0.08	-1.87
1980-90	2.22	2.61	0.15	2.61	1.95	1.34
1990-98	0.71	1.42	-5.26	1.45	1.04	0.94

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.

Production

Pulses production in the region increased till the 1980s (Table 6). During 1990s, production trend was negative; it declined at an annual rate of 1%. At disaggregated level, the growth in production was negative in Bihar (except during 1980s), and West Bengal. On the other hand, in Madhya Pradesh (except during 1970s), pulses production grew at 2.2–2.5% a year. In Orissa too, pulses production increased until 1990 though at a variable rate during different decades, but decreased during 1990s.

Yield

During 1960s and 1970s, the average yield of pulses in the rice fallow systems was less than the national average of about 600 kg ha^{-1} (Fig. 4). During 1980s pulses yield at the national level declined sharply, while the yield in the rice fallow states remained almost stagnant. Subsequently, the national average recovered but pulses yield increased faster in the rice fallow systems. At present, the average yield of pulses in the rice fallow systems is about 11% higher than the national average while in Bihar it is higher by 30%, in West Bengal by 19%, and in Madhya Pradesh by 15%. In Orissa, the average yield of pulses has always remained below the national average.

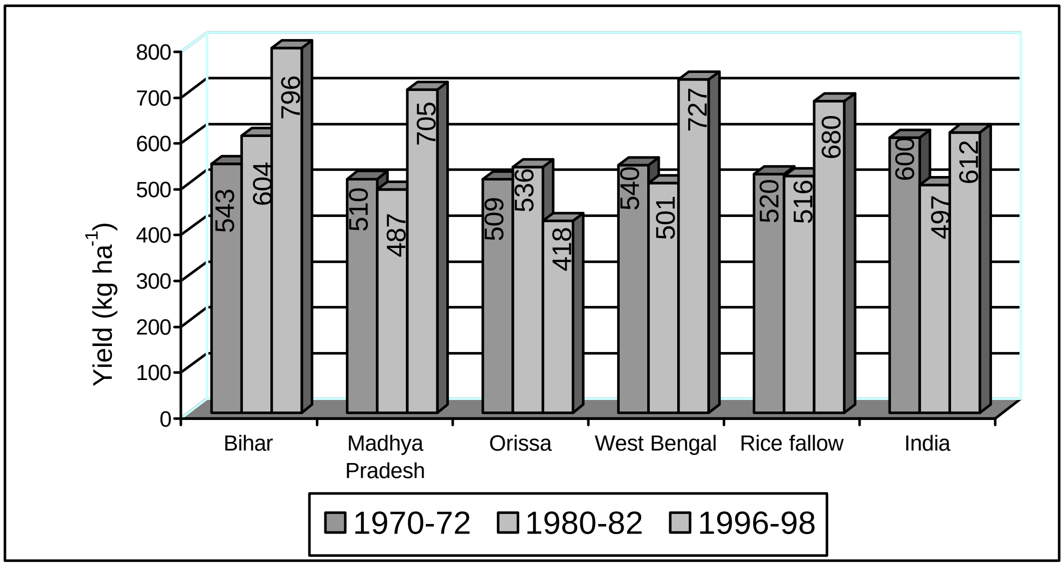

Figure 4. Average yield of pulses in rice fallow states.

The rate of growth in yield varied considerably across states (Table 6). In Bihar yield increased sharply until 1990, but later declined. In Madhya Pradesh and West Bengal the yield trend remained positive throughout, except during 1970s. During 1980s it increased at a rate of 2.6% a year but declined during 1990s. In Orissa it remained below 1% a year until 1990 but was negative at 5.3% a year during 1990s. On the whole, pulses yield in the rice fallow systems increased faster than the national average. Except in Orissa, yield growth has contributed positively to the growth in production, counteracting the faster decline in production due to area contraction. In Orissa growth in production occurred mainly due to area expansion.

Amongst different pulses chickpea is the most important in Madhya Pradesh accounting for 53% of the area and 69% of the pulses production (Table 7). Mung bean, lentil, and lathyrus each account for about 22% of the area in Bihar. Chickpea shares 14% of the area and 15% of the production. Black gram, mung bean, and pigeonpea occupy more than 80% of the area, and contribute 70% to the total production in Orissa. In West Bengal black gram is the most important pulse crop, followed by lentil. In these states chickpea accounts for less than 10% of the pulses area.

Table 7. Area and production of pulses in selected rice fallow states, 1996-98[1].

Crop	Bihar		Madhya Pradesh		Orissa		West Bengal		India	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
Chickpea	13.5	15.0	53.0	69.2	4.3	5.0	9.3	10.1	33.0	43.6
Pigeonpea	7.8	12.7	7.9	9.1	19.6	18.4	1.3	1.2	15.4	18.0
Black gram	9.5	5.0	10.3	4.0	31.8	25.5	42.9	36.0	14.0	9.0
Mung bean	22.2	12.3	2.7	1.1	32.3	25.5	4.6	2.9	14.0	8.1
Pea	3.5	2.2	3.0	1.5	3.3	2.8	2.5	2.2	3.4	4.3
Lentil	20.6	22.5	9.3	6.4	0.0	0.0	21.0	21.0	5.9	6.7
Lathyrus	22.9	23.8	12.8	8.5	0.0	0.0	9.2	10.5	4.4	4.0
All pulses	100	100	100	100	100	100	100	100	100	100

1. Data is percentage of total pulses.

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.

Yields of chickpea and pigeonpea in rice fallow states, except Orissa, are higher than the national average of 807 kg ha^{-1} (Table 8). Black gram and mung bean yields are highest in West Bengal, followed by Bihar, Orissa, and Madhya Pradesh. Pea yield is better in West Bengal, but still lower than the national average of 788 kg ha^{-1}. Lentil and lathyrus yields are higher than the national average in Bihar and West Bengal.

Table 8. Yield (kg ha^{-1}) of major pulses in selected rice fallow states, 1996-98.

Crop	Bihar	Madhya Pradesh	Orissa	West Bengal	India
Chickpea	922	920	568	885	807
Pigeonpea	1358	810	457	703	716
Black gram	444	277	391	685	393
Mung bean	463	279	385	516	353
Pea	520	357	418	716	788
Lentil	915	485	-	812	685
Lathyrus	867	468	-	931	557

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.

Despite high yield, chickpea area and production in the region declined during the last two decades, except in Madhya Pradesh (Table 9). But the yield growth has been positive and prevented a sharp decline in pulses production due to area contraction. Also, the pigeonpea area and production declined, except in Orissa. The decline was sharper in West Bengal. Yield growth was positive but low in Bihar and Madhya Pradesh. In rest of the states it declined at a rate of more than 1% a year. Black gram area and production declined at 2.4% a year except in West Bengal. In West Bengal, production increased at 2.8% a year, and most of the growth occurred due to increase in yield. In Madhya Pradesh also, yield increase checked sharp decline in the production. Mung bean area and production declined sharply in the region except in Bihar. Yield growth was negative or positive but low.

Pea production increased in Madhya Pradesh and West Bengal, and more than half of the growth was due to yield increase. Lentil performed better in Madhya Pradesh and Bihar. Lentil yield too increased; a faster increase took place in Bihar. Lathyrus production declined at 2.9% and 4% a year in Bihar and West Bengal respectively; most of it was due to area contraction. In Madhya Pradesh lathyrus production increased at a rate of 3.9% per annum, and the growth was solely due to yield increase.

Table 9. Annual compound growth (%) in area (A), production (P), and yield (Y) of major pulses in selected states of India, 1980-99.

Pulse	Description	Bihar	Madhya Pradesh	Orissa	West Bengal	India
Chickpea	A	-2.90	1.67	-2.26	-7.29	-0.05
	P	-1.58	3.98	-1.90	-5.86	1.26
	Y	1.36	2.27	0.38	1.54	1.31
Pigeonpea	A	-1.53	-1.72	2.10	-11.64	0.99
	P	-1.05	-1.67	0.63	-12.60	0.89
	Y	0.48	0.05	-1.44	-1.09	-0.10
Black gram	A	-2.39	-3.22	-3.06	0.25	0.40
	P	-2.88	-2.14	-3.47	2.79	1.60
	Y	-0.50	1.12	-0.43	2.53	1.20
Mung bean	A	0.57	-3.69	-6.50	-5.90	0.32
	P	1.11	-3.17	-7.92	-6.50	-0.05
	Y	0.54	0.54	-1.51	-0.64	-0.37
Pea	A	-0.54	2.07	-	3.40	4.06
	P	-2.17	3.42	-	8.64	4.53
	Y	-1.64	1.32	-	5.07	0.46
Lentil	A	0.18	2.87	-	-3.41	1.81
	P	2.46	4.13	-	-0.31	3.49
	Y	2.27	1.22	-	3.20	1.65
Lathyrus	A	-4.58	-0.07	-	-8.89	-1.76
	P	-2.91	3.86	-	-4.06	0.75
	Y	1.75	3.93	-	5.29	2.55

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.

During 1990s both area and production of most of the pulses in the region declined, whereas at the national level these witnessed a positive trend. However, yield trend of most of the pulses in these states has been stronger compared to the national trend. Thus yield increases have counteracted the sharper fall in production of pulses in the rice fallow systems. These findings imply that there is a considerable scope to introduce pulses in rice fallow systems. Nevertheless, the relative yield potential of different pulses, their profitability and consumer acceptance should be given due consideration while targeting introduction of pulses in a particular rice fallow system.

4. Constraints to Rainfed Rabi Cropping

In the previous section it was observed that production of pulses declined significantly in the rice fallow systems in the recent decade, mainly due to contraction in their area. The rate of decline would have been much higher had there been no productivity growth. Amongst the rabi pulses, chickpea area declined except in Madhya Pradesh, lentil area in West Bengal, and lathyrus in all the rice fallow states. The issue is whether the decline is due to supply or demand problem or both. Nevertheless, there is a possibility of growing a wide range of crops in rabi fallow lands under rainfed conditions. This section identifies abiotic and socioeconomic constraints to area expansion under rabi crops in general and pulses in particular in the rice fallow systems.

Abiotic constraints

A number of abiotic factors limit utilization of rabi fallow lands (Table 10). Broadly these factors can be put into two main categories: water related and soil related. Water is critical for seed germination and crop growth. Water related constraints include low moisture content in the soil after rice harvest, faster decline in water table with advancement of rabi season, and risk of drought towards flowering and harvest stages. As rabi crops in rice fallow systems are grown on residual moisture after rice harvest, a good rainfall towards terminal period of rice crop provided sufficient moisture for germination and establishment of the next crop. But the rainfall is uncertain. During kharif season water table is generally high but as the monsoon rains withdraw, the water table recedes very fast. This restricts investment in irrigation. Further, rabi rainfall is uncertain, and even if the crop has established well utilizing available soil moisture, lack of rabi rainfall towards harvesting stage creates drought conditions leading to crop failure. The success of rabi cropping is thus viewed uncertain by the farmers. Soil related constraints include soil hardiness after harvest of puddled rice, soil cracking after rice harvest, low organic matter content of the soil, and problem of salinity and alkalinity. Amongst these, soil hardiness is the most limiting factor, followed by low organic matter content in the soil. Other constraints are not so important and are location specific.

Table 10. Percentage of households reporting water and soil related constraints to rabi cropping in rice fallows.

Constraint	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Low water table	96	93	10	96	93
Low residual moisture	91	97	80	94	97
Soil hardiness after puddled rice	85	99	69	94	96
Low organic matter content	79	97	76	94	90
Terminal drought	66	63	37	69	78
Soil cracking	21	1	0	21	6
Salt-affected soils	6	0	0	6	1

Source: Field survey (2002).

Crop management and growth related constraints

Chickpea, wheat, mustard, and lathyrus have the potential for cultivation in almost all the states. Chickpea, however, is preferred everywhere. Lathyrus is important in Chhatisgarh, Jharkhand, Orissa, and West Bengal. Lentil is important for farmers of Madhya Pradesh. Table 11 presents farmers' perceptions on crop management and growth related constraints to cultivate these crops.

Non-availability of short-duration varieties of the identified crops is the main limiting factor for their cultivation (Table 11). This is reported by a majority of the farmers in all the states and for all the crops. Short sowing period is the next important limiting factor, as the farmers have to sow the rabi crops on residual moisture. At the same time farmers have to undertake threshing of the rice crop. The residual moisture disappears in due course, and delay in sowing reduces seed germination resulting in loss of seed. However, farmers feel that if the seed is sown soon after rice harvest, seed germination rate is high and plant stand is good. Further, as the crop advances the probability of crop failure increases if there is no rainfall. Long-duration varieties often suffer the most from terminal drought.

Two important implications emerge from this. First, there is a need to develop or introduce short-duration varieties that can escape terminal drought. Second, there is also a need either to introduce short-duration varieties of rice or if possible promote early sowing of rice crop to facilitate sowing of the rabi crops on residual moisture in time.

Table 11. Percentage of households reporting crop management and growth related constraints in rice fallows.

Constraint	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Chickpea					
Short sowing period	22	95	60	57	90
Lack of short-duration varieties	95	97	90	64	93
Poor seed germination	17	8	3	7	6
Poor plant stand	31	8	3	11	4
Lathyrus					
Short sowing period	30	69	-	46	82
Lack of short-duration varieties	82	73	-	96	88
Poor seed germination	3	4	-	5	0
Poor plant stand	3	2		14	0
Lentil					
Short sowing period	-	9	70	83	88
Lack of short-duration varieties	-	94	92	67	88
Poor seed germination	-	22	0	17	25
Poor plant stand	-	11	5	33	25

Source: Field survey (2002).

Even if the crop is sown timely and establishes well, farmers from their experience have narrated high incidence of insect pests and diseases. Table 12 presents farmers' response to the insect pest and disease problems in rabi crops. In chickpea, insect pests (particularly *Helicoverpa*) is reported to be a potentially severe problem in Chhatisgarh, Jharkhand, and Madhya Pradesh. Diseases are also viewed as a severe problem by a considerable number of respondents in these states. In Orissa and West Bengal, area under chickpea is small and farmers perhaps are not much aware of the pest problem.

Table 12. Percentage of households reporting severe pest problems in rice fallows.

State	Insect pests			Diseases		
	Chickpea	Lathyrus	Lentil	Chickpea	Lathyrus	Lentil
Chhatisgarh	91	79	-	50	15	-
Jharkhand	62	67	44	44	56	22
Madhya Pradesh	90	56	-	67	71	-
Orissa	30	64	33	11	18	33
West Bengal	41	64	13	10	9	0

Source: Field survey (2002).

Insect pests and diseases are also viewed as serious problems in lathyrus, but not so severe as in chickpea. Similarly, these problems are less severe in lentil. It is to be noted that lathyrus and lentil are hardy crops and can withstand pest attack better as compared to chickpea. This implies that before introduction of new crops in rice fallow areas it is important to consider the potential damages due to insect pests and diseases, and accordingly recommend varieties that are resistant to these stresses. Further, the pest management packages should minimize the potential losses to crops.

Resource constraints

Even if a crop has the technical potential to thrive under rainfed conditions, non-availability of inputs and resources may not allow its cultivation. A majority of the farmers in all the five selected states lack capital to meet the operational costs of cultivation (Table 13). Farmers feel that it is difficult to cultivate rabi crops without irrigation, and most of them indicated a lack of capital to invest in on-farm irrigation facilities.

Table 13. Percentage of households reporting resource constraints to rainfed rabi cropping.

Constraint	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Lack of capital to invest in irrigation	97	91	60	96	96
Lack of funds to purchase inputs	84	96	97	100	94
Scarcity of human labor during sowing period	21	55	33	58	71
Lack of draft power during sowing period	15	21	34	10	17

Source: Field survey (2002).

Labor is surplus in these states and laborers remain idle after rice harvest. Yet, the farmers experience scarcity of labor during the sowing period. This is because of higher demand for labor for rice harvesting and threshing, while at the same time farmers have to quickly sow the next crop so as to utilize the available soil moisture. Some farmers also report shortage of draft power for timely sowing of the rabi crops.

Information constraints

Improving farmers' access to information related to crops and their cultivation practices is important in the process of utilization of fallow areas. In the selected villages non-governmental organizations (NGOs) have been the main source of information on rabi crops (Table 14). This is because the NGOs implemented the participatory research trials on behalf of ICRISAT and DFID. The next important source of information is the government extension system. But the extension system is quite weak as this is reported as a source of information by only 10-37% of the farmers in the selected states. Input dealers and mass media too provided information on rabi cropping in some states.

Table 14. Percentage of households reporting sources of information on rainfed rabi crops.

Source	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
NGO	93	97	91	88	94
Extension workers	37	14	10	23	14
Input dealers	19	1	0	15	0
Radio	15	16	0	2	0
Magazines/newspaper	9	11	0	2	0

Source: Field survey (2002).

Input constraints

More than 90% of the respondents indicate non-availability of good quality seed as the most binding constraint to rabi cropping (Table 15). Besides, prices of quality seeds are often many times higher than the home produced seeds. Non-availability of pesticides in adequate quantity and at right time is also an important hindrance in cultivation of both rabi and kharif crops. The use of pesticides is very low in these states (Birthal 2001). Besides, cost of pesticides is also an important consideration. Fertilizer is not a serious constraint but is not readily available. Some farmers also feel that fertilizers are costly. It may be surprising that without cultivating rabi crops how farmers could indicate these problems. Problems related to seed are real, but those related to other inputs are largely based on their experiences for kharif crops.

Table 15. Percentage of households reporting constraints related to input availability and their prices.

Constraints	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Non-availability of good quality seed	91	90	90	100	96
Non-availability of pesticides	68	58	69	54	86
High cost of seed	56	84	63	92	91
High cost of fertilizers	27	45	44	31	16
Irregular availability of fertilizers	27	33	59	19	38
High cost of pesticides	50	76	51	60	83

Source: Field survey (2002).

Marketing constraints

Apart from availability of critical inputs in right quantity and time, assured procurement of produce at a remunerative price is essential to promote new crops particularly in the backwards areas such as rice fallow states. This section examines farmers' perception regarding marketing constraints for rabi pulses.

Lack of markets for the produce appears to be an important limitation in promotion of pulses in rice fallow areas (Table 16). For most of the pulses some farmers feel that there is a local demand for pulses in the rice fallow states. Demand for lathyrus is extremely limited due to fear of toxins in it. This, in recent years, has caused hazards to human health in certain areas. Markets are far away from the selected villages. Although for most of the pulses transactions take place in these markets, their marketable surplus is low due to low level of production. Transportation is not a binding constraint in disposal of the produce. It appears that market for pulses are not well developed in the region. These results are in conformity with the observation of Byerlee and White (2000) that markets are thin for pulses in the marginal environments.

Output prices play an important role in farmers' choice of crops. Farmers choose those crops that yield maximum net profit. Farmers in the rice fallow systems feel that prices of pulses are low, particularly for all the rabi pulses. This is perhaps due to low marketable surplus as some unscrupulous persons might under-price the produce. In India the Commission for Agricultural Costs and Prices of the Government of India fixes minimum support prices for most of the pulses.

Table 16. Percentage of households reporting marketing constraints to rabi crops.

Description	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Chickpea					
Low local demand	36	31	23	27	4
Distant market	0	28	17	34	16
No dealing in local market	3	13	13	7	7
Lack of transport	0	20	10	18	7
Low price	48	33	70	43	34
Lathyrus					
Low local demand	12	93	-	96	97
Distant market	0	28	-	34	16
No dealing in local market	0	11	-	18	6
Lack of transport	0	20	-	9	7
Low price	94	87	-	96	100
Lentil					
Low local demand	-	39	42	67	25
Distant market	-	28	17	34	16
No dealing in local market	-	11	3	17	13
Lack of transport	-	20	10	18	7
Low price	-	56	58	50	25

Source: Field survey (2002).

Farm harvest prices in the selected markets during 2000-01 were higher than the minimum support price (Fig. 5). The ruling market prices are higher than the minimum support price. However, these prices represent the averages of the prices in selected markets. The producers in the selected villages might be receiving less than these prices due to low marketable surplus.

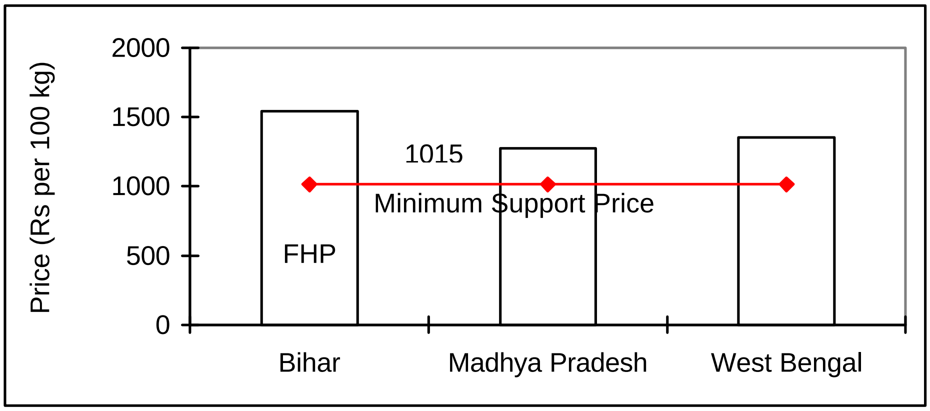

Figure 5. Farm gate price of chickpea in the selected rice fallow states, 2000-01.
[Source: Report of the Commission of Agricultural Costs and Prices, Government of India (2002).]

Yield and price risk

Both the yield and price risks are higher for pulses production compared to cereal production (Byerlee and White 2000). The risk is mainly due to conditions in which pulses are grown; in general pulses are grown in marginal areas and under largely rainfed conditions. Table 17 presents farmers' response to yield and price risk in pulses production. In all the states about 50% or more of the farmers feel that yield risk is quite high in pulses production. Yield risk is relatively higher in chickpea compared to lentil and lathyrus. Similar observations are made for price risk.

Table 17. Frequency distribution (%) of farmers perceiving high risk in pulses production in selected states in India.

Type of risk	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Chickpea					
Yield	45	55	70	50	60
Price	45	46	63	32	32
Lathyrus					
Yield	44	41	-	47	44
Price	49	33	-	44	49
Lentil					
Yield	-	22	22	33	38
Price	-	33	17	18	25

Source: Field survey (2002).

Coefficient of variation (CV) in yield and price of chickpea was calculated to examine the degree of yield and price risk. The variability in yield increased during 1990s except in Orissa (Fig. 6). The CV in real wholesale prices of chickpea is greater than that in yield, and the variability in yield has increased during 1990s.

Animal grazing

When a considerable proportion of land remains fallow, domestic animals are often left to graze freely. This is a common practice in the region and is likely to be a major threat to rabi crop production at least until a sizeable proportion of the fallow land is brought under cultivation. This has happened in the study region, where a number of contact farmers have reported destruction of crop by stray animals. However, as more and more area is brought under cultivation, the threat would disappear. For example, a similar threat existed for soybean when it was first introduced in fallow systems of Madhya Pradesh. However, when technical and economic feasibility of soybean production was proven, its cultivation spread on a wider area, and free animal grazing was stopped.

The observations made in this section suggest that abiotic factors are the potential limiting factors to rainfed rabi cropping in rice fallow systems. Socioeconomic factors are also restricting cultivation of rabi crops. These need not be ignored while planning introduction of rabi crops in rice fallow systems. The constraints need to be alleviated through technological, agronomic, and policy interventions. The findings suggest the following interventions to promote rainfed rabi cropping in the rice fallow systems:

- Introduction of short-duration varieties of pulses capable of escaping the terminal drought.
- Introduction of short-duration varieties of rice to enable farmers to sow rabi crops on residual moisture in time or promote early sowing of rice, whichever is feasible.
- Strengthen farmers' access to information on rabi crops and their cultivation practices by strengthening the agricultural extension system.

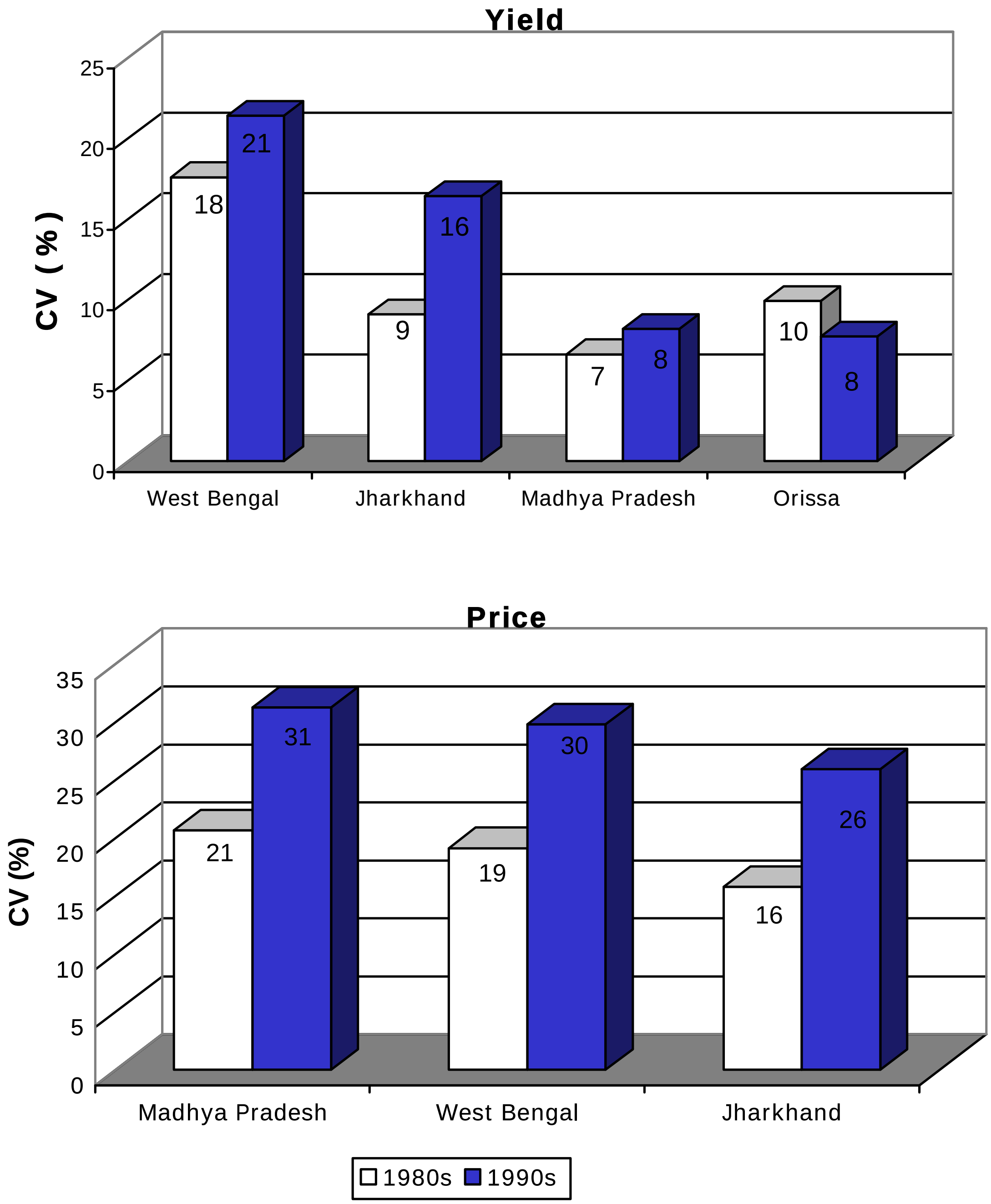

Figure 6. Coefficient of variation (CV) in chickpea yield and price in the selected rice fallow states of India.

- Improve farmers’ access to improved seeds and critical inputs.
- Technological efforts to overcome production risk may be accompanied by implementation of area-wide crop insurance scheme.

Some of these issues are examined in the following section.

5. Opportunities in Rainfed Rabi Cropping

Having examined the potential crops suitable for cultivation in rice fallow systems under rainfed conditions and the factors limiting their cultivation, two questions on their technical and economic feasibility need to be addressed. If rabi cropping is feasible, then what kind of technologies and policies will be required for area-wide cultivation of rabi crops? Further, is there a market to absorb the increased production? This section examines the technical and economic feasibility of chickpea cultivation, farmers' acceptance of the crop/variety, benefits of rabi pulses in terms of income and employment generation, nutritional value of pulses, and effect of pulses cultivation on soil fertility in the rice fallow states; and market opportunities for pulses at the national level.

Technical and economic feasibility of chickpea cultivation

The first and foremost opportunity to utilize the rabi fallow lands lies in farmers' acceptance of the crop and its technology of production. Opportunity cost of the fallow land is zero, and any crop that generates returns greater than its cost of production is likely to be acceptable to the farming community. In order to demonstrate that it is feasible to grow crops on residual moisture in the fields vacated by rice, ICRISAT and DFID conducted on-farm participatory chickpea trials in the rice fallow states utilizing mainly three inputs, i.e., seed, human labor and bullock labor. Three different varieties of chickpea namely ICCV 2, ICCC 37, KAK 2 were sown with two different technologies: seed priming and non-priming[2]. Each of these varieties was cultivated on a 100 m^2 plot in the fields of the contact farmers. An economic analysis of these trials was undertaken to examine their technical and economic feasibility in the states of Madhya Pradesh and Jharkhand. In other states the crop could not reach the harvesting stage because of grazing by stray animals, human encroachment for green leaf consumption, and terminal drought due to late sowing. This happened in many farmers' fields in Madhya

[2] Under seed priming the seed is soaked overnight then dried before sowing. ICCV 2 and KAK 2 are white bold-seeded, kabuli types while ICCC 37 is a brown-seeded desi variety. ICCV an KAK 2 carry a premium price.

Pradesh, and Jharkhand, but a few farmers who could sow the seed timely and protect the crop from stray animals reaped a good harvest. Tables 18 and 19 present costs and returns of only those farmers who could harvest a good crop.

Table 18. Yield, cost, and returns of different chickpea varieties using seed priming technology in Madhya Pradesh[1].

Item	Non-priming	Priming	% change over non-priming
ICCV 2			
Cost of cultivation (Rs ha^{-1})	4875	5140	5.44
Yield (kg ha^{-1})	1400	1450	3.57
Gross returns (Rs ha^{-1})	22400	23200	3.57
Net returns (Rs ha^{-1})	17525	18060	3.05
Cost of production (Rs kg^{-1})	3.48	3.54	1.80
ICCC 37			
Cost of cultivation (Rs ha^{-1})	4373	4682	7.07
Yield (kg ha^{-1})	1367	1400	2.41
Gross returns (Rs ha^{-1})	17771	18200	2.41
Net returns (Rs ha^{-1})	13398	13518	0.90
Cost of production (Rs kg^{-1})	3.20	3.34	4.54
Local variety			
Cost of cultivation (Rs ha^{-1})	3761	3961	5.32
Yield (kg ha^{-1})	1025	1083	5.66
Gross returns (Rs ha^{-1})	13325	14079	5.66
Net returns (Rs ha^{-1})	9564	10118	5.79
Cost of production (Rs kg^{-1})	3.67	3.66	-0.32

1. Cost of cultivation includes the cost of human labor, bullock labor, and seed.
Source: Field survey (2002).

In Madhya Pradesh, yield comparison across varieties indicates better performance of ICCV 2 both with and without seed priming technology compared to ICCC 37 and local variety. The difference in yield of ICCV 2 and ICCC 37 is, however, negligible but compared to the local variety their yields are much higher. Further, yield and gross returns of the three varieties are higher with seed priming than non-priming but the differences are negligible (Table 18).

Cost of cultivation with seed priming is slightly higher compared to non-priming. But the net returns are higher with seed priming. The unit cost of production is marginally higher for seed priming due to higher cost. ICCC 37 appears to be cost-efficient both with and without seed priming.

Analysis of Jharkhand trials shows little difference in the yield of ICCC 37 and KAK 2 both with and without seed priming. However, the yield of both the varieties is about 15-16% higher with seed priming than with non-priming (Table 19). Although seed priming is costly, higher net returns (20-21%) are obtained. The unit cost of production with seed priming is less by 10% in ICCC 37 and 12% in KAK 2. However, cultivation of KAK 2 is cost-efficient compared to ICCC 37.

Table 19. Yield, cost, and returns of different chickpea varieties using seed priming technology in Jharkhand[1].

Item	Non-priming	Priming	% change over non-priming
ICCC 37			
Cost of cultivation (Rs ha^{-1})	4474	4638	3.67
Yield (kg ha^{-1})	900	1033	14.78
Gross returns (Rs ha^{-1})	13500	15500	14.81
Net returns (Rs ha^{-1})	9026	10862	20.34
Cost of production (Rs kg^{-1})	4.97	4.49	-9.66
KAK 2			
Cost of cultivation (Rs ha^{-1})	4559	4629	1.54
Yield (kg ha^{-1})	942	1090	15.71
Gross returns (Rs ha^{-1})	16950	19620	15.75
Net returns (Rs kg^{-1})	12391	14991	20.98
Cost of production (Rs kg^{-1})	4.84	4.25	-12.19

1. Cost of cultivation includes the cost of human labor, bullock labor, and seed.
Source: Field survey (2002).

These results are based on limited observations and need to be interpreted cautiously. Size of the plot was small and chances of errors particularly in estimation of cost could be high. We feel that due to small size of plot there is an overestimation of cost. However, as the cultivation becomes widespread cost towards human labor and bullock labor is expected to decline due to economies of scale in their utilization. Nevertheless, the results suggest that it is feasible to grow rabi pulses under rainfed conditions technically as well as economically.

Farmers' willingness to grow chickpea

Despite incidences of animal grazing, human encroachment, and terminal drought a majority of the contact farmers are satisfied with the participatory research trials (Table 20). These trials have generated hope of growing pulses on residual moisture in the fields vacated by rice through technological interventions and agronomic manipulations. The seed germination was good, crop established well, and in some cases there was a good harvest. Further, almost all the contact farmers have expressed their willingness to grow chickpea in the coming season (Table 20). These farmers could recognize the benefits of seed priming and preferred to use this technology in the future.

Table 20. Contact farmers (%) willing to grow rainfed chickpea.

State	Satisfied with demonstration	Willing to grow chickpea	Technology preference	
			Seed priming	Relay cropping
Chhatisgarh	97	100	91	9
Jharkhand	85	97	79	21
Madhya Pradesh	100	100	94	6
Orissa	70	97	85	12
West Bengal	100	97	89	11

Source: Field survey (2002).

Nevertheless, contact farmers have desired to have a better access to inputs and more information to grow chickpea on a continuous basis (Table 21). Seed is their main requirement. Short-duration varieties of chickpea are preferable so as to avoid terminal drought. At the same time, farmers also expect short-duration varieties of rice to be made available so that they can get sufficient time for land preparation and sowing of chickpea on the residual moisture. Besides facilitating timely sowing of chickpea, short-duration rice crop would also help chickpea to escape terminal drought. To harvest a good crop many farmers have desired to have an assured supply of fertilizers and pesticides, and the credit to purchase these inputs. The problem of input availability, however, is location specific.

Table 21. Input and information requirement of contact farmers (%) willing to grow chickpea.

Input and information	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Seed availability	94	94	100	97	100
Short-duration chickpea variety	13	85	89	97	97
Short-duration rice variety	25	79	91	70	89
Fertilizers	53	42	91	42	17
Pesticides	97	67	97	85	83
Bullock labor	3	15	14	6	3
Tillage equipment	3	18	14	12	6
Assured market	13	33	3	30	14
Credit facilities	0	82	9	76	86

Source: Field survey (2002).

The participatory research trials have created a good demonstration effect on non-contact farmers. A majority of the farmers reported to have visited trial sites with the curiosity to learn about rainfed rabi cropping practices (Table 22). These farmers are sensitized, and have expressed their willingness to grow chickpea in the forthcoming rabi season provided seed is available. Like contact farmers, a majority of the non-contact farmers willing to grow chickpea have indicated using seed priming technology.Seed, however, is their main requirement (Table 23). Availability of short-duration varieties would provide further incentives. These farmers also need information

Table 22. Non-contact farmers (%) willing to grow chickpea.

Description	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Awareness about trials	100	97	100	100	100
Frequency of visit to the site					
Regular	86	97	100	100	65
Never	14	3	0	0	35
Willingness to grow					
Yes	94	94	97	100	97
No	6	3	3	0	0
Undecided	0	3	0	0	3
Preference of method of sowing					
Relay cropping	44	85	3	87	71
Seed priming	56	15	97	13	29

Source: Field survey (2002).

on insect pest and disease management. Being small landholders, they are capital starved and need credit support to purchase the critical inputs such as seed, fertilizers, and pesticides. Some farmers do not possess draft power, and thus they also need credit support to acquire bullocks so as to ensure timeliness in sowing.

Table 23. Input and information requirement of non-contact farmers (%) willing to grow chickpea.

Input and Information	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Seed availability	100	97	100	100	100
Information on method of sowing	86	91	94	100	91
Short-duration variety	67	100	94	87	100
Information on disease control	100	85	100	0	100
Information on insect control	92	85	100	0	91
Credit facilities	97	94	100	100	100
Bullock labor	56	85	83	0	94
Tillage equipment	0	12	0	0	3
Assured market	0	12	20	0	0

Source: Field survey (2002).

Benefits of rabi cropping

Utilization of fallow lands is likely to generate substantial income and employment opportunities for the millions of small landholders in the region. To assess the economic benefits of chickpea cultivation in rabi fallows some rough calculations of economic surplus were made assuming 10%, 20%, and 30% utilization of rabi fallow area for chickpea cultivation over a period of 10 years. Utilization rate is assumed to increase linearly. One hectare of land under chickpea is assumed to yield a minimum of Rs 5000. A discount rate of 10% is applied to estimate the present value of net benefits. If 10% of the rabi fallow area is brought under chickpea cultivation over a period of 10 years, it is expected to generate an additional net income worth Rs 13792 million (Fig. 7). Assuming an upper limit of 30% area under chickpea cultivation net benefits would be substantially high (Rs 41376 million).

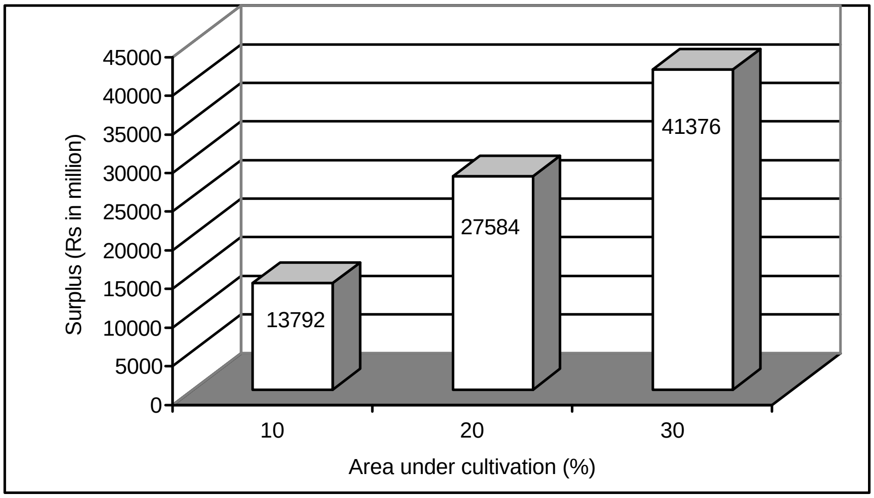

Figure 7. Ex-ante estimates of economic surplus in the rice fallow region (Source: Field survey, 2002).

Estimates were also made on additional employment generation due to rabi cropping on fallow lands. The assumption concerning utilization rates remains the same as for income. Estimates from trials indicate that on average one hectare of land under chickpea generates about 50 mandays of employment. Based on this assumption, it is estimated that if at any point of time 10% of the rabi fallow is brought under chickpea cultivation it would generate 47 million mandays of employment per annum (Fig. 8). If 30% of the rabi fallow land is utilized at any point of time it would add another 95 million mandays.

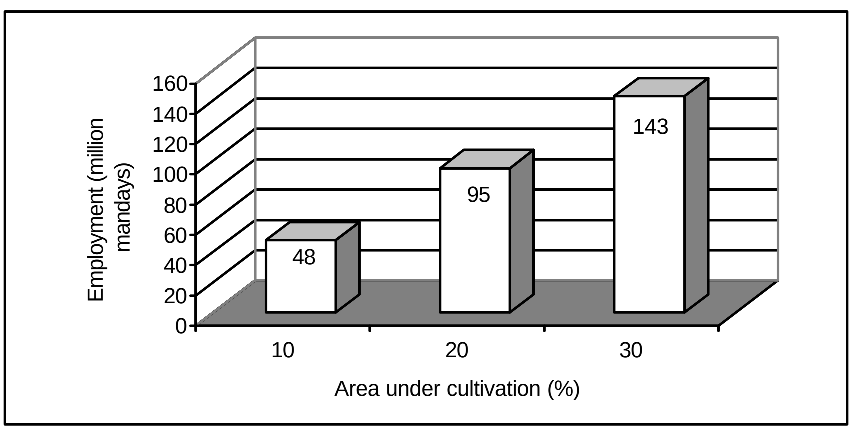

Figure 8. Ex-ante estimates of employment generation in the rice fallow region (Source: Field survey, 2002).

Apart from income and employment benefits, pulses provide much needed protein to the majority vegetarian population in India, help improve soil fertility by fixing atmospheric nitrogen, and improve soil structure by adding organic matter content. Farmers are aware of some of these benefits. More than half of the farmers are aware of the nutritive role of pulses in human diet (Table 24). The awareness about its beneficial effects on soil fertility is limited. In Jharkhand 31% of the farmers are aware of it, whereas in other states only about 7-11% of the farmers are aware of it. Awareness about the role of pulses in breaking pest cycle is extremely limited.

Table 24. Percentage of farmers aware of the benefits of pulses.

Benefits	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Nutritive value	44	55	43	56	57
Soil fertility	7	31	8	11	9
Insect pest control	1	24	0	8	0

Source: Field survey (2002).

Rising demand for pulses

In India pulses supply is short of demand. This offers major opportunity to increase pulses production by bringing rabi fallow lands under their cultivation. The per capita pulses availability in India declined from about 60 g day^{-1} in 1950s to about 30 g day^{-1} in 1990s (Fig. 9). One of the reasons for this is the movement of pulses production from favored to marginal areas. In favored regions wheat and rice area increased at the cost of coarse cereals, pulses, and oilseeds. Lack of technology to improve pulses yield and thereby their profitability paved way to cultivation of less risky and profitable crops such as rice and wheat. In the immediate future there are remote possibilities that in the favorable regions pulses will regain their lost area. The hope to raise pulses production lies in marginal areas such as rice fallow systems.

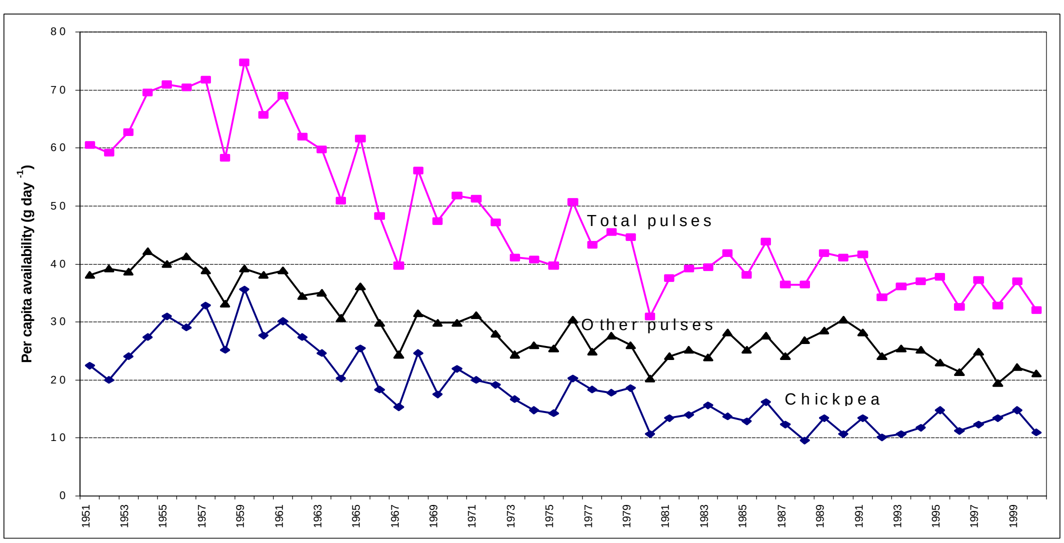

Figure 9. Trends in per capita availability of pulses in India.

At present, per capita consumption of pulses in rural India is about 10 kg $year^{-1}$ (Table 25). But there is a marked variation across states including rice fallow states. Per capita consumption of pulses in Bihar and Madhya Pradesh is closer to the national average. In Orissa and West Bengal it is half of the national average. The consumption of substitutes of pulses as a source of protein indicates that in West Bengal fish, egg, and meat substitute pulses to some extent. Consumption of milk is much less compared to the national average particularly in Orissa and West Bengal. The introduction of pulses in these states is therefore expected to contribute to improving nutritional security.

Table 25. Per capita consumption of pulses in the rice fallow states, 1999-2000.

Item	Bihar	Madhya Pradesh	Orissa	West Bengal	India
Cereals (kg yr^{-1})	165	155	181	163	153
Pulses (kg yr^{-1})	9	10	6	6	10
Milk (L yr^{-1})	29	33	8	16	45
Eggs (number yr^{-1})	6	4	6	36	13
Fish (kg yr^{-1})	2	1	4	7	3

Source: Level and pattern of consumer expenditure in India, 1999-2000. National Sample Survey Organization. Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

There are marked differences in consumer preferences for pulses (Fig. 10). In Madhya Pradesh pigeonpea is the most preferred pulse, followed by chickpea and lentil. These together share 62% of the total pulses consumed in the state. Lentil is most preferred in West Bengal, Bihar, and Orissa. Chickpea ranks second in Madhya Pradesh and Bihar. In West Bengal chickpea consumption is almost negligible. Yet there is considerable demand for chickpea outside rice fallow states as is indicated by its share in total pulses consumption in the country.

Demand for pulses is increasing. Paroda and Kumar (2000) have projected pulses demand towards 2030 at 24.5 million t assuming that the economy grows at a rate of 3.5% per annum (Table 26). It is expected to be 26.3 million t if the economy grows at a faster rate of 5.5% per annum. The per capita consumption is expected to increase from the current 10 kg yr^{-1} to around 12 kg yr^{-1}. Further, the demand for pulses is expected to grow faster than that of cereals. To meet the projected demand, productivity of pulses has to be raised to about 1 t ha^{-1} from the current 0.6 t ha^{-1} assuming that area under pulses is not going to expand. If the pulses yields do not increase, the rabi fallow areas offer enormous opportunities to meet the future demand for pulses.

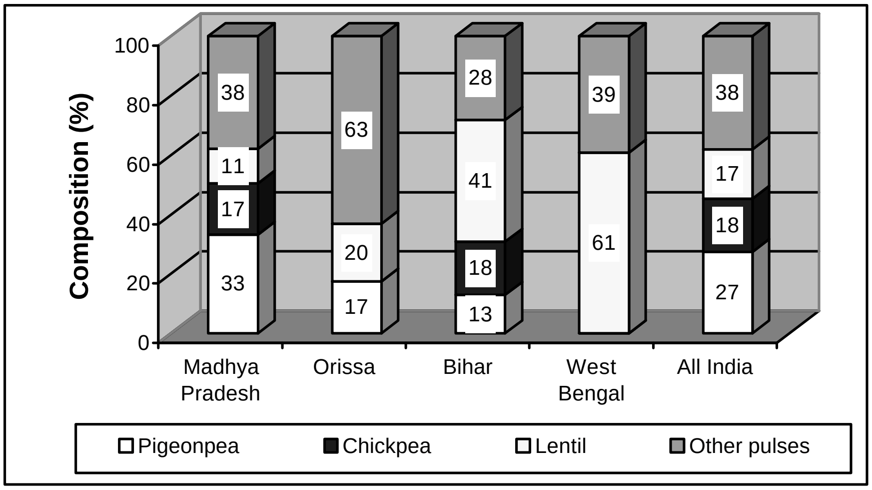

Figure 10. Composition of pulse consumption basket in the selected rice fallow states, 1999-2000.

Table 26. Demand projections for pulses in India towards 2030.

Particulars	Economic growth rate	
	Low (3.5%)	High (5.5%)
Per capita demand (kg yr^{-1})	11.7	12.5
Total demand (million t)	24.5	26.3
Annual growth in demand (%)		
Pulses	1.5	1.7
Cereals	1.2	1.1
Target pulses yield to meet demand (t ha^{-1})	0.96	1.0

Source: Paroda and Kumar (2000).

Import substitution

To meet the domestic demand India imports huge quantities of pulses (Fig. 11). In recent years India's imports have risen. Every year the country imports around 200 thousand t of pulses but in certain years it has gone up to 1100 thousand t. India also exports pulses such as mung bean and black gram but negligible amounts. Bringing rice fallow area under cultivation of pulses would contribute towards reducing import dependency of the country.

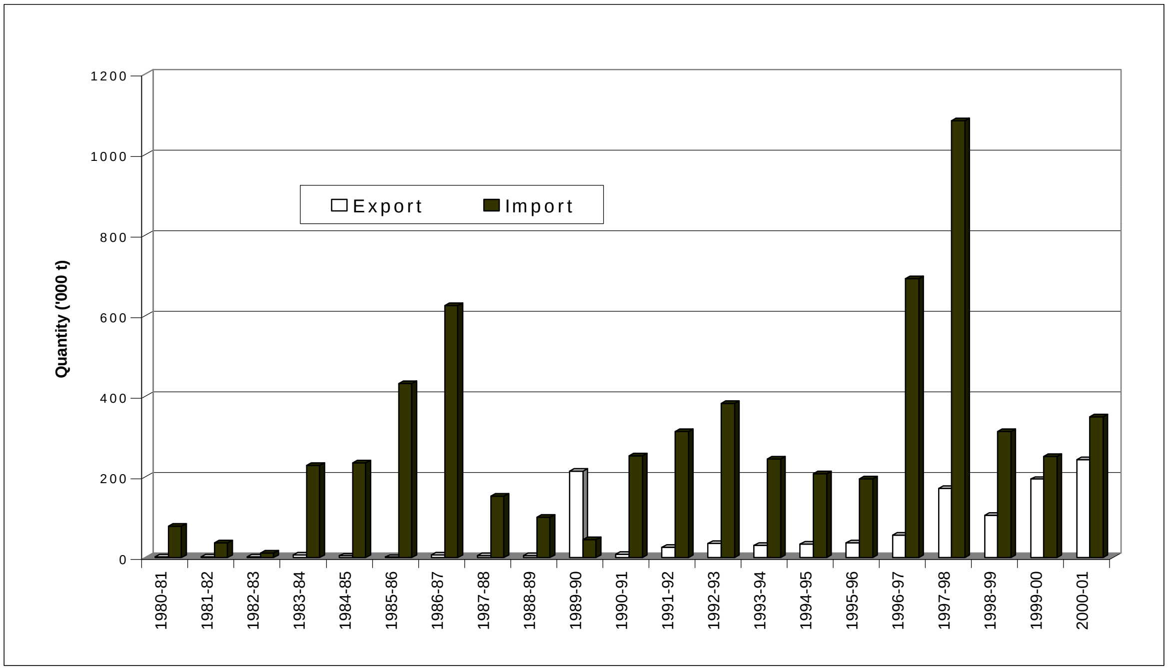

Figure 11. Trends in import and export of pulses in India (Source: Economic Survey (various years), Ministry of Finance, Government of India, New Delhi, India).

Pulses as a low-cost source of protein

Pulses are an important source of protein for the poor. These are the cheapest source of protein, compared to their substitutes like milk, eggs, and meat (Fig. 12). Protein from mung bean is the least costly protein, followed by chickpea, black gram and pigeonpea. The cost of obtaining 100 g protein from these pulses is Rs 9 to Rs 13. The cost of obtaining the same amount of protein from milk is Rs 14 and from eggs Rs 21. The cost of protein from beef and mutton is about three times higher than that of mung bean, chickpea, and black gram.

With appropriate technologies and extension support, rice fallow lands can make significant contribution to increase pulses production in India and reduce import dependence. The Government of India has consistently been making efforts to improve pulses production. The Technology Mission on Pulses and Oilseeds was launched during late 1980s. The Commission on Agricultural Costs and Prices announces minimum support price for most of the pulses. Prices of pulses have been higher than their competing cereals rice and wheat, but because of their low yields pulses are less profitable than rice and wheat. The key to increasing pulses production in India lies in achieving a breakthrough in technology of pulses production, and utilization of rice fallow lands.

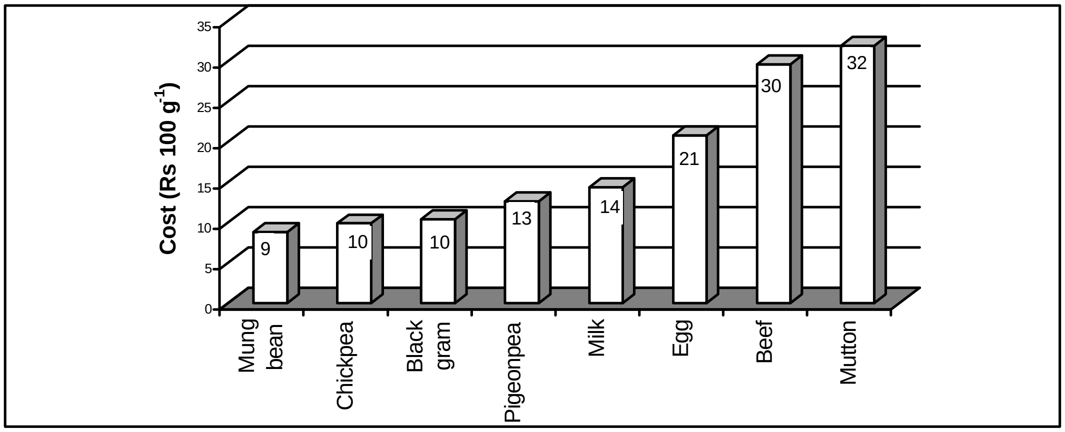

Figure 12. Cost of protein from pulses and their substitutes in rural India (Source: Computed using information in Gopalan, C., Rama Sastri, B.V., and Balasubramanian, S.C. 2000. Nutrient value of Indian foods. National Institute of Nutrition, Hyderabad; and Government of India. 2001. Level and pattern of consumption expenditure in India, 1999-2000. National Sample Survey Organization, Ministry of Statistics and Programme Implementation, New Delhi, India).

6. Conclusions and Implications

In India about 30% of the 40 million ha of kharif rice area remains unutilized due to a number of biotic, abiotic, and socioeconomic constraints. More than 80% of this lies in the eastern states of Chhatisgarh, Jharkhand, Madhya Pradesh, Orissa, Assam, and West Bengal. Predominance of small and marginal land holdings is a characteristic feature of the region, and unlike in Punjab and Haryana private and public investment in agriculture is poor. The net result of non-utilization of this vital resource is agricultural backwardness, low levels of income of rural population, abject poverty, unemployment, and labor migration to the cities and agriculturally developed states. Bringing fallow land under cultivation would help overcome many of the social and economic problems of the region. ICRISAT and DFID/PSP have jointly taken an initiative to promote rainfed rabi cropping in rice fallow lands by sensitizing farmers through on-farm participatory research.

The study has shown that rabi cropping in the region has the potential to become popular despite existence of multifarious constraints. Table 27 summarizes the results of the study in the form of a SWOT analysis (strengths, weaknesses, possible opportunities and threats).

Strengths of rice fallow areas

The main strengths of the region are the existence of huge rabi fallow area and availability of abundant and cheap labor, which remains grossly underutilized during the rabi season. Further, yields of the pulses in the region are higher than the national average, implying a possibility to profitably introduce these in the rabi fallow land. Economic analysis of chickpea cultivation presented in this study suggests that pulses can be profitably cultivated in rice fallows in the postrainy season. The region is endowed with fertile soils, and monsoon rainfall is good and facilitates cultivation of pulses on residual moisture in the rice harvested fields.

Weaknesses of rice fallow areas

Major weakness of the region is that it has been bypassed by the agricultural research and extension systems. Some of the major constraints in promotion of rabi cropping under rainfed conditions are lack of quality seed, lack of short-duration drought escaping varieties of pulses, lack of short-duration varieties of rice facilitating timeliness in sowing pulses on residual moisture, uncertain rabi season rainfall, and problem of insect pests and diseases. Extension system is weak to transfer the technologies and information and lack of access to these might be a disincentive. Demand for pulses in India is increasing and market does not seem to be a limiting factor in promotion of rabi pulses. Yet initially due to low marketable surplus farmers may face problems in disposing the produce and might be exploited by the unscrupulous local traders. Nevertheless, the Government of India has recently lifted restrictions on interstate movement of agricultural produce under its domestic market reforms program.

Opportunities for rainfed rabi cropping

In India per capita consumption of pulses has been declining and is less than the recommended dietary allowance. The major opportunity for rabi pulses thus lies in meeting the rising demand for pulses. Further, India imports considerable amount of pulses to meet the domestic food demand. Increasing pulses production by intensifying the rabi fallow areas offers opportunities to reduce dependence on imports. Moreover, pulses are the cheapest source of protein compared to animal products including milk and eggs and can be afforded by the majority of low and middle income class. Vegetarianism is a typical characteristic of the majority of the Indian population, and thus pulses would find greater acceptance among the vegetarian population.

Introduction of any new crop is often resisted by farmers probably due to risk considerations. The study brings out clearly that a majority of the farmers is willing to grow rabi pulses provided there is an assured supply of inputs and cropping information. Farmers visualize opportunities to augment income and employment. The study indicates considerable addition to income and employment at the regional level even at low rates of utilization of fallow land for rabi cropping.

Threats to rainfed rabi cropping

Production and price risks are more for pulses compared to cereals. Year to year fluctuations in yield is a common feature of pulse economy. Uncertain rainfall and high incidence of insect pests and diseases are the major production risks. Price fluctuation is a common phenomenon; prices fall considerably during good harvest years. Differences in regional consumer preferences for pulses may also threaten the production if the local consumers do not prefer a particular pulse.

Table 27. SWOT analysis of rainfed rabi cropping in rice fallows.

Description	Characteristics
Strengths	• Huge rice fallow land • Abundant and cheap labor • Higher yield of pulses • Technical and economic feasibility of pulses cultivation • Fertile soils
Weaknesses	• Lack of availability of quality seed • Low marketable surplus • Incidence of insect pests and diseases • Lack of irrigation • Terminal drought
Opportunities	• Income augmentation • Employment generation • Rising demand for pulses • Import substitution • Farmers' willingness to grow pulses
Threats	• Yield instability • Price risk • Regional/consumer preferences

Implications for research and development

Many implications emerge from the SWOT analysis. The existence of huge rice fallow land is an indicator of the fact that these areas did not receive adequate attention in agricultural research and policy. Experiences from different parts of the world suggest that it is possible to utilize the fallow lands through suitable technological, agronomic, and policy interventions (Byerlee and White 2000).

Technology

Development of technologies and their effective transfer is important for successful promotion of rabi cropping in rice fallow lands. Three main technologies should receive priority attention. First, in rainfed regions early-maturing varieties are more important than yield, and therefore there is a need to develop or introduce, if available, the short-duration drought escaping varieties of the crops. Second, short-duration varieties of rabi crops alone are unlikely to yield desired results. Rather the technological problems should be looked into from the system perspective. Long-duration rice crop could be a major hindrance to introduction of rabi crops. It is therefore imperative to develop and introduce short-duration varieties of rice so as to enable timely sowing of the rabi crops. Third, rabi crops in rainfed environments are grown on residual moisture, and therefore it is imperative to develop and promote moisture conservation technologies to facilitate growing of rabi crops, or develop and introduce technologies such as seed priming that enable seed germination even in low moisture regimes.

Agronomic manipulations

Possibilities need to be explored for early sowing of rice. This can be achieved through agronomic manipulations in crop management practices such as broadcasting or dry seeding of rice rather than transplanting it.

Seed multiplication

Availability of quality seed to the producers would be the main limiting factor at least in the initial phase of introduction of new crops. Mechanisms should be developed for seed multiplication, storage, and distribution. The agencies promoting rabi cropping need to establish seed banks in the selected villages with seed contribution from farmers who have already adopted the crops and varieties. Subsequently the concept of seed village may be promoted. Seed should be provided at subsidized rates.

Involvement of private seed sector may be rewarding in production and distribution of seeds.

Technology transfer

Public extension system for transfer of the technologies and cropping practices is weak in the region. Farmers would require considerable amount of information particularly in the initial stages of introduction of rabi crops in the rice fallow systems. This can be achieved either by strengthening the existing technology transfer system or evolving innovative mechanisms for transfer of technology and information. Also, there is a need for strong interface between researchers, extension system, and farmers for higher returns to investment in agricultural research.

Community approach

Uncontrolled animal grazing is a common practice in rabi fallow lands. This is likely to be a major threat to rabi crops particularly when grown on scattered plots. There are two approaches to overcome this problem. First, rabi cropping should be promoted widely by sensitizing the farming community through demonstrating the feasibility of cultivation of rabi crops. Further, fodder is important for livestock production. Therefore, cultivation of fodder crops simultaneously should be promoted.

Consumer preferences

Local consumer preferences for crops and/or their varieties need to be given due consideration while promoting rabi crops. Lack of local demand for a particular crop could be a disincentive to the producers. Therefore, possibilities of introduction of a wide range of crops should be explored.

Credit and insurance support

Production risk is higher for rabi pulses in the rainfed regions due to uncertain and erratic rainfall and higher incidence of insect pests and diseases. Farmers are poor and often depend on informal sources of credit, which often are exploitative. Access to institutional credit is restricted due to cumbersome loan procedures and collateral requirements. Improving access to institutional credit would help improve their access to new agricultural technologies. Introduction of crop insurance scheme for risky crops such as pulses particularly in new areas would provide incentives to farmers to undertake cultivation of pulses.

Marketing and prices

At present, market for rabi pulses in the region is thin mainly due to their low marketable surplus. The price risk is also higher for pulses when first introduced in an area. Unscrupulous traders might exploit the poor farmers mainly because of under-developed market. The Government of India, however, protects pulses producers by fixing minimum support prices. To sustain rabi pulses production in the long run markets should be improved for legumes by creating awareness among the consumers about nutritional and health benefits of pulses consumption.

References

Birthal, P.S. 2001. Economic potential of biological substitutes for agrochemicals. Project report. New Delhi, India. National Centre for Agricultural Economics and Policy Research. 140 pp.

Byerlee, D., and **White, R.** 2000. Agricultural intensification and diversification through food legumes: Technological and policy options. Pages 31-46: *In* Linking research and marketing opportunities for pulses in the 21st century (Knight, R., ed.). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Kumar, J., Rahman, M., Musa, A.M., and **Islam, S.** 1994. Potential for expansion of chickpea in the Barind region of Bangladesh. International Chickpea and Pigeonpea Newsletter 1:11–13.

Kumar, P., and **Joshi, P.K.** 1999. Socioeconomic factors contributing to nutritional security of rural households. Paper presented at the workshop on Diversification of agriculture for human nutrition. New Delhi, India: National Academy of Agricultural Sciences, and Hyderabad, India: National Institute of Nutrition.

Paroda, R.S., and **Kumar, P.**2000. Food production and demand situations in South Asia. Agricultural Economics Research Review 13(1): 1–25.

Satyanarayana, A., Murthy, S.S., Johansen, C., Singh, L., Chauhan, Y.S., and **Kumar Rao, J.V.D.K.** 1988. Introducing pigeonpea in rice fallows of coastal Andhra Pradesh. International Pigeonpea Newsletter 7:11–12.

Subbarao, G.V., Kumar Rao, J.V.D.K., Kumar, J., Johansen, C., Deb, U.K., Ahmed, I. Krishna Rao, M.V., Venkataratnam, L., Hebbar, K.R., Sai, M.V.S.R., and **Harris, D.** 2001. Spatial distribution and quantification of rice-fallows in South Asia - potential for legumes. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 316 pp.

Annexures

Annexure 1. Details of the surveys undertaken in the selected rice fallow states.

State	Districts	No. of villages selected	Farm households selected		
			Contact	Non-contact	Total
Chhatisgarh	Bastar	2	32	36	68
Jharkhand	Ranchi Hazaribagh	7	33	34	67
Madhya Pradesh	Mandla	1	35	35	70
Orissa	Sambhalpur	4	33	15	48
West Bengal	East Midnapur West Midnapur	4	35	34	69
Total	7	18	168	154	322

Source: Field survey (2002).

Annexure 2. Access of selected villages to agricultural infrastructure.

Infrastructure	Chhatisgarh		Jharkhand		Madhya Pradesh		Orissa		West Bengal	
	% villages having the facility	Average distance (km)	% villages having the facility	Average distance (km)	% villages having the facility	Average distance (km)	% villages having the facility	Average distance (km)	% villages having the facility	Average distance (km)
Produce market	0	8	0	8	0	12	0	13	0	4
Agro-input shop	0	16	0	9	0	12	0	15	0	4
Agri. Extension Office	0	16	0	21	0	12	0	15	0	16
Primary School	100	0	14	5	100	0	100	0	75	5
Secondary School	0	4	0	9	0	12	25	3	0	8
Electricity	100	0	29	4	100	0	50	10	100	0
Post Office	0	8	0	7	0	4	25	6	0	3
Commercial bank/ Cooperative society	0	8	0	7	0	12	0	8	0	3

Source: Field survey (2002).

Annexure 3. Socioeconomic characteristics of the selected households.

Characteristic	Chhatisgarh	Jharkhand	Madhya Pradesh	Orissa	West Bengal
Size of land holding (ha)	1.9	1.4	1.1	1.7	1.3
Family size (number)	6.8	7.5	5.3	6.4	5.4
Labor[1] (number ha^{-1})	2.0	3.2	2.7	2.0	2.5
Education of household head (%)					
Illiterate	57.4	38.8	62.9	39.6	23.2
<5 years	20.6	29.9	14.3	31.3	37.7
5–10 years	20.6	20.9	18.6	27.1	30.4
>10 years	1.5	10.4	4.3	2.1	8.7

1. Includes adult male and female members dependent on agriculture.