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

V A Bourai, K D Joshi, and Nityanand Khanal

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

Authors

V A Bourai
Reader, Department of Economics
S G R R Post Graduate College
Dehradun
Uttaranchal 248 001

K D Joshi
CIMMYT South Asia Regional Office
P O Box 5186
Lazimpat, Kathmandu
Nepal

Nityananda Khanal
Program Manager, FORWARD
P.O.Box:11 (Bhp.)
Bharatpur-2, Kshetrapur
Chitwan, Nepal

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Acknowledgments

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Executive Summary

Nepal has 0.26 million ha rice fallow land of which 75% lies in the eastern region. In the eastern region approximately 43% of the kharif (rainy season) rice area remains fallow during rabi (postrainy season). Introduction of rainfed rabi crops in the rice fallow areas would help improve the socioeconomic situation of this region particularly of the poor, small and marginal land holders who are solely dependent on agriculture for their livelihood. This study has identified major limiting factors to the cultivation of rabi crops under rainfed conditions and has explored opportunities for their sustained production.

Lack of irrigation is the main limiting factor for the non-utilization of the rabi fallow lands. The focus of this study, however, is on rainfed crops because an overwhelming majority of farmers in the region is poor and lack capacity to invest in creating the irrigation infrastructure. Some rabi crops specifically pulses and oilseeds can be successfully grown, under rainfed conditions, on fallow lands, given the appropriate technology and needed technical training to the farmers.

The major requirements for rainfed rabi cropping are:

- Training to preserve the fast receding residual moisture from the rice vacated fields.
- Short-duration varieties of rice to facilitate timely sowing of rabi crops.
- Short-duration drought escaping varieties of rabi crops.

For the utilization of residual moisture, rabi crops are sown soon after rice harvest. Farmers in Nepal are ignorant about the soil moisture conservation practices and efficient sowing technologies. The inputs such as seed, pesticides, and fertilizers are beyond the reach of the poor Nepali farmers. The credit market is in the hands of indigenous bankers. The most important input, which is reported as major constraint in growing rabi crops, is the “seed”. The extension system is weak in disseminating good seed. Insect pests and diseases are the major biotic risks.

In Sagarmatha and Koshi, grazing of crops by stray animals is another limitation to cultivation of rabi crops. Low volume of produce and lack of market may deprive the small and marginal producers to get the market prices.

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

The marketing of the increased production is not a problem, as Nepal depends on imports of food grains. Pulses are the cheapest source of protein and unfortunately their availability is declining due to constraints on the supply side. Domestic supply of pulses is grossly inadequate to meet the rising demand. This offers an opportunity to increase consumption of pulses.

The rice fallow systems have been bypassed in the research 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 development of short-duration drought escaping varieties of rabi crops, short-duration rice varieties to facilitate timely sowing of rabi crops on residual moisture, and technology to enhance seed germination in the low moisture regime. Another option is to effect agronomic manipulation like early sowing of rice, if possible. Simultaneously, extension system needs to be strengthened by using more participatory methods to sensitize the farming community to technology transfer. The seed sector should be strengthened to ensure timely supply of quality seeds to the farmer. These efforts need to be backed up by institutional support such as provision of credit, crop insurance, and agricultural market to improve farmer investment capacity and risk bearing ability.

1. Introduction

Rice is the principal staple food of Nepal. It occupies an area of 1.37 million ha, of which 0.78 million ha is in the eastern Terai region (Manandhar and Sakhya 1996). Cereals including rice occupy 91% of the total cropped area. Pulses and cash crops each share 0.7% of the area. The kharif (rainy) season rice area is not fully utilized for crop production in the subsequent rabi (postrainy) season and about 0.26 million ha remains fallow[1]. Of this more than 75% lies in the eastern region. This unutilized area offers enormous opportunities to overcome the problem of food and nutritional insecurity. Accomplishing household food security remains the primary concern. Food crops such as pulses and oilseeds are critical to food security. Nutritional security is equally important in resource-poor countries like Nepal. A considerable number of population suffers from malnutrition. The per capita availability of pulses has been declining. Nepal is deficit in food grains as well as pulses and edible oil, and imports huge quantities of these commodities to meet the domestic demand.

Nepal has a per capita income of US$ 210 which is the lowest in South Asia (Fig. 1).

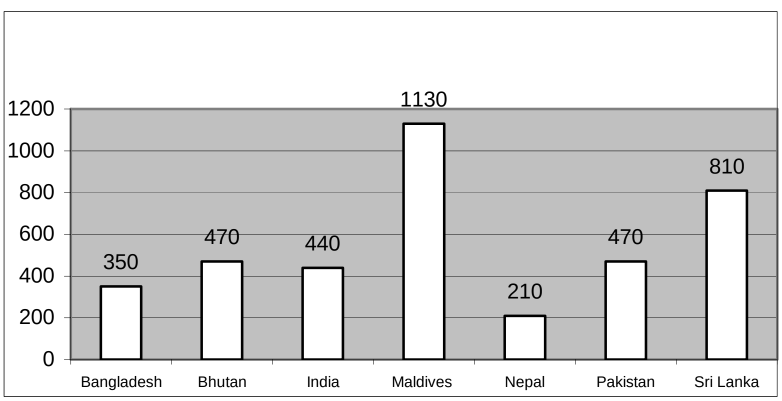

Figure 1. Per capita income of SAARC countries.

1. This estimate is much lower to the estimate of rice fallows of 0.39 million ha reported by Subbarao et al. (2001). This discrepancy is probably due to the area of spring maize that might have appeared as fallow in the satellite remote sensing methodology used by Subbarao et al. (2001), thus over-estimating rice fallow area.

Poverty is widespread. Unemployment is acute in rural areas, and opportunities for employment in rural farm and non-farm sectors are limited. Agriculture engages 81% of the rural population, 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 mass migration to neighboring countries, cities, and agriculturally prosperous areas in search of employment. Problems of poverty, unemployment, illiteracy, sale of female children, migration, etc. are more acute in the rice fallow system.

The existing fallow area of 0.26 million ha is more than the cultivated area of the eastern region in rabi season. This is also more than the cultivated area of midwest region. Ninety percent of the fallow area lies in eastern region comprising Koshi, Mechi, and Sagarmatha zones. If this area is brought under cultivation, it will benefit many poor, deprived, and small and marginal holders. Promotion of crops such as pulses in the existing fallows would also improve sustainability of the rice production system besides enhancing production and income of the cropping system.

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. Cost of creating public irrigation infrastructure (surface and groundwater) 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 manipulation in rice cropping schedule (early sowing), and/or introduction of short-duration 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 disrupting the kharif cereal production system.

There exist enormous market opportunities for rainfed rabi crops. Pulses in particular are a low cost source of protein. Agricultural intensification through pulses and other rabi crops such as oilseeds would benefit both producers and consumers. Producers would benefit through income and employment augmentation, and consumer through reduced prices of these crops, as the prices are expected to fall with increase in supply.

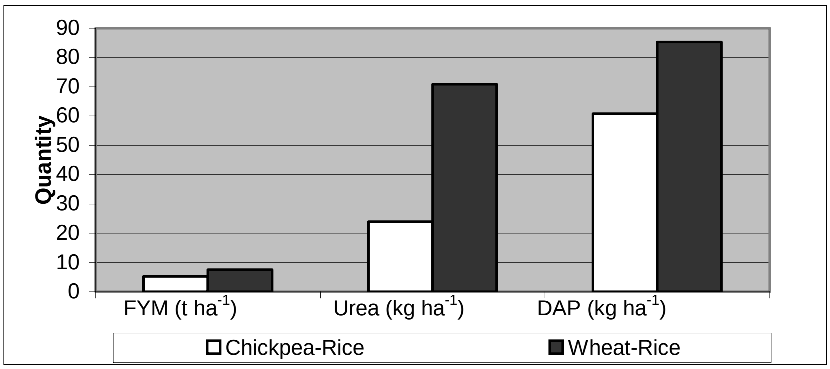

Figure 2. Consumption of fertilizer in rice under different rotations in Nepal (FYM = farmyard manure; DAP = diammonium phosphate).

Incorporation of legumes in rice-based cropping system would be an important source of nitrogen. Besides improving soil fertility (Fig. 2) pulses improve the water-holding capacity of the soil and its organic matter content. Pulses and other rainfed rabi crops can be grown in a cost efficient manner because of their low input requirements. In Nepal opportunity cost of human labor is either very low or nil.

To improve the economic status of the poorest farmers in general and the poverty ridden small landholders in particular the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India and the Department for International Development/Plant Sciences Research Programme (DFID/PSP), UK are in the process of exploring possibilities of utilizing rice fallow area through technological and agro-economic interventions. The program aims at demonstrating the technical feasibility of introducing rainfed rabi crops (chickpea, field pea, buckwheat) in the dominant rice fallows zones of Koshi, Mechi, and Sagarmatha through on-farm participatory research. Chickpea, field pea, and buckwheat trials were conducted in farmers' fields with minimal inputs under rainfed conditions during the rabi season of 2001–02. It is hoped that these trials will continue for next few years so as to sensitize and educate farmers to take up cultivation on residual moisture. At the same time it was considered appropriate to identify biotic, abiotic, and socioeconomic constraints to production of rabi crops that can be addressed through technological and policy interventions; and to explore market opportunities for rainfed rabi crops to sustain their production in the long run. The main objectives of this study are:

- To identify constraints to rainfed rabi cropping in the rice fallow system of selected zones;
- To explore socioeconomic opportunities for pulses.

The study is organized in six sections. The next section describes the methodology and data used to achieve the specified objectives. Section 3 assesses the performance of pulses in the rice fallow system. 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 points and implications are reported in Section 6.

2. Methodology

Nepal lies in between China in the north and India, which adjoins the whole range in the east, south, and west (Figs. 3 and 4). The east-west length of the country is 800 km, and width varies between 130 and 240 km. There is a wide climatic variation ranging from torrid and humid subtropical in the lowland to captive areas 4 m above sea level. The whole of Terai region adjoins the Indian Terai and is the most fertile and productive belt in Nepal. Indian Terai witnessed the green revolution as a result of improved agricultural technologies. On the contrary, the Nepal Terai is deteriorating in the absence of appropriate production and policy environment. This section provides an outline of the study area, sampling approach, and the data for the study. Only eastern economic development region is considered for the purpose of this study.

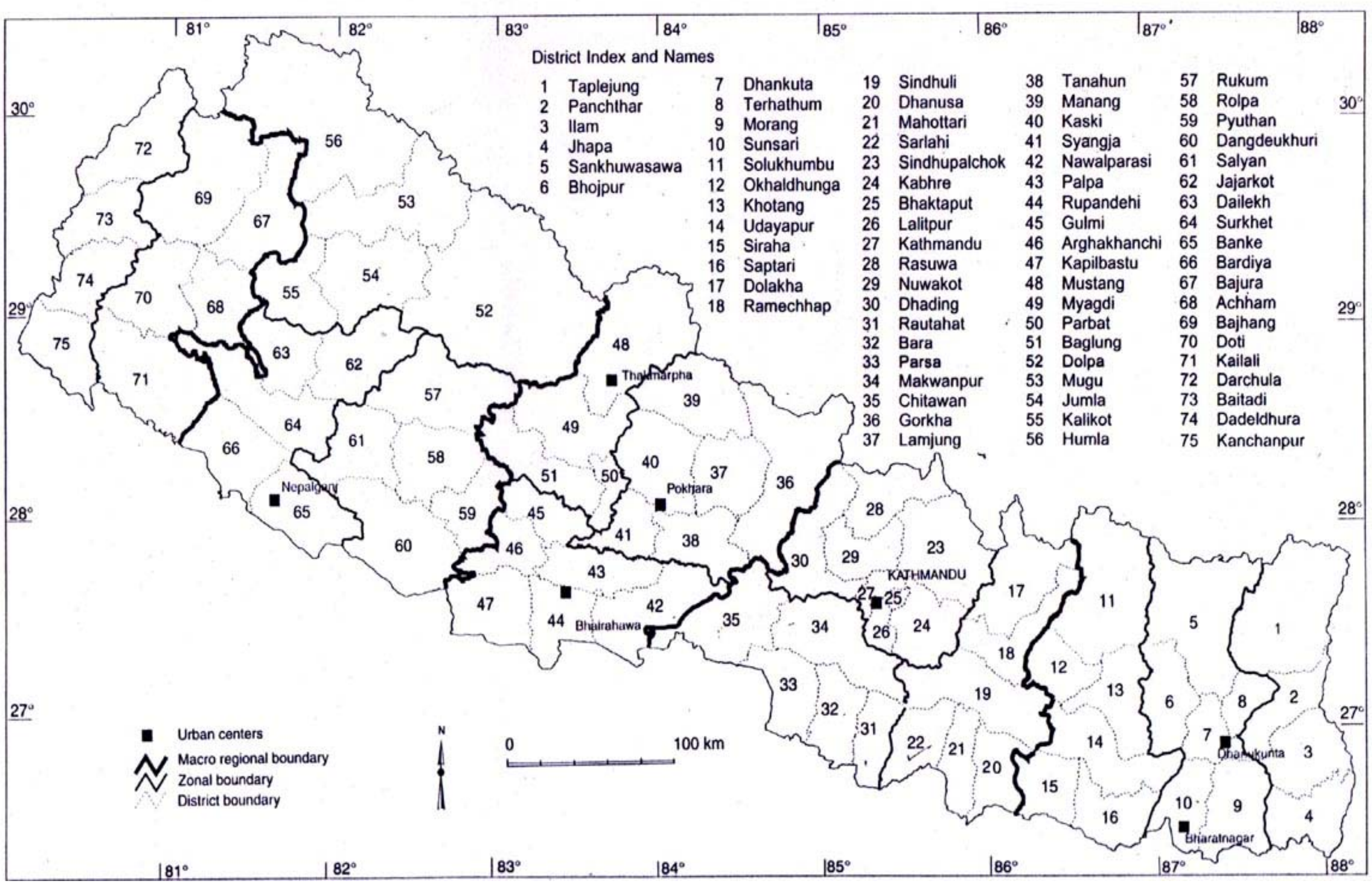

Figure 3. Administrative divisions (districts) and major urban centers in legume-growing areas of Nepal.

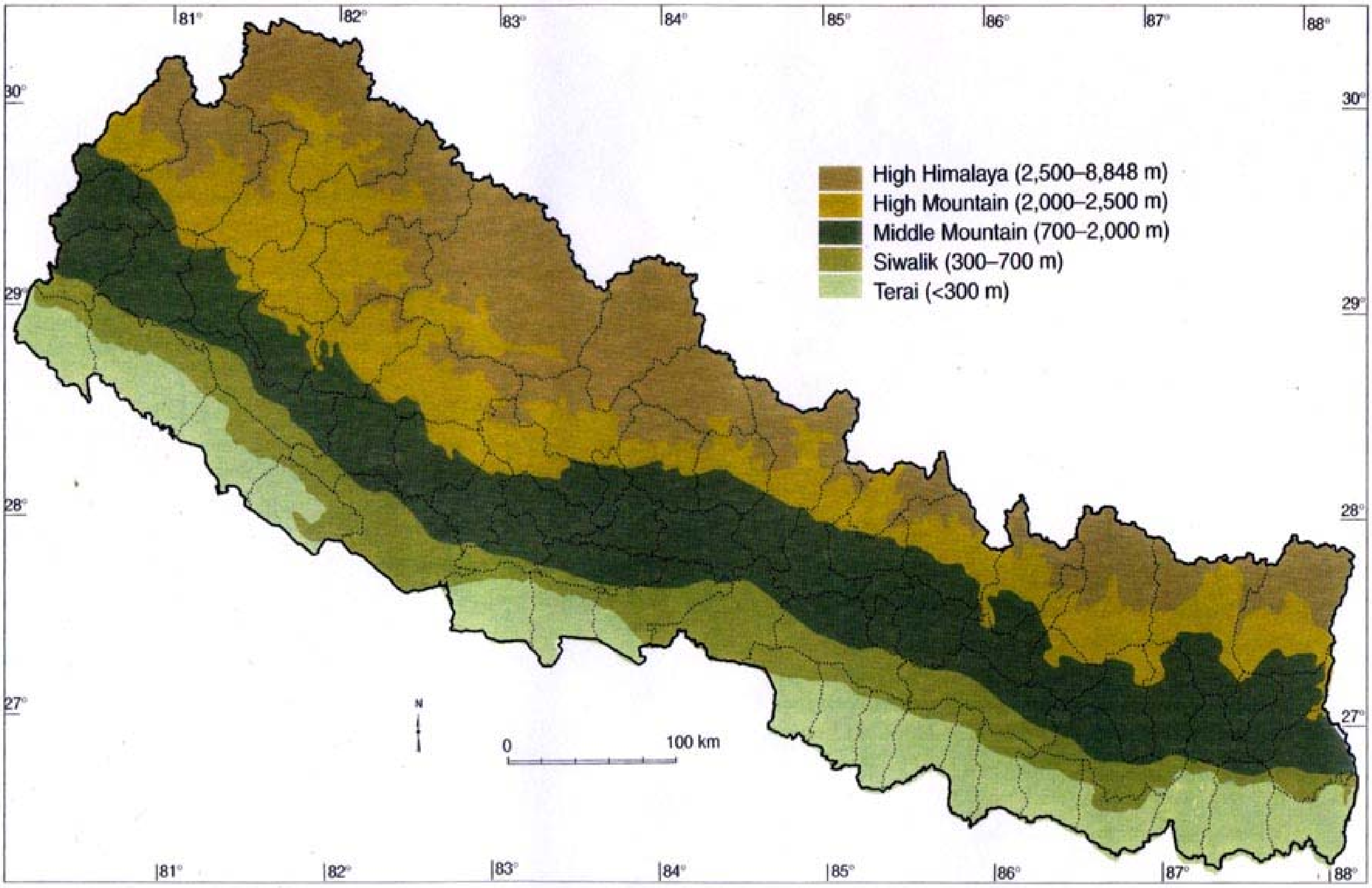

Figure 4. Physiographic regions of Nepal (source: Topographic Survey Branch, Department of Survey, His Majesty's Government, Nepal 1983).

Study sites

The zones Mechi, Koshi, and Sagarmatha lie in the eastern development region of Nepal. The land area of the Terai is 23% of the total area of Nepal, but accounts for 52% of the total cultivated land of the country. It was originally a forest and was largely composed of alluvial soil highly suited for agricultural activities. The Terai region, referred to as the country's breadbasket, produces agricultural surplus. There is more rice cultivation in the eastern Terai than in the west mainly due to a greater proportion of higher quality alluvial soils in the east. The eastern region consists 71% rainfed area.

The eastern development region has approximately 43% rice fallows in rabi season. The intensity, however, varies across the zones. In Mechi 67% of the kharif rice area remains uncultivated during the rabi season. In the other two zones it is relatively less (Fig. 5).

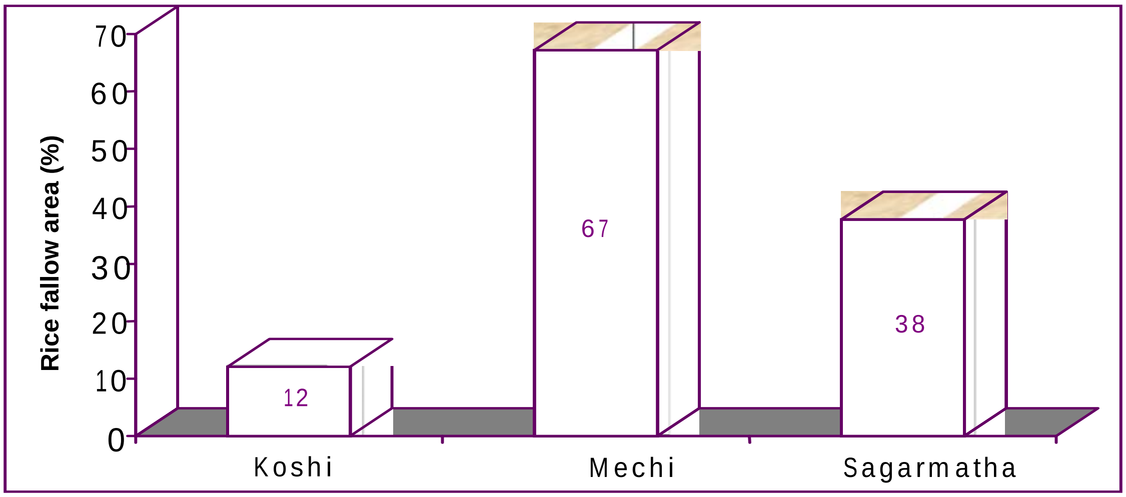

Figure 5. Rice fallow of eastern region of Nepal.

Sampling

The study was conducted in all the villages where participatory on-farm research trials were undertaken. The trials were conducted in Mechi, Koshi, and Sagarmatha zones of Nepal. Districts selected from the above stated zones were from eastern Terai only. The districts are Jhapa, Morang, Saptari, and Sirha. 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 25 contact farmers were selected from two villages of Koshi, 23 were selected from one village of Mechi, and 31 were selected from 4 villages of Sagarmatha. All these farmers were included in a sample and referred to as “contact farmers” (Annexure 1).

To obtain unbiased results, non-contact farmers from the same villages were also selected. This comprised about 10 non-contact farmers from Mechi and 27 from

Sagarmatha. The survey of non-contact farmers could not be undertaken in Koshi. Further, 11 farmers from Mechi and 19 from Sagarmatha growing rabi crops, other than the trial crops were selected. In Koshi, such farmers were not available. Thus a total of 146 farmers were selected (Annexures 1 and 2).

Data

The selected households were interviewed for their perceptions on constraints to and possibilities for rainfed rabi cropping with the aid of a questionnaire particularly structured for the study. The information pertaining to constraints to rabi cropping included agro-ecology, crop management infrastructure, inputs and output markets, yield and price risk, technical and advisory services, and farm resources. Farmers' views were also sought on the possible crops that can be grown under rainfed condition during the rabi season, local demand for pulses, their willingness to grow rabi pulses, their awareness of the benefit 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. From contact farmers, information was also collected on inputs used in chickpea, field pea, and buckwheat trials and their respective yield to examine technical and economic feasibility of rainfed rabi crops in Nepal. Whether there were any differences in the perceptions of contact farmers, alternative growers, and non-contact farmers related to constraints and opportunities in rabi cropping, initially separate analysis was undertaken for all these groups. The analysis indicated little, if any, differences in the perceptions of the group, and therefore it was considered appropriate to pool the information. Wherever necessary, separate results are presented for the contact, alternative growers, and non-contact farmers.

Village and household characteristics

Small farm agriculture is a noted feature of the selected villages. In Koshi two-third of the holdings are of less than 2 ha in size (Annexure 3). A similar situation exists in Mechi and Sagarmatha.

A considerable proportion of kharif rice area remains fallow in the selected villages. In Koshi, Mechi, and Sagarmatha villages, more than 39% of the kharif rice area remains uncultivated during rabi season. The extent of rabi fallow areas is less in Koshi villages (12.09%) (Table 1). The farmers in Koshi have access to irrigation by pumps thus facilitating cultivation of rabi crops.

Table 1. Extent of rabi fallow area (ha) in the study villages in Nepal.

Zone	Total kharif rice area ('000 ha)	Rice fallow in rabi season ('000 ha)	Rice fallow area (%)
Koshi	1561	189	12.09
Mechi	2151	1446	67.22
Sagarmatha	3231	1251	37.68

Source: Field survey, 2002.

Rice is the main kharif crop in the selected villages of Koshi, Mechi, and Sagarmatha zones; more then 95% of the kharif area is under rice production. In the rabi season, wheat, oilseeds, potato, lentil, chickpea, pigeonpea, black gram, horse gram and soybean are grown under rainfed conditions. These crops are grown during the rabi season in the eastern region of Nepal on 57.2% of arable land.

Average family size of the selected households ranges from 5.48 in Koshi to 8.10 in Sagarmatha (Annexure 4). The average size of family in the eastern region is 6.85. Children account for more than 40% of the total population. Most of the selected villages have primary schools. Thirty one percent household heads are illiterate, 20% had schooling up to 5 years, 33% up to 10 years, and only 16% had schooling up to 10 years or more.

Labor availability is 2 persons ha^{-1} in Koshi, 1 person ha^{-1} in Mechi, and 1.7 persons ha^{-1} in Sagarmatha. Agriculture is the main source of employment. A large number of Nepalis migrate for petty jobs to towns in Nepal as well as in India. Temporary migration increases during rabi season, causing scarcity of human labor during sowing period.

None of the villages in the selected districts has the required infrastructure facilities to promote agriculture (Annexure 5). Agriculture markets are located too far with an average distance varying from 3 km to 8 km in selected villages. The input markets and credit facilities are also not easily accessible. Farmers have to travel large distance (5 km) to seek advisory services from extension staff. A comparison of the three zones indicates almost the same accessibility in villages to agriculture infrastructure.

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

3. Rainfed Rabi Cropping in Rice Fallow Systems

Pulses and oilseeds are the ideal candidates for cultivation in rice fallow areas during rabi season. Pulses like chickpea, lentil, field pea, and lathyrus are hardy crops and germinate well on the residual moisture and take up nutrients from the lower layers of the soil. Pulses are leguminous species; they fix atmospheric nitrogen, which partly meets the requirement of the plant, and the residual nitrogen is utilized by the subsequent crops. Pulses also improve the soil structure by adding organic matter content. Yield of rice was reported high (3.1 t ha^{-1}) in chickpea-rice rotation when compared with 2.3 t ha^{-1} in rice-wheat.

Rice fallow states are inhabited by poor people, having small size of landholding and little access to irrigation and other critical farm inputs. Agriculture is their main source of livelihood. But employment opportunities are limited. Pulses production being less capital intensive easily fit into the cropping system. This section first presents some important socioeconomic characteristics of the rice fallow of eastern development region in Nepal, and then examines the performance of pulses in different zones.

Socioeconomic characteristics

Forty-four percent of the population in the eastern region is literate, which is marginally higher than the national average of 39% (Table 2). In the study villages, 11% farmers are landless, while 70% farmers are marginal or sub-marginal. A large number of farmers migrate for the petty jobs in India as well as large townships of Nepal. The average size of landholding in Nepal is 0.96 ha while the average size in Mechi, Koshi, and Sagarmatha it is 1.86 ha, 1.26 ha, and 1.42 ha respectively. Agriculture is the main source of income for the rural population; it contributes 40–50% of the gross domestic product (GDP) of the eastern region.

Table 2. Socioeconomic features of eastern development region of Nepal.	
Features	Value
Share of geographical area (2000)	19.9%
Share of population (2000)	24%
Density of population (2000)	156 km^{-2}
Literacy rate	44.4%
Average size of land holding (Terai)	1.26 ha
Small and marginal farmers (Nepal)	89.1
Per capital income of Nepal (GDP) (N Rs)	16681
Per capital income of Nepal (GNP) (N Rs)	17284
Share of agriculture in GDP at constant prices	43.7%

Source: Government of Nepal (2000).

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 3). Growing of rabi crops solely depends on the availability of moisture in the fields after rice harvest. Except Koshi, development of irrigation facility in rice fallow zone is very low (Fig. 6). In these zones less than quarter of the gross cropped area has access to irrigation. The irrigation intensity is just half of the national average.

Table 3. Agroecological features of the eastern region of Nepal.	
Features	Value
Rainfed area	71%
Annual rainfall	1873 mm
Maximum temperature	30°C
Minimum temperature	18°C

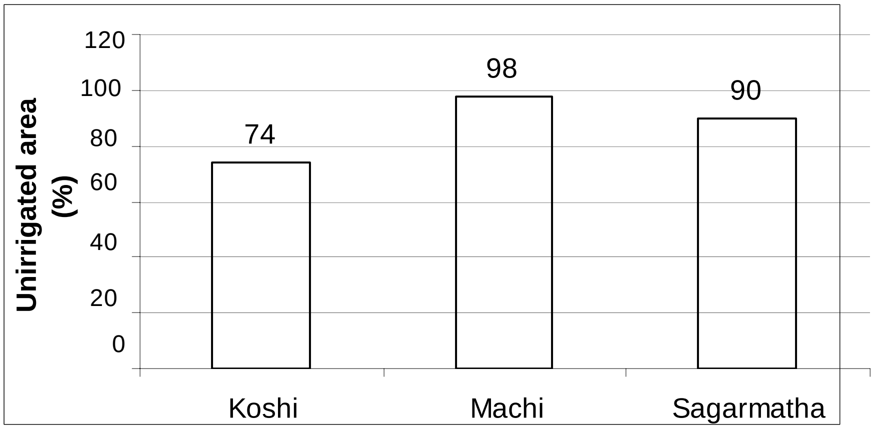

Figure 6. Unirrigated area in rabi season of selected households in the three zones in Nepal.

Nepal agriculture is largely cereals based. Cereals account for a major share of gross cropped area in all the three zones of eastern region (Tables 4 and 5). Kharif rice is the dominant crop. Pulses constitute the next important group of crops after wheat, oilseeds, and cash crops in the rabi season.

Table 4. Cropping pattern in the eastern region of Nepal.

Koshi	Kharif	Paddy (88%)
	Rabi	Wheat, chickpea, and lentil (77%)
Mechi	Kharif	Paddy and maize (100%)
	Rabi	Wheat, linseed, and mustard (73%)
Sagarmatha	Kharif	Paddy and maize (93%)
	Rabi	Wheat, lentil, linseed (70%)

Table 5. Cropping pattern in rice fallows of the eastern region of Nepal.

Crops	Area (% share)
Cereals	90.60
Paddy	54.33
Maize	23.50
Millet	7.95
Wheat	13.84
Barley	0.31
Oilseeds	3.78
Cash crops	0.70
Pulses	0.69
Total	100

Contribution of rice fallow systems to pulses production

Area under lentil, pigeonpea, and chickpea has decreased in the Terai districts over the last ten years (from 1984/85 to 1994/95). It is interesting to note that chickpea cultivation is also concentrated in the Terai districts (Bardia, Kailali, and Kanchanpur) of far western Nepal, where lentil and pigeonpea intensification has taken place. This shift in chickpea cultivation from central to western parts of the country relates to the severe incidence of botrytis gray mold in the eastern part compared to the western part (Pandey et al. 2000).

The eastern region of Nepal had large area under chickpea and the output was also considerably good. But the crop has shifted to western part of Nepal and eastern part has witnessed increase in rice fallow during winter (Figs. 7 and 8). Approximately 60% chickpea area has reduced in Koshi, Mechi, and Sagarmatha. On the other hand, chickpea area in western region has increased by 41%. The shift is mainly due to abiotic and biotic constraints.

Production performance of pulses

Area

Area under pulses in the eastern region has declined though at a slow rate. The growth in area is consistently showing a negative trend. The area of chickpea is declining fast at an annual rate of 6% in the eastern region of Nepal (Fig. 7).

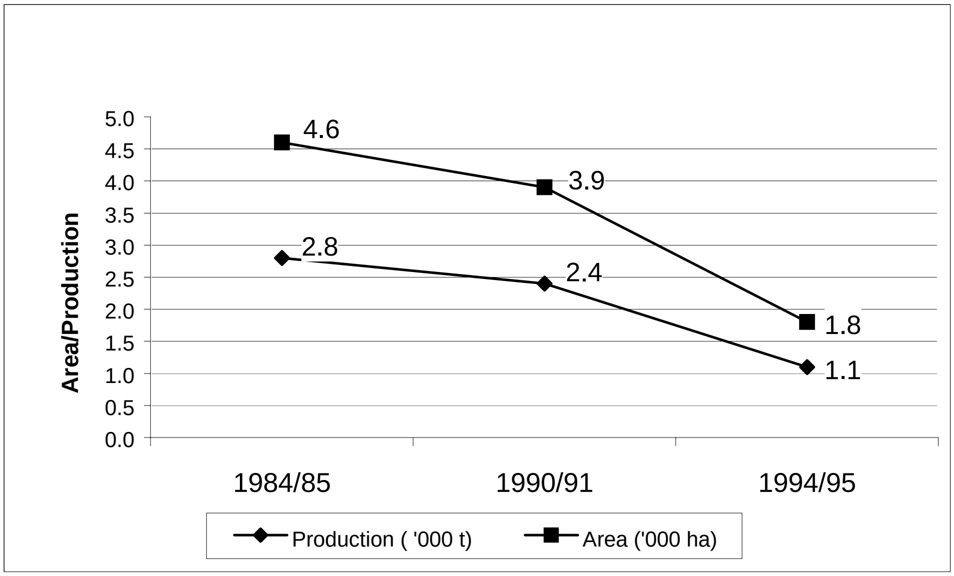

Figure 7. Chickpea area and production in the eastern region of Nepal.

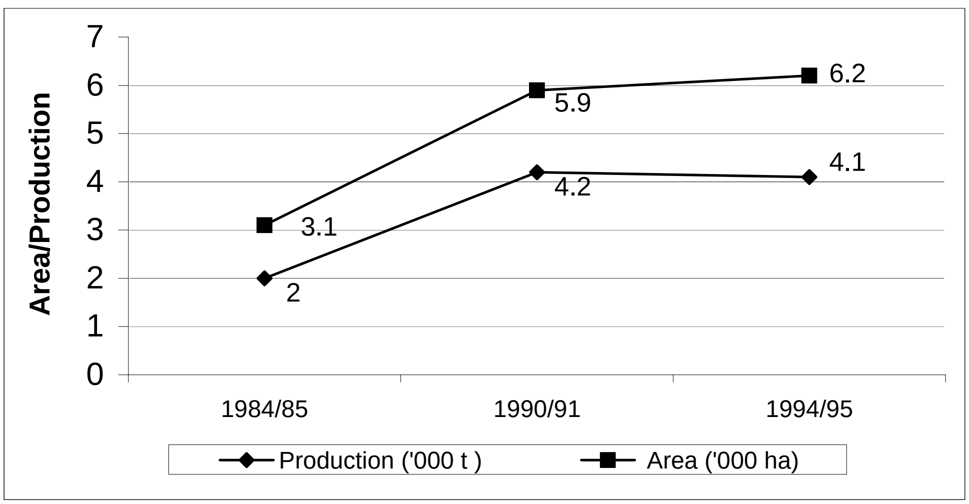

Figure 8. Chickpea area and production in the midwest region of Nepal.

Production and yield

Production of chickpea, pigeonpea, and grasspea shows negative trend while that of other pulses shows a positive trend. The area of pigeonpea has shown an increasing trend but its yield has decreased from 789 kg ha^{-1} to 660 kg ha^{-1}. Similarly, the area of horse gram has expanded but the yield has decreased from 536 kg ha^{-1} to 469 kg ha^{-1}.

The yield of chickpea has increased from 609 kg ha^{-1} in 1984/85 to 748 kg ha^{-1} in 1997/98 (Table 6).

Table 6. Area ('000 ha) production ('000 t), and yield (kg ha^{-1}) of rainfed pulses in eastern region of Nepal.

Crop	1984/85			1997/98		
	Area	Production	Yield	Area	Production	Yield
Lentil	8.7	5.5	632	18.2	12.4	682
Chickpea	4.6	2.8	609	2	1.5	748
Pigeonpea	1.9	1.5	789	2	1.3	660
Black gram	2.4	1.2	500	8.4	5.2	620
Grasspea	19.3	9.3	482	14.2	7.5	533
Horse gram	4.1	2.2	536	4.6	2.2	469
Soybean	2.6	1.4	538	6.0	3.9	644
Other pulses	1.4	0.8	550	2.7	1.7	656

Source: Government of Nepal (1995–98).

4. Constraints to Rainfed Rabi Cropping

It is observed that production of pulses declined significantly in the rice fallow system in the recent decade, mainly due to contraction in their area. Amongst the rabi pulses, chickpea area has shifted from eastern Terai region to farwest and midwest region of Nepal. The decline and shift may be due to both supply and demand problems. There is a possibility of growing a wide range of crops in rabi fallow lands under rainfed conditions. This section identifies abiotic, biotic, and socioeconomic constraints to rainfed rabi crop production.

Abiotic constraints

A number of abiotic factors limit utilization of rabi fallow land (Table 7). These factors can be broadly classified 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 during flowering and harvest stages. As rabi crops in the rice-fallow system are grown on residual moisture after rice harvest, a good rainfall towards the terminal period of the rice crop provides sufficient moisture for germination and establishment of the next crop. But the rainfall is uncertain. During kharif season water table is generally very high, but as the monsoon rains withdraw, the water table recedes. The poor farmers of Nepal cannot invest in irrigation facilities; only a few rich farmers can afford. Further, rabi rainfall is usually uncertain. Even if the crop is established well by utilizing the soil moisture resource, lack of rabi rainfall towards flowering and harvesting stages creates drought conditions leading to crop failures. Hence the adoption of rabi cropping is viewed uncertain by the poor farmers. The low water table is reported in all the three zones of eastern Nepal Terai, while the residual moisture is less reported in Koshi, Mechi, and Sagarmatha. Soil hardness is reported by maximum number of farmers – 88% in Koshi, 73% in Mechi, and 49% in Sagarmatha. Sagarmatha has less hard soil in comparison to Koshi and Mechi. In Koshi, 80% of farmers have reported that their land has less organic matter content, which is again an important constraint.

Table 7. Percentage of households reporting water and soil related constraints to rabi cropping in rice fallows in Nepal.

Constraints	Koshi	Mechi	Sagarmatha	Average in Nepal
Low water table	28	50	68	55
Low residual moisture	16	32	39	33
Soil hardness after puddling of rice	88	73	49	63
Low organic matter content	80	52	18	39
Terminal drought	64	52	42	49
Soil cracking	52	57	23	38
Poor quality water	24	60	14	16

Source: Field survey, 2002.

Crop management and growth related constraints

Chickpea, lentil, linseed, mustard, buckwheat, and field pea have the potential for cultivation in all the three zones of eastern region of Nepal. Chickpea is most preferred in Koshi and Sagarmatha and mustard in Mechi.

Short sowing period after rice is the major crop management constraint in Koshi in chickpea cultivation (Table 8). In Mechi and Sagarmatha non-availability of short-duration varieties of chickpea is the major constraint. Poor seed germination and poor plant stand are also reported as important constraints to chickpea cultivation in all the three zones. In fact farmers have to sow the rabi crops on residual moisture. At the same time farmers undertake threshing of the rice crop. The residual moisture disappears with the passage of time, and delay in sowing reduces prospects of seed germination and results in poor plant stand. Hence, farmers reported that if the seed is sown soon after rice harvest, seed germination will be high and good plant stand is established. Further, as the crop advances the probability of the crop failure increases if there is no rainfall. Long-duration varieties often suffer the most from terminal drought.

Table 8. Percentage of households reporting crop management and growth related constraints in rice fallows in Nepal.

Constraints	Koshi	Mechi	Sagarmatha
Chickpea			
Short sowing period after rice	68	39	18
Lack of short-duration varieties	44	43	43
Poor seed germination	8	18	16
Poor plant stand	8	36	10
Lentil			
Short sowing period after rice	60	-	12
Lack of short-duration varieties	40	-	30
Poor seed germination	0	-	19
Poor plant stand	16	-	6
Mustard			
Short sowing period after rice	-	41	-
Lack of short-duration varieties	-	48	-
Poor seed germination	-	27	-
Poor plant stand	-	30	-
Linseed			
Short sowing period after rice	60	-	12
Lack of short-duration varieties	28	-	22
Poor seed germination	4	-	12
Poor plant stand	8	-	13

1. - = Crop is not grown.
Source: Field survey, 2002.

Two important implications emerge. 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 rainfed rabi crops on residual moisture in time.

Even if the crop is sown timely and established well, farmers from their experience have narrated high incidence of insect pests and diseases (Table 9). In chickpea, insect pest (particularly pod borer) is reported to be a potentially severe problem in Koshi, Mechi, and Sagarmatha. Diseases are also considered a severe problem in Koshi, Mechi, and Sagarmatha. In lentil, insect pests are reported in Koshi but in Mechi and Sagarmatha the intensity is medium and low respectively. Linseed is reported to be severely attacked by insect pests and diseases in Mechi and Sagarmatha.

Table 9. Percentage of households reporting pest problems in Nepal.

Pests	Kochi			Mechi			Sagarmatha		
	S	M	L	S	M	L	S	M	L
Chickpea									
Insect pests	72	-	-	55	14	18	21	38	26
Weeds	4	4	4	14	39	23	5	9	21
Diseases	48	20	12	34	23	27	17	23	35
Stray animals	8	4	12	2	7	36	23	6	22
Lentil									
Insect pests	24	4	8	25	30	30	14	30	35
Weeds	-	4	20	11	32	30	5	13	14
Diseases	20	8	24	14	34	32	8	26	32
Stray animals	4	-	4	2	5	34	21	8	22
Linseed									
Insect pests	8	-	8	20	14	34	9	25	39
Weeds	-	4	24	7	20	30	4	9	16
Diseases	4	4	12	5	23	34	6	14	34
Stray animals	-	-	4	2	7	32	17	9	21

S = Severe; M= Moderate; and L = Less.
Source: Field survey, 2002.

Grazing of stray animals is also reported as a severe problem in Sagarmatha perhaps because this zone has more rice fallows. Insect pests are also reported in lentil but it is not as severe as in chickpea. Therefore, before introduction of new crops in rice fallows, it is important to consider the potential damage due to insect pests and diseases, and accordingly recommended varieties that are resistant to these stresses. Further, integrated pest management (IPM) packages should be developed to minimize the potential losses to crops. Government and non-governmental organizations (NGOs) should organize IPM training programs for the farmers in Nepal specially for the rabi crops to control huge damages due to biotic constraints.

Resource constraints

Although some crops have the potential to thrive under rainfed conditions, non-availability of inputs and resources may not allow their cultivation. A majority of farmers lacks capital to meet the operational cost of cultivation (Table 10). This holds true in all the selected zones of Nepal. Farmers feel that it is difficult to cultivate rabi crops without irrigation and most of them indicate a lack of capital in carrying out on-farm irrigation. The Nepali farmers are so poor that usually they do not have funds to purchase even the basic inputs. In Mechi 48% farmers and in Sagarmatha 60% farmers have reported this as a major constraint.

Table 10. Percentage of households reporting resource constraints to rainfed rabi cropping in Nepal.

Constraints	Mechi	Sagarmatha
Lack of capital to invest in irrigation	84	79
Lack of funds to purchase inputs	48	60
Scarcity of human labor during sowing period	32	43
Lack of draft power during sowing period	18	18

Source: Field survey, 2002.

Labor is surplus in these zones and laborers remain idle after rice harvest. Yet 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 reported shortage of draft power for timely sowing of the rabi crop.

Information constraints

Improving farmer access to information related to crops and their cultivation practices is important in the process of utilization of fallow areas. In the selected villages government and non-governmental organizations (NGOs) are the main sources of information of rabi crops because the NGOs implemented the participatory research trials on behalf of ICRISAT and DFID (Table 11).

Radio and TV are also reported to be important media for information acquisition. But these are available to selected farmers only in Koshi and Sagarmatha. Some farmers have reported newspaper as a source of information regarding rabi crops.

Table 11. Percentage of households reporting source of information on rainfed rabi crops in Nepal.

Source of information	Koshi	Mechi	Sagarmatha
Village extension workers (NGOs)	68	43	43
Radio	56	43	34
TV	16	25	13
Newspapers	16	11	3
Others	16	20	5

Source: Field survey, 2002.

In Koshi information related to insect control measures is rarely available to the farmers. Farmers reported that they are helpless because they do not know how the pest management technology is used. They also lack information on diseases and insect pests and improved sowing techniques. In the Mechi zone, farmers lack information on improved sowing techniques of rabi crops (Table 12). If farmers have adequate information on rainfed rabi crops, these crops will spread in eastern Terai.

Table 12. Percentage of households reporting lack of information on rainfed rabi crops in Nepal.

Description	Koshi	Mechi	Sagarmatha
Improved sowing techniques	52	84	44
Moisture conservation techniques	44	55	66
Treatment of saline alluvial soil	16	55	42
Treatment of saline alkaline water	16	39	35
Credit facilities	16	61	32
Insect control measures	84	48	35
Weed control measures	40	30	60
Disease control measures	96	43	26

Source: Field survey, 2002.

Input constraints

More than 65% of the farmers indicated non-availability of good quality seed as the most binding constraint to rabi cropping (Table 13). Besides, prices of quality seeds are often higher than self-produced seeds. In Sagarmatha and Mechi zones, non-availability of fertilizers is also reported as a serious constraint to cultivation of rabi crops. The cost of chemical fertilizer is also reported high in Koshi and Mechi zones.

Table 13. Percentage of households reporting constraints related to input availability and their prices in Nepal.

Constraints	Koshi	Mechi	Sagarmatha
Non-availability of quality seeds	88	91	69
Non-availability of pesticides	16	48	35
High cost of seeds	48	73	53
High cost of fertilizers	56	50	36
Irregular availability of fertilizers	20	52	56
High cost of pesticides	20	23	22

Source: Field survey, 2002.

Marketing constraints

Timely availability and sufficient quantity of inputs and assured procurement at a reasonably profitable price are important factors for promoting new crops, particularly in less agricultural development area as in rice fallow zones. Farmers' perceptions on marketing constraints of rabi pulses were noted. In chickpea, lack of local as well as organized market for the produce appears to be an important limitation in promotion of the crop in rice fallow areas (Table 14). Distant market as well as low local demand are reported very high in Koshi zone, while in Mechi the respondents report low price of rabi crops. Villages in Sagarmatha are geographically located in such a way that maximum farmers have reported transport as the main constraint.

More respondents in Koshi reported low price of lentil and distant market for it as major constraints, while in Sagarmatha maximum reported transport as a constraint. In linseed, low price is reported in Koshi as well as in Mechi. Due to low price farmers are not attracted to these crops. Mustard is a preferred crop in Mechi zone but low price is reported as the major constraint (Table 14).

Table 14. Percentage of households reporting marketing constraints to rabi crops in Nepal.

Constraints	Koshi	Mechi	Sagarmatha
Chickpea			
Low local demand	56	7	4
Distant market	72	2	8
No dealing in local market	18	9	19
Lack of transport	16	16	39
Low price	16	25	16
High price fluctuation	17	7	17
Lentil			
Low local demand	36	-	1
Distant market	40	-	8
No dealing in local market	11	-	10
Lack of transport	16	-	26
Low price	56	-	21
High price fluctuation	25	-	19
Linseed			
Low local demand	24	18	4
Distant market	28	5	8
No dealing in local market	16	16	8
Lack of transport	16	16	25
Low price	42	32	10
High price fluctuation	12	7	21
Mustard			
Low local demand	-	11	-
Distant market	-	5	-
No dealing in local market	-	18	-
Lack of transport	-	14	-
Low price	-	36	-
High price fluctuation	-	11	-

Source: Field survey, 2002.

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 system feel that prices of rabi pulses are low. This may be due to low marketable surplus. In Nepal there is no support price policy for pulses production.

Yield and price risk

Approximately half of the farmers reported low yield of rainfed rabi crops in Koshi and Mechi (Table 15). This yield risk is correlated to abiotic and biotic constraints. About 40% farmers have reported poor quality of produce. Quality products is an important issue in the changing global economic circumstances.

Table 15. Percentage of farmers reporting their perceptions on yield risk in Nepal.

Particulars	Koshi	Mechi	Sagarmatha
Low yield	48	61	36
Greater yield fluctuation	8	7	47
Poor quality of produce	44	45	31

Source: Field survey, 2002.

The observations made in this section suggest that abiotic factors are the potential limiting factors to rainfed rabi cropping in rice fallow system. Socioeconomic factors are also restricting cultivation of rabi crops. These should be considered while planning introduction of rabi crops in rice fallow system.

The constraints need to be alleviated through technologically, agronomic, and policy interventions. The findings suggest the following interventions to promote rainfed rabi cropping in the rice fallow system:

- Introduction of IPM package through training programs to reduce crop damage.
- Distribution of improved seeds and critical inputs in time and on subsidized rates.
- Development of information system on rabi crops and its cultivation practices by strengthening the agriculture extension system.
- Introduction of short-duration varieties of pulses capable of escaping terminal drought.
- Introduction of short-duration varieties of rice so as to enable farmers to sow rabi crops on residual moisture in time or promote early sowing of rice, whichever is feasible.
- Use of TV and radio for dissemination of information on rabi crops through attractive, informative programs.

- Technological efforts to overcome production risk. NGOs should develop crops insurance mechanism.
- Cooperative marketing to provide remunerative price to the farmers.
- Government policy for support price of pulses.

5. Opportunities in Rainfed Rabi Cropping

After evaluation of the potential crops suitable for cultivation in rice fallow systems under rainfed conditions and the factors limiting their cultivation, we examined their technical and economic feasibility. If rabi cropping is feasible, then what kind of technologies and policies will be required for area-wide cultivation of rabi crops? This section examines the technical and economic feasibility of rainfed rabi crops, farmers' acceptance of the crops/variety, benefits of rabi pulses in terms of income and employment generation, nutritional value of pulses and effects of pulses cultivation on soil fertility in rice fallow zones, and market opportunities for the pulses.

Technical feasibility of rainfed rabi crops

The first and foremost opportunity to utilize the rabi fallows 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 highly acceptable to the farming community. To demonstrate that it is feasible to grow crops on residual moisture in the field vacated by rice, ICRISAT and DFID conducted on-farm participatory chickpea, field pea, and buckwheat trials in the rice fallow zones utilizing mainly three inputs, i.e., seed, human labor, and bullock labor. Three different varieties of chickpea namely Avrodhi, BG 372, and KPG 59 were sown with two different technologies, i.e., seed priming and non-priming, minimal tillage, and intensive tillage. Each of these varieties were cultivated on 100 m^2 plots in the fields of contact farmers. An analysis of trials was undertaken to examine their technical feasibility in Nepal. In some cases the crops could not reach the harvesting stage because of either grazing by stray animals or cutting for green consumption by other villagers, and terminal drought due to late sowing. This happened in several fields. But a few farmers who could sow the seed timely and protect the crop from stray animals or from cutting were able to reap a good harvest (Table 16).

In Nepal Terai farmers do not favor seed priming because 14% to 60% less yield is reported with seed priming. The participatory varietal selection (PVS) trials are more successful.

Table 16. Yield of varieties of different rabi crops in Nepal.

		Yield (kg ha^{-1})		% change over
Zones	Crops/Varieties	PVS[1]	Priming	priming
Koshi	Chickpea			
	Avrodhi	400	300	-25
	BG 372	800	-	-
	KPG 59	800	600	-25
	Field pea			
	Arkel	367	250	-31
	Azad	556	300	-46
	E-6	533	400	- 4
	Buckwheat			
	Thulometho	300	-	-
Sagarmatha	Chickpea			
	Avrodhi	1024	-	-
	BG 372	1100	-	-
	KPG 59	900	-	-
	Field pea			
	Arkel	500	500	0
	Azad	686	500	-27
	E-6	563	424	-24
	Buckwheat			
	Thulometho	750	-	-
Mechi	Chickpea			
	Avrodhi	400	400	0
	BG 372	400	-	-
	KPG 59	700	600	-14
	Field pea			
	Arkel	500	400	-20
	Azad	250	100	-60
	E-6	600	600	0

1. PVS = Participatory varietal selection trials.
Source: Field survey, 2002.

Farmers' willingness to grow rainfed rabi crops

Despite incidences of animal grazing, cutting by human beings and terminal drought a majority of the contact farmers are satisfied with the participatory trials because these trials have generated a hope of growing pulses on residual moisture in the fields vacated by rice through technological interventions and agronomic manipulation. Seed germination was good; crops established well, and in some cases there was a good harvest. Further, almost all the contact farmers have expressed their willingness to grow rainfed rabi crops in the coming season (Table 17).

Table 17. Percentage of contact farmers willing to continue to grow rainfed chickpea in Nepal.

Zones	Satisfied with demonstrations	Willingness to continue	Technology preference		
			Delay cropping	Minimum tillage	Intensive tillage
Koshi	64	80	8	0	72
Mechi	45	48	0	9	32
Sagarmatha	36	38	4	36	0

Source: Field survey, 2002.

Farmers in Koshi and Mechi could recognize the benefit of intensive tillage and preferred to use this technology, while farmers in Sagarmatha preferred minimum tillage. Contact farmers have desired to have better access to input and more information to grow chickpea on a continuous basis. The participatory research trials have created a good demonstration effect on non-contact farmers (Table 18). Like contact farmers, a majority of non-contact farmers in Mechi and Sagarmatha are willing to grow chickpea and other crops provided they would have seed. Koshi has no non-contact farmers.

In Sagarmatha, more farmers than in Mechi reported to have visited trial sites with the curiosity to learn about rainfed rabi cropping practices. These farmers are aware and expressed their willingness to grow chickpea in the forthcoming rabi season if seed was provided. Like contact farmers, a majority of non-contact farmers are willing to grow rainfed rabi crops. Seed, however, is their main requirement (Table 19). Availability of short-duration varieties would provide further incentives to these farmers.

Table 18. Percentage of non-contact farmer households reporting willingness to grow rabi crops in rice fallows of Nepal.

Particulars	Mechi	Sagarmatha
Awareness about the demonstration.	11	27
Frequency of visit to demonstration site		
Every week	-	8
Once a week	2	12
Once a month	9	4
Never	30	29
Discussion with contact farmer	5	12
Willingness to grow rabi crops	34	12
Preference for method		
Relay cropping	2	53
Minimal tillage	11	1
Intensive tillage	23	1

Source: Field survey, 2002.

Table 19. Percentage of non-contact farmers reporting input and information requirement to grow rabi crops in rice fallows of Nepal.

Input/ information	Mechi	Sagarmatha
Quality seed	34	38
Method of sowing	36	39
Short-duration varieties	20	32
Short-duration rice varieties	16	23
Information on diseases control	18	30
Information on insect control	27	19
Credit facility	-	8
Bullock labor	27	4
Tillage equipment	7	4
Assured markets	20	9

Source: Field survey, 2002.

Non-contact farmers also need information on insect pest and disease management. Being small landholders they lack capital and need credit support to purchase the critical inputs such as seed, fertilizer, and pesticide. Some farmers do not posses draft power and thus they also need credit support to acquire bullocks so as to ensure timely sowing.

Benefits of rabi cropping

Utilization of fallow lands is likely to generate substantial income and employment opportunities for the thousands of small holders in the region. Chickpea cultivation is assumed to yield a minimum of NRs 8000 $ha^{-1.}$

Estimates are made on additional employment generation due to rabi cropping on fallow land. An estimate from trials indicates that chickpea cultivation on rice fallows generates almost 50 mandays of employment per hectare. Assuming this across the board it is estimated that if at any point of time 10% of the rabi fallow land is brought under rabi crops cultivation, it would generate approximately one million mandays of employment per annum. If 30% of the rabi fallow land is utilized at any point of time it would add another three million mandays alone in eastern region.

If it is extended to the western region where another 54.3 thousand ha of rice fallows exist, it can generate a total of 1.29 million mandays of employment at the 10% utilization of fallow land in the country. If 30% is used then a total of 3.88 million mandays of employment will be generated.

Apart from income and employment benefits, pulses provide much needed protein to the poor population, help improve soil fertility by fixing atmospheric nitrogen, and improve soil structure by adding organic matter content. Farmers of Nepal are aware of some of these benefits. Maximum farmers are aware about nutritive role of pulses in human diet (Table 20). More than half of the farmers are aware about the effect on soil fertility. A considerable number of farmers in the eastern region are aware about the residual effect of legumes on the following cereal crops. In Koshi zone, 72% farmers have reported chickpea cropping useful for enhancing income. In Mechi and Koshi, farmers feel that it can also enrich the soil structure. The insect pest control benefit of rainfed rabi cropping is reported by few farmers.

Table 20. Percentage of farmers reporting awareness of the benefits of pulses in Nepal.

Benefits	Koshi	Mechi	Sagarmatha
Human nutrition	48	89	79
Soil fertility	44	82	47
Residual impact	44	20	30
Additional income	72	16	30
Soil structure	20	27	9
Insect pests control	8	30	5

Source: Field survey, 2002.

Demand for pulses

In Nepal, pulses supply is short of demand. This offers major opportunities to increase pulses production by bringing rabi fallow land under their cultivation. Table 21 shows chickpea demand projections in 2010 (Joshi et al. 2001). The short supply of chickpea is attributed to its production having been shifted from favorable to marginal areas. In favorable 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 the less risky and profitable rice and wheat crops. 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 in rice fallows.

Table 21. Chickpea demand projections in 2010 in Nepal.

Item	Estimate
Present consumption ('000 t)	13.8
Population growth rate (%)	2.2
Income growth rate (%)	2.4
Demand growth rate (%)	3.2
Income elasticity	0.4
Projected demand for chickpea seed ('000 t)	20.9

Source: Joshi et al. (2001).

Import substitution

To meet the domestic demand not only of pulses but food grains in general, Nepal imports from other countries. The requirement of food grains in Nepal has been increasing (Table 22). Pulses can also contribute to sustainability of rice production.

Bringing rice fallow area under cultivation of pulses would contribute towards reducing import dependency and deficit of food grains of the country.

Table 22. Edible cereals grain production and requirement in Nepal.

Year	Production (t)	Requirement (t)	Balance (t)
1995-96	3913878	3948229	- 34351
1996-97	3972587	4079135	-106548
1997-98	4027348	4178077	-150729
1998-99	4099597	4285856	-186259

Source: Government of Nepal (2000).

Pulses as a low cost source of protein

Pulses are an important cheap source of protein for the poor. They are the cheapest source of protein compared to their substitutes like milk, eggs, and meat (Fig. 9). The 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 NRs 14.40 to NRs 20.80. The cost of obtaining the same amount of protein from milk is NRs 22.40 and from eggs is NRs 33.60. The cost of protein from beef and mutton is about 3 times higher than that of mung bean, chickpea, and black gram.

With appropriate technologies and extension support rice fallow land can make sufficient contribution to increase pulses production in Nepal and reduce import dependence. The Nepal Agricultural Research Council (NARC) has consistently been making efforts to improve pulses production.

It may be noted that 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 Nepal lies in achieving a breakthrough in technology of pulses production and utilization of rice fallow lands.

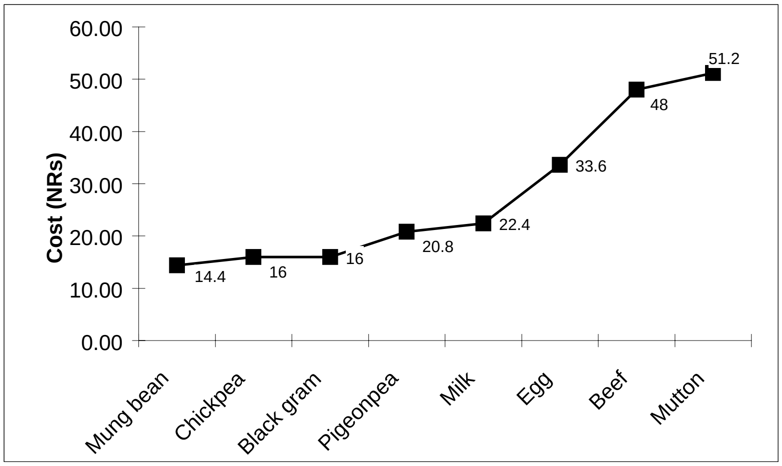

Figure 9. Cost of 100 g of protein from pulses and other sources in Nepal.

6. Conclusion and Implications

About 43% of the rice fallow area in Nepal remains unutilized due to several biotic, abiotic, and socioeconomic constraints. Of this, more than 75% area lies in the eastern development region of Nepal where Koshi, Mechi, and Sagarmatha zones are situated. Predominance of landless, submarginal, marginal and small landholders is a characteristic feature of the region. The private and public investment in agriculture is very 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 cities, agriculturally developed zones, and neighboring countries. Bringing fallow land under cultivation would help overcome many social and economic problems of the region. ICRISAT and DFID have jointly taken initiatives to promote rainfed rabi cropping in rice fallow lands by sensitizing farmers through on-farm participatory research.

The study has shown that rainfed rabi cropping has high potential in the region despite existence of multifarious constraints. Table 23 summarizes the results of the study in the form of a SWOT analysis (strengths, weakness, possible opportunities, and threats).

Strengths of rice fallow systems

The most important strength is the wide unutilized resource, i.e., rice fallow land with zero or very low opportunity cost. The second important strength is large labor force with zero opportunity cost that exists in the eastern Terai region of Nepal. Further, the regional average yield of pulses such as lentil and chickpea is higher than the national average. The average yield of pigeonpea, black gram, grasspea, horse gram, and soybean is higher at the national level compared to the eastern region. This implies that there is a possibility to profitably introduce these crops in the rabi fallow land. The yield analysis of rainfed rabi crops (chickpea, buckwheat, and field pea) presented in this study suggests that pulses can be cultivated with considerably good yield in the rabi season. The region has fertile soils and good monsoon rainfall, which is enough to facilitate cultivation of pulses on residual moisture after rice harvest. The Nepal Terai soils retain moisture for a long period after rice harvest. Hence, use of such lands seems to be profitable.

Weaknesses of rice fallow systems

The region has not received adequate attention in agricultural research and extension. The major constraints in promotion of rainfed rabi cropping include quality seed, short-duration drought escaping varieties of pulses, short-duration varieties of rice facilitating timeliness in sowing the pulses on residual moisture, uncertain rabi season rainfall, and problems of insect pests and diseases. The extension system is weak to transfer the technologies and information and lack of access to these might act as disincentive. The area under pulses is increasing and market does not seem to be a limiting factor in promotion of rabi pulses.

Opportunities for rainfed rabi cropping

In Nepal per capita consumption of pulses has been declining and is less than the recommended dietary allowance. The major opportunity for rainfed rabi pulses thus lies in meeting the rising demand for pulses. Further, Nepal imports considerable amount of not only pulses but also food grains to meet the domestic food demand. If Nepal increases pulses production by utilizing the rabi fallow area, imports could be reduced. Pulses are the cheapest source of protein compared to animal products including milk and eggs and can be afforded by the majority including low and middle income classes. Vegetarianism is a typical characteristic of some Hindu communities of the Nepali population and thus pulses would find greater acceptance among such communities.

Introduction of any new crop is often resisted by the farmer probably due to risk. The study brings out clearly that the majority of the farmers are willing to grow rainfed rabi crops provided there is an assured supply of inputs and cropping information. Farmers visualize opportunities of augmenting income, employment, and food security.

The study indicates considerable addition to income and employment at the regional level even at low rates of utilization of fallow land for rainfed rabi cropping.

Threats to rainfed rabi cropping

Nepali farmers are illiterate and the acceptance of new technologies is expected to be low initially, if dissemination is not participatory and properly executed. Production and price risks are more for pulses compared to cereals. Year to year fluctuations in yield is a common feature of pulses economy. Uncertain rainfall and high incidence of insect pests and diseases are the major production risks. Price fluctuation is the common phenomenon; prices fall considerably during good harvest year. The differences in regional consumer preferences for pulses may also threaten the production if the local consumers do not prefer a particular pulse.

Implications for research and development

A number of implications emerge from the SWOT analysis. The existence of huge rice fallow land is an indicator 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 land through suitable technological, agronomic, and policy interventions.

Technology development

Development of technologies and their effective transfer would be key to successful promotion of rabi cropping in rice fallow lands. Three main technologies should receive priority attention.

Table 23. SWOT analysis of rainfed rabi cropping in rice fallows in Nepal.

Description	Characteristics
Strengths	Huge labor with lowest opportunity cost Huge rice fallow with moisture content for longer period Excellent yield rates of rabi rice fallow Technological feasibility of rabi crops
Weaknesses	Non-availability of quality seeds of rabi crops Severe incidence of insect pests and diseases Non-availability of irrigation infrastructure Terminal drought Poor input purchasing power of farmers
Opportunities	Employment generation Income augmentation Improves soil structure Agricultural sustainability Food security to the poorest Import substitution Farmers willingness to grow crops
Threats	Yield instability Poor acceptance of technology if dissemination is poor Market price risk

First, in rainfed areas early-maturing varieties are more important than yield, and therefore there is a need to develop or introduce, if available, short-duration varieties of rabi crops. These are unlikely to yield desired results; however, the technological problems should be looked into from the systems prospective. Second, long-duration rice crop could be a major hindrance to the 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 environment are grown on residual moisture. Therefore, it is imperative to develop and promote moisture conservation technologies to facilitate growing of more rabi crops.

Agronomic manipulation

Time of sowing of rice should be advanced so as to facilitate timely sowing of rabi crop. Early sowing of rice can be achieved through agronomic manipulations in crop management practices such as broadcasting or dry seeding rather than transplanting rice.

Seed availability

Quality seed availability is the main limiting factor to the producers, particularly in the initial phase of introduction of new crops. Market mechanism 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 early adoption of farmers. Subsequently the concept of seed village may be promoted. Seed should be provided at subsidized rates. After a period of at least 10 years, involvement of private seed sector may be rewarding in production and distribution of seeds**.**

Technology transfer

Due to illiteracy and less education, the extension system has failed to transfer technologies in the region. Farmers would require considerable amount of information, particularly in the initial stages of introduction of rabi crops in the rice fallow system. This can be achieved either by strengthening the existing technology transfer system or evolving an innovative mechanism for transfer of technology and information. Also, there is a need for strong interface between researchers, extension system, and farmers for higher returns to investments in agricultural research. The transfer of technology seems to be the challenging job in Nepal Terai.

Community approach

Stray animal grazing is a common problem in rabi fallow land when rabi crops are grown on scattered plots. There are two approaches to overcome this problem. First, promote rabi cropping area widely by sensitizing the farming community through demonstrative feasibility of cultivation of rabi crops. Second, fodder is important for livestock production and therefore it should be promoted. Also, fodder crops should be cultivated.

Consumer preferences

Local consumer preferences for crops and 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

Promotion 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 or unorganized resources of credit, which often are exploitative. Access to institutional credit is almost nil. Improving access to institutional credit would help to improve their access to new agricultural technology. Introduction of crop insurance schemes for risky crops such as pulses particularly in new areas would provide incentives to farmers to undertake cultivation of pulses. At present Nepal does not have any form of crop insurance.

Marketing and prices

The market for rainfed rabi crops 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 underdeveloped market. The Government of Nepal does not protect pulses producers by fixing minimum support prices. To sustain rabi pulses, markets should be improved by creating awareness among the consumers about nutritional and health benefit of pulses consumption.

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Annexures

Annexure 1
Number of farmer households selected for the study in Nepal.

Zones	Contact	Alternative RC	Non-contact	Total
Koshi	25	-	-	25
Mechi	23	11	10	44
Sagarmatha	31	19	27	77
Total	79	30	37	146

Annexure 2
Study area according to zones in Nepal.

Zones	District	Villages
Koshi	Morongo	Rangoli, Taberwa
Mechi	Thapa	Jouropani
Sagarmatha	Saptari	Madhupati, Manhasma
	Siraha	Chandra Vaidyapur
		Chandra Ayodyapur

Annexure 3
Average size of landholding (ha) of selected households in Nepal.

Zones	Owned area	Operated area in kharif	Operated area in rabi
Koshi	1.79	1.86	1.86
Mechi	1.69	1.77	1.26
Sagarmatha	1.50	1.62	1.42

Source: Field survey, 2002.

Annexure 4
Profile of selected households in Nepal.

Zones	Average family size (persons)	Adult male (%)	Adult female (%)
Koshi	5.48	32.84	24.09
Mechi	7.11	37.70	35.78
Sagarmatha	8.10	27.56	26.10
Total average	6.89	32.70	28.66

Source: Field survey, 2002.

Annexure 5
Availability of infrastructure in seven selected villages in Nepal.

Type of infrastructure	Number of villages having infrastructure	Average range of distance where available (km)
Torrid road	5	8
Railway station	0	33
Market for farm produce	5	8
Agriculture input shop	4	6
Agriculture extension office	1	5
Health center	7	0
Primary school	7	0
Secondary school	4	4
Veterinary center	1	6
Electricity	6	3
Post office	7	0
Credit institution	2	5
Community TV	1	5
Library	2	5

Source: Field survey, 2002.