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Farmers' empowerment, soil enrichment and wealth generation through chickpea-IPM in Nepal

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Abstract

IPM for chickpea is a sustainable development model developed and implemented in Nepal by DFID, NRI, ICRISAT and NARC. It has positively affected soil fertility, human health and aided income generation for the poor. The study was conducted with the help of PRA, RRA techniques. The results suggest that IPM-chickpea has brought about a revolution in study villages. The empirical studies on chickpea-IPM cultivars show that the technology is an effective tool for eradicating hunger in Nepal's Terai region. The resulting starvation is prevented by systematically recreating a minimum level of incomes and entitlements. The project has proved that in the short run something effective can be done to remedy these desperate situations.

The production of chickpea will lead to higher yields of paddy; restoration of soil health and fertility; increase in human nutrition and reduce consumption of fertilizers; import substitution and exports promotion; reduction in poverty, through wealth generation and social upliftment, besides creating opportunities for development in Nepal. This project has provided food and nutritional security to farmers.

The IPM-chickpea model can be replicated elsewhere in the world where the same agroecological features exist.

Introduction

Chickpea is the most preferred pulse crop in Nepal. The production in Nepal had been declining before IPM intervention mainly because of BGM and pod borers (*Helicoverpa armigera*). The epidemics brought down chickpea production drastically in the Central and Eastern Terai of Nepal. The viciousness

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of their combined attack made it very difficult to rehabilitate chickpea farming in Nepal. The farmers became poorer due to repeated crop failure and shied away from taking further risks.

ICRISAT and NARC have reversed this trend by using Improved Pest Management technology, which changed the economics of the crop. A large number of marginal and poor farmers participated and learned technologies to avert the risk of the crop failure and improve their livelihoods.

Nepal has the lowest per capita income among the SAARC nations. Opportunities for employment on rural farms and in non-farm sectors are limited. Agriculture engages 81% of the rural population and the pace of transfer of labor from agriculture to non-agriculture sectors is slow. The lack of adequate opportunities in agriculture causes many social problems such as mass migration to agriculturally prosperous areas, to cities and outside the country. Since 1995-96, Nepal's import bill for food has been rising. The introduction of the IPM package has helped the farmers use rice and maize fallow lands and encouraged them to graduate to crops that are more remunerative.

Land holdings in Nepal are very small and marginal: approximately 89% are uneconomic; 8.4% are medium and only 2.6% belong to the large category[1] (Fig.1). Nepal is a small country and 50.3% of its population lives below the poverty line. It is ranked as the poorest country in the world on the development indicators of the World Bank[2] (Fig. 2).

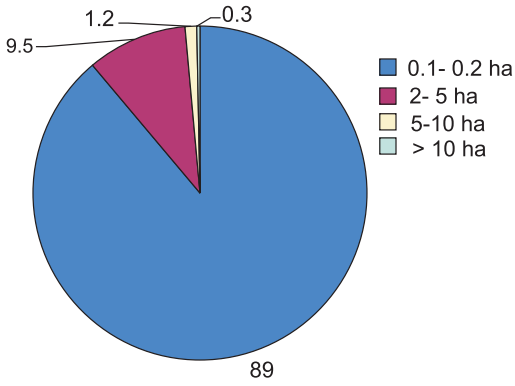

Fig. 1. Size of landholding in Nepal, 1991-92.

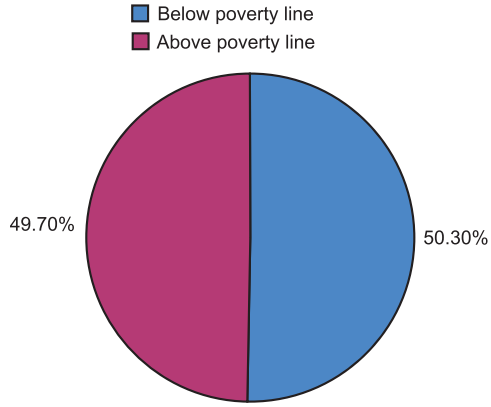

Fig. 2. Population below poverty line in Nepal.

To address this issue and help chickpea farmers, ICRISAT and NRI, in collaboration with NARC, have launched an aggressive program in the Terai region. The initiative was supported and funded by DFID. The aim of this program was to raise chickpea productivity through technology intervention

[1]Central Bureau of Statistics, HMG Nepal. 2002.
[2]World Development Report, Washington DC, The World Bank, 1991.

and improve the economic well being of chickpea producers. The objective of this study is to analyze the impact of IPM on livelihood of farmers (Fig. 3).

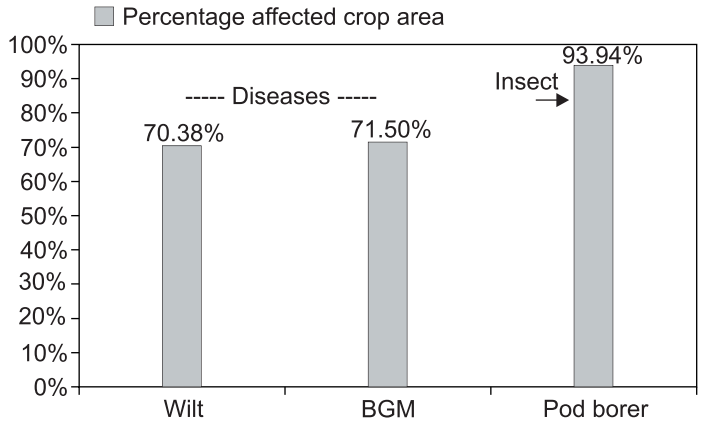

Fig. 3. Damage due to biotic constraints.

Methodology

Nepal is bounded by China in the north and India in the east, south and west. The east-west length of the country is 800 km and the width varies between 130 and 240 km (Fig. 4). The whole Nepal Terai adjoins the Indian Terai and is

Fig. 4. Administrative divisions (districts) and major urban centers in legume-growing areas of Nepal.

the most fertile and productive belt in Nepal. Agriculture in the Nepalese Terai is deteriorating in the absence of appropriate products and a favorable policy environment.

The districts Bardia, Banke, Sarlahi and Mahottari were selected for the impact study on livelihood. These districts are situated in the midwest and central economic development regions of Nepal. The land area of the Terai is 23% of the total area, but accounts for 52% of the total cultivated land of the country (Manandhar and Shakya 1996). It is a narrow belt of 50 to 20 km in breadth, while its length stretches along the entire length of the country. The slope or gradient ranges from 2-10 m/kilometer.

Sampling

The data was recorded randomly from selected farmers. The study groups were:

1. Contact farmers of ICRISAT/NARC.
2. Non-contact chickpea growers.

Considerable time was devoted to each farmer to elicit personal data. The number of respondents contacted by NARC/ICRISAT was 200 in both the regions. To obtain unbiased results, 50 non-contact farmers (growing chickpea, but not using IPM) were also selected for the study (Table 1).

Table 1. Number of sample households in Nepal.

Eco-Regions	Districts	Villages	Contact farmers	Non-contact farmers
Mid-west region	Bardia	Munal Basti	40	10
		Kurvinpur	18	-
		Kamalpur	-	10
	Banke	Betehni	6	-
		Dhaulagiri	-	10
		E-Gaon	2	-
		D-Gaon	32	-
Central region	Sarlahi	Lalbandi	52	-
		Jabdik	-	10
	Mahottari	Bardibas	50	10
Total			**200**	**50**

Source: Field survey 2003

Data

The respondents were asked to fill in a questionnaire pertaining to livelihood impact in an exercise of participatory learning. The selected respondents were the decisionmakers who were later interviewed. The questions quantified the impact of IPM technologies on the farmers' livelihood. The research team, trained in Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA), worked on a one-to-one basis (ie, with individual farmers) for data collection.

Income generation

The use of IPM has increased family income in both the mid-west and central regions. The respondents from lower levels of income from agriculture (0-20%) were 18 percent of the sample before IPM use. This figure came down to 9% after IPM use, while 41 percent respondents reported that their family income had nearly doubled (80-100%), which had been only 18 percent before IPM use. IPM has brought about more uniform and consistent income growth, and appeared to have greater impact in the central region compared to the mid-western region (Table 2).

Table 2. Family income from agriculture.

	Mid-west region		Central region	
Income	Before IPM	After IPM	Before IPM	After IPM
0 - 20%	18%	09%	12%	-
20 - 40%	20%	16%	24%	09%
40 - 60%	18%	18%	33%	07%
60 - 80%	26%	16%	14%	36%
80 - 100%	18%	41%	17%	48%

Source: Field Survey, June 2003.

The percentage share of family income from chickpea among the 0-20 percent class of farmers before IPM was 70% in mid-west region, which changed to 37% after IPM. In the changed scenario from the 80-100% class, 4% respondents' income rose. Chickpea has become a vehicle of economic development in the central region (Table 3).

Impact on consumption

The dietary contribution of chickpea also showed positive results in the mid-western region. In approximately 80% of respondents, intake of chickpea had increased (Table 4).

Table 3. Family income from chickpea.

	Mid-west region		Central region	
Class	Before IPM	After IPM	Before IPM	After IPM
0 - 20%	70%	37%	63%	12%
20 - 40%	16%	35%	24%	25%
40 - 60%	11%	15%	08%	30%
60 - 80%	03%	09%	05%	18%
80 - 100%	-	04%	-	15%

Source: Field Survey, June 2003.

Table 4. Dietary contribution from chickpea.

	Mid-west region		Central region	
Class	Before IPM	After IPM	Before IPM	After IPM
0 - 20%	55%	20%	68%	02%
20 - 40%	43%	45%	30%	43%
40 - 60%	02%	30%	02%	40%
60 - 80%	-	05%	-	10%
80 - 100%	-	-	-	05%

Source: Field Survey, June 2003.

Impact on production

The respondents had shown preference for the crop due to low labor, low returns, high yield, as well as its nitrogen fixation quality (Table 5).

Table 5. Reasons for crop preference.

Reasons	Mid-west region	Central region
Low labor input	23%	15%
Low cost input	27%	15%
High yield	27%	58%
Benefits for soil/land	23%	12%

Source: Field Survey, June 2003.

Crop preference for profit

In the mid-western region (MWR), rice and wheat are the most preferable crops (although not the most profitable, because these cereals are the staples). Among the five most important crops, chickpea was most profitable. In the central region (CR), farmers chose chickpea as the most preferred and profitable crop (Table 6).

Table 6. Crop preference for profit.

	Preference (%) (Top 5)									
	Mid-west region					Central region				
Crops	1	2	3	4	5	1	2	3	4	5
Rice	64	02	09	14	05	23	14	20	08	02
Wheat	02	41	09	07	09	-	04	06	04	06
Maize	02	-	-	04	04	-	10	04	10	04
Pigeonpea	04	14	14	11	04	-	06	10	18	14
Chickpea	18	16	37	11	04	37	33	10	04	04
Lentils	04	20	14	34	16	-	04	04	10	12
Black gram	-	-	02	-	02	-	-	-	-	-
Grass pea	-	-	-	-	04	-	-	-	-	-
Vegetables	-	04	09	09	09	31	08	14	12	02
Others	-	-	02	02	14	02	04	02	-	06

Source: Field Survey, June 2003.

Crop preference for food

After IPM, many farmers reported choosing chickpea as the second most preferred crop (Table 7).

Impact on housing

Chickpea cultivation has had a major impact on the housing sector. In MWR, 64% households had thatched mud houses. Post-IPM, this has come down to 44%. The percentage of brick and mortar houses before IPM was 38%, but went upto 60%. In CR, 82% households had thatched mud houses, which came down to 67%. On the whole, 7% respondents in MWR and 10% in CR were able to construct new houses (Fig. 5 and 6).

Table 7. Crop preference for food.

	Preference (%) (Top 5)									
	Mid-west region					Central region				
Crops	1	2	3	4	5	1	2	3	4	5
Pigeonpea	52	11	14	02	04	48	22	12	02	-
Chickpea	16	43	30	02	02	40	40	10	06	-
Lentils	18	36	39	02	-	04	-	22	20	16
Black gram	-	02	02	14	04	-	06	12	08	24
Grass pea	-	-	02	07	04	02	02	04	08	02
Vegetables	07	04	09	41	07	06	08	14	24	10
Others	02	-	02	16	30	-	08	06	02	06

Source: Field Survey, June 2003.

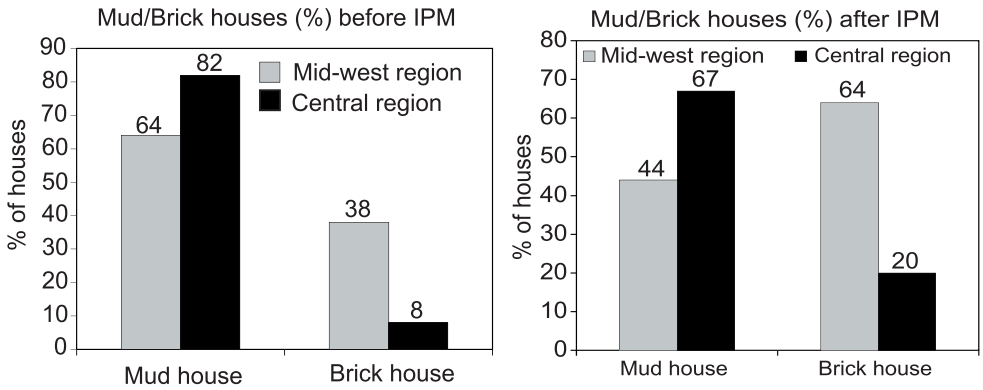

Fig. 5 and 6. Mud/brick houses % change in study area.

Spending of chickpea earnings

Chickpea has become a very important source of earning in regions. According to farmers, it fetches the highest profit in terms of cash. In MWR, 56% farmers have reported increased incomes available for household expenses. These respondents are now able to buy groceries in ample quantities. They also have electricity in their houses. Apart from these, they are spending more on medicines and healthcare. In CR, 26% farmers reported similar results. In MWR, 4% farmers have paid back former debts. In CR, 22% farmers were able to discharge debts (Fig. 7). The most important trend is that 11% farmers in the mid-west are purchasing new improved chickpea seed called Avarodhi, while 13% are doing so in the central region with their enhanced income.

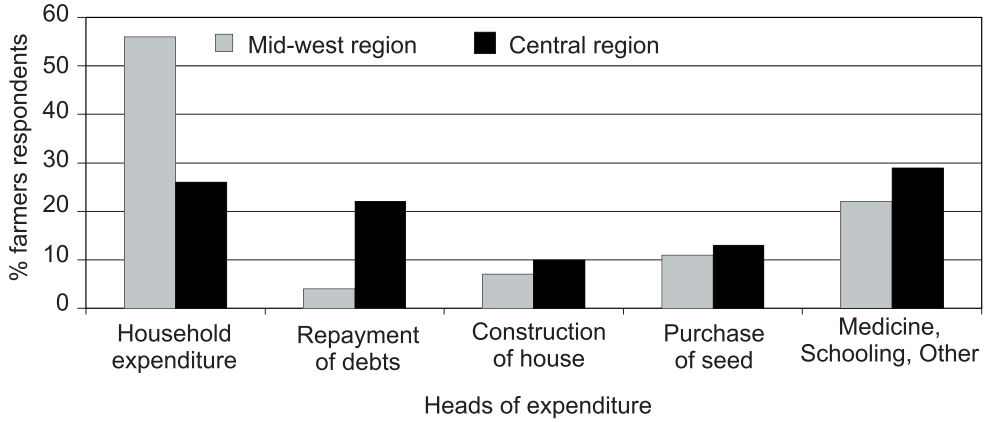

Fig. 6. Change in household expenditures after IPM.

Table 9. Change in household expenditure after IPM.

	% Change after IPM	
Expenditures	Central region	Mid-west region
School education	80	51
Wedding expenses	59	57
Clothes expenditure	49	25
Social/family expenditures	33	66
Agriculture technology	27	23
Medicines	20	30
Overall average change	45	42

Source: Field survey, 2003.

IPM technologies have made major changes in the expenditure pattern of the farmers. In CR, there has been 80% increase in expenditure on children's education, while the figure is 51% for MWR.

Increase in expenses on weddings is 59% and 57 % in central and mid-west regions, respectively. Expenditure on clothes has increased by 49% in CR and 25% in MWR. Social/family-related expenditure has increased by 33% in CR and 66% in MWR. However, increase in expenditure on agriculture technology has been 23% in both regions. The allocation for healthcare and medicine has risen by 20% in CR and 30% in MWR (Table 15). The cumulative increase is 45% in CR and 42% in MWR. Assuming the annual rate of inflation at 5%, farmers' income and expenditures have increased three-fold in three years in real terms (2000-2003).

Impact on livestock ownership

Chickpea income has also marginally changed livestock ownership of chickpea farmers in Nepal. About 14% in CR and 16% in MWR more farmers are able to buy oxen. Similarly, 20% more farmers in CR and 10% in MWR have bought milch cattle. A few have also started small dairies, while possession of poultry and goats has gone up as well (Table 10).

Table 10. Impact on livestock ownership.

	% Change in purchasing of livestock in Nepal	
Livestock	Central region	Mid-west region
Oxen	14	16
Milch cattle	20	10
Poultry	6	30
Goats	42	11

Source: Field survey, 2003.

Impact of chickpea on wealth generation

Economic benefits for farmers can be calculated from various angles: A benchmark survey in December 2000 found that CR had no improved varieties of chickpea. But IPM-Chickpea has reversed the trend, and now an average household seed transaction is about 127 kg of Avarodhi. Farmers are selling seed to other farmers and also to national NGOs @ NRs 27/kg. Even if only 10% of chickpea farmers transacted such quantities of seed, the seed economics would generate benefits equaling NRs 68,580.00. If adoption of IPM and improved seeds spreads at the same rate then chickpea cultivation has even greater potential to generate wealth.

Consumption and sale of surplus product

Chickpea farmers sell surplus produce to others. A three year average shows us that per katha output of chickpea is 50 kg. On average, a land holding of 10 kathas translates to 500 kg per farmer. If farmers sell half of the produce at NRs @ 27/kg, 5000 kg chickpea pumps in an additional 1.35 lakh rupees into the village economy. Apart from the 50 kg of chickpea that is retained for family consumption, this is equivalent to savings of NRs 1500/family. Even if only 10% families are taken into account, the savings work out to NRs 30,000 per year. One chickpea-IPM benefit model is presented in Fig. 8.

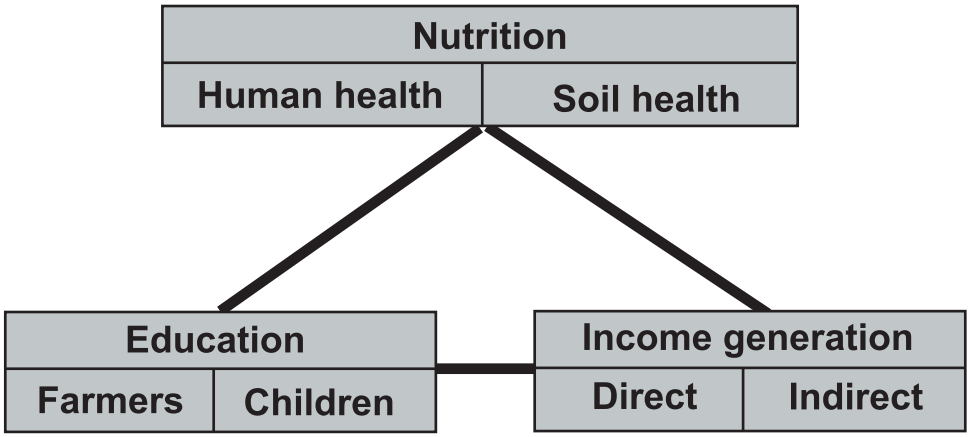

Fig. 8. Chickpea-IPM sustainable development model.

Reduced burden of fertilizers

The farmers reported that the use of chemical fertilizers has gone down due to chickpea cultivation. After chickpea harvesting, 24 man-days of labor/ha was saved on FYM input in the next paddy crop due to nitrogen fixation, leading to the savings worth NRs 1200/household. The total FYM saving in the village equaled NRs 8000. Savings on urea was NRs 3133, and NRs 2286 on DAP. The total fertilizers' savings was NRs 13,419 (Fig. 9).

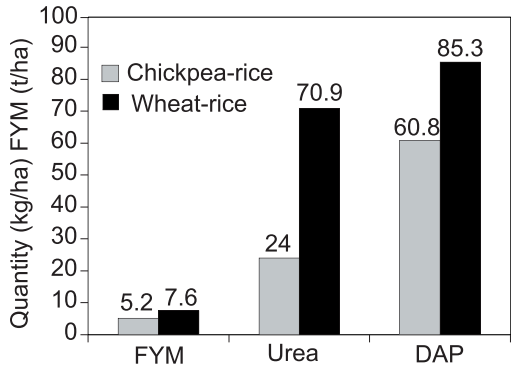

Fig. 9. Consumption of fertilizers in rice under different rotations, Nepal.

Increase in yield due to restoration of soil fertility

Crop rotation with chickpea increases yield of paddy to 7.71 quintal/ha, ie, an additional income of NRs 5397/household. For 20 families which is 10% of the households studies, additional income amounts to NRs 107940.

The income of an average contact chickpea farmer has increased by NRs 15148. The amount of wealth generated by chickpea has a multiplier effect on the economy.

This particular example is deliberately taken from a low profile village called D-Gaon to make a cautious assessment. The impact is more spectacular than the figures show. When the same method of calculation is used for the entire

study area, the cultivation of chickpea is found to have generated NRs 21, 20,853 in additional wealth and 1000-man days of more seasonal employment in the study villages (Fig. 10).

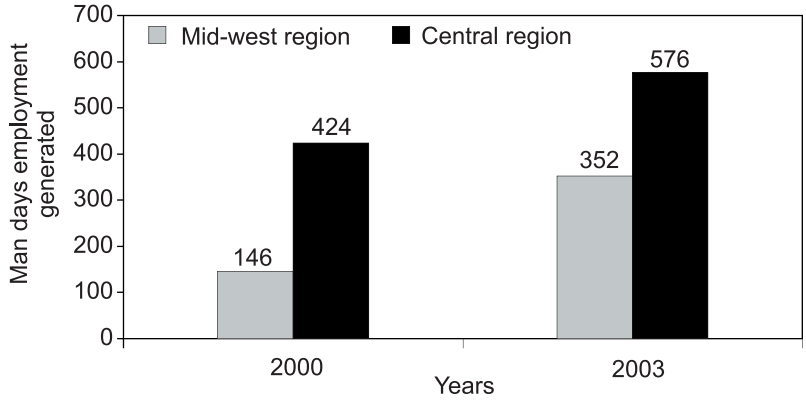

Fig. 10. Employment generation in the study area.

IPM cultivation of chickpea is generating additional employment in the study area. In comparison to 2000, employment has increased (Fig. 10). The utilization of fallow lands is likely to generate substantial incomes and employment opportunities for thousands of smallholders in the region in the future. Chickpea cultivation is projected to generate an additional NRs 8000/ha.

Estimates indicate that chickpea cultivation on rice fallow generates almost 50 man days of employment per hectare. If 10% of the rabi rice fallows were brought under cultivation, it would generate approximately 1.29 million man days of employment per annum. 30% of fallows would add another 3.88 million man-days of employment. (Bourai et al. 2002)

Impact on biodiversity

The impact of this study can be seen through the spread of improved varieties of seed (Fig. 11). Avarodhi has maximum spread in the study areas. Chickpea farmers in MWR report 83.33% Avarodhi seed transaction, while in CR it is 100%. Some other improved varieties reported in circulation among a small number of farmers in MWR are Chandra (4.1%), Koseli (8.3%) and Tara (4.1%). Overwhelmingly, a large number of farmers prefer Avarodhi to other varieties.

Seed transaction

Bardibas is an identified chickpea seed village, where farmers reported a number of seed transactions with their relatives, friends, NGOs, NARC and traders

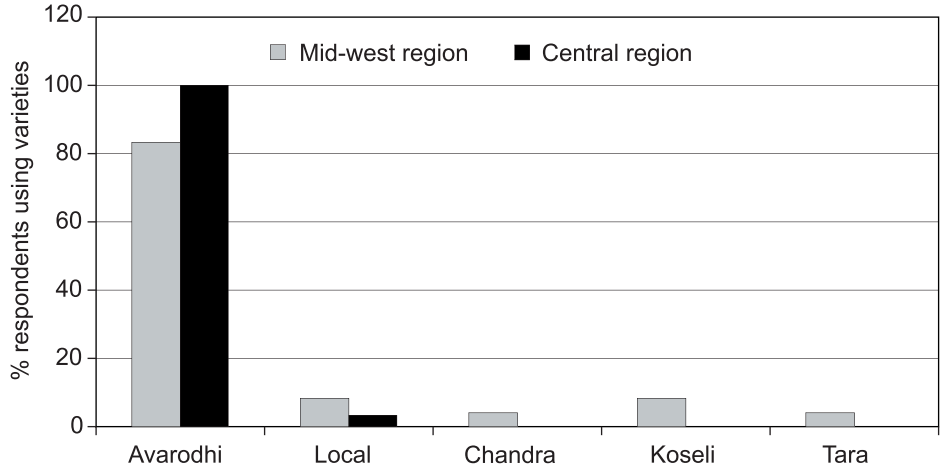

Fig. 11. Presence of chickpea varieties in the study areas.

(Table 20). The seed has been transacted far and wide. In all these villages, Avarodhi has spread due to its disease tolerance, high yield, and availability of IPM technology (Fig. 12). Lalbandi and D-Gaon are other very important seed villages from where self-generated demand of Avarodhi is spreading elsewhere. The demand for Avarodhi with IPM technology is accelerating in the study areas of Nepal (Fig. 12). The average seed transaction is 127 kg/household in NWR and 279 kg/household in CR. The price for seed is NRs 27/kg and NRs 33/kg respectively (Table 12).

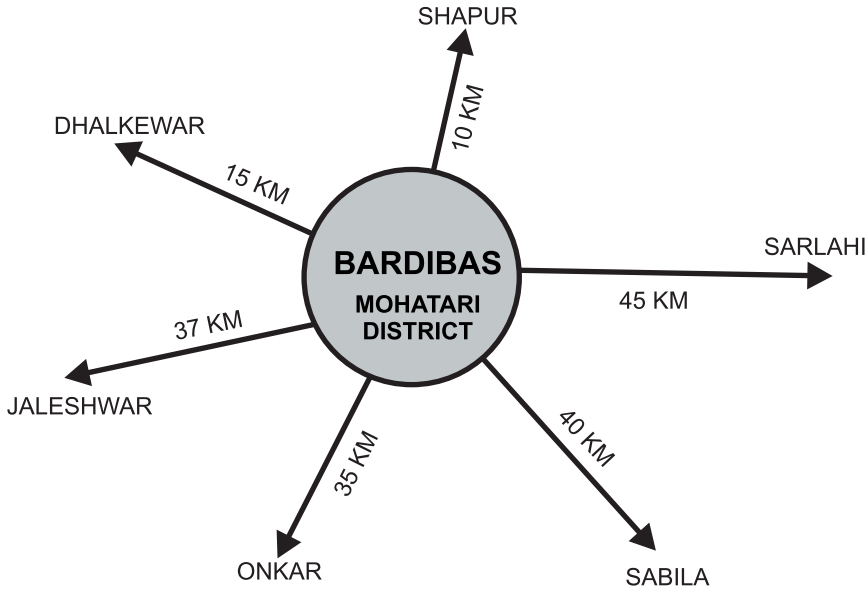

Fig. 12. Seed spread from the seed villages.

Table 11. Total benefits from chickpea – Case study of village, D-Gaon.

	(In NRs)
Seed transaction benefits	68,580
Sale of surplus product	1,35,000
Consumption of chickpea	30,000
Reduced burden of fertilizers	13,419
Increased yield due to restoration of soil fertility	35,980
Total	2,82,979

Table 12. Average quantity/price of seeds transaction.

	Mid-west region	Central region
Average amount (in kg)	127	279
Average price (in NRs)	27	33

Farmers in the study areas are able to produce and store chickpea seed. In MWR, 62% farmers are able to produce their own Avarodhi seed, 4% farmers get it from other farmers, while 20% get the seed from farmers' co-operatives. In CR, 94% farmers produce their own seed; 4% farmers buy it from other farmers, while only 2% farmers buy it from commercial sellers. Seed transactions takes place through a number of methods viz, sale, barter, gifts to relatives and others (Table 13, 14).

Table 13. Percentage breakup of chickpea sources.

	Mid-west region				Central region			
Source of Seed	Chick-pea	Rice	Wheat	Pigeon-pea	Chick-pea	Rice	Wheat	Pigeon-pea
Self-produced	62	77	56	53	94	92	62	82
From other farmers	4	18	18	13	14	4	10	8
Commercial sellers	-	4	9	-	2	2	4	-
Farmers' cooperative	20	9	9	2	-	-	-	2

Table 14. Types of seed transactions.

Transactions	Mid-west region (%)	Central region (%)
Sale	83	73
Barter	4	19
Gift	21	32
Other	12	8

Resource utilization

In MWR, 91% of the respondents have used rice fallows for chickpea production. In CR, 75% respondents use rice fallows and 49%, maize fallows. The overlapping is due to many respondents cultivating both rice and maize (Fig. 14). The rice fallow land is an important natural resource, which provides sufficient moisture to chickpea growth (Kumar Rao et al. 1998). If agronomic manipulations are made and short duration rice varieties are provided for the uplands, the synergy will bring a boom in the region. The chickpea average area/household has increased in MWR and CR. Before IPM, the figures were 1 katha/household in MWR and 0.5 katha/household in CR (Fig. 13).

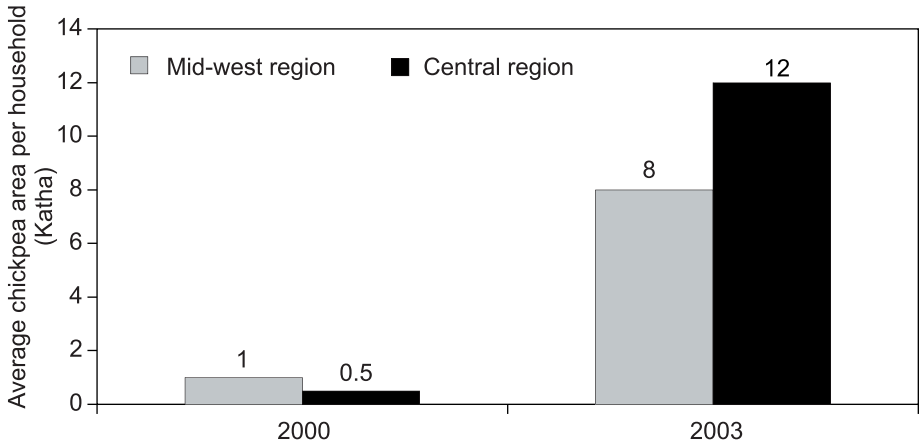

Fig. 13. Average chickpea area changed/household after IPM.

Chickpea not only enhances soil fertility through nitrogen fixation but also provides ground cover and fodder, and is a nutritious high-value human food. Chickpea is an integral part of the diet cooked as dal and eaten with roti (unleavened wheat bread) and boiled rice. The importance of chickpea has been recognized for enrichment of soil fertility through its ability to symbiotically fix atmospheric nitrogen and tolerate drought hazards (Fig. 14).

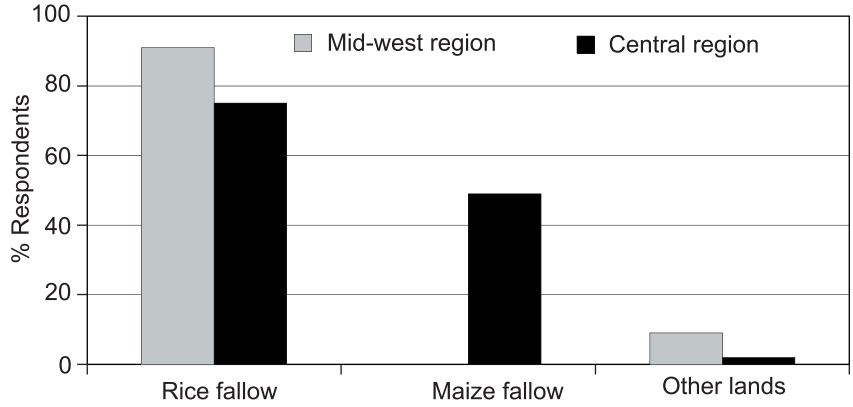

Fig. 14. Utilization of fallow land.

Table 15. Chickpea demand projections for 2010 in Nepal.

Items	Estimates
Present consumption ('000t)	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 ('000t)	20.9

Source: Joshi et al. 2001.

In Nepal, pulses are in short supply. This offers major opportunities to increase pulses production by bringing fallow land under cultivation. Table 15 shows chickpea demand projections for 2010 (Joshi et al. 2001). The short supply of chickpea is attributed to its shift in production from favorable to marginal areas. In favorable regions, the coverage of wheat and rice has increased at the cost of coarse cereals, pulses and oil-seeds. Lack of technology to improve the yield of pulses and thereby their lack of profitability paved the way for the cultivation of crops such as rice and wheat which were less risky and comparatively profitable. The hope of raising pulses production lies in marginal areas such as rice and maize fallows (Table 17).

Table 16. Output and income projections from chickpea.

Years	Average land area (ha) under chickpea	Average chickpea output/katha	Average total chickpea output (kg)	Actual total output (t)	Chickpea price (million NRs)
2000	.18	50	277	5.55	1.66
2001	.20	50	307	6.15	1.89
2002	.26	50	385	7.70	2.31
2003	.36	50	535	10.71	3.21
2004	.53	50	784	15.69	4.70
2005	.80	50	1157	23.15	6.94
2006	1.14	50	1680	32.60	9.78
2007	1.62	50	2377	47.55	14.20
2008	2.23	50	3275	65.51	19.65
2009	3	50	4399	87.99	26.39
2010	3.90	50	5775	115.50	34.65

Extrapolation formula used: Y3 – 3 Y2 + 3 Y1 – Y0 = 0.

Table 17. Estimate of rice fallow areas in Nepal.

Eco-Regions	Rice fallows (million ha.)	Rabi fallows as % of Kharif rice area
Eastern	0.217	50.9%
Central	0.018	4.5%
Western	0.068	25%
Mid-western region	0.055	38%
Far-western region	0.015	11.79%

Further, if IPM technology were disseminated to 5% of marginal and sub marginal farmers, then the estimated supply of chickpea in Nepal in the year 2010 would be 3,99,000 tons. These estimates are based on some assumptions:

1. About 0.36 million ha rice fallow land is suitable for chickpea production
2. Chickpea will automatically extend to rice and maize fallows
3. The extrapolation of land use is based on increase per year of chickpea coverage
4. The constant margin of profit will remain up to 2010.

The demand and supply gap will exist even after continuous efforts. In the neighboring countries, demand for chickpea will not depress its price in Nepal. The production of chickpea will lead to higher yields of paddy, restoration of soil health and fertility, increase in human nutrition, lesser consumption

of fertilizers, import substitution, exports promotion, reduction in poverty, equitable distribution of wealth and social justice, through empowerment of the weak and marginal farmers, besides creating sustainable development in Nepal.

Chickpea has the ability to give better harvests than the other crops on marginal lands. However, there are increasing concerns that continuous rice-wheat cropping has caused deficiency of soil nutrients and degradation of soil. The use of fertilizers is being promoted for raising rice-wheat productivity and maintaining soil fertility. However, the high cost of fertilizers, their non-availability at the right time, and poor purchasing power of farmers have limited the use of fertilizers in Nepal. Besides, with their excessive use leading to environmental hazards, donors have reduced or stopped fertilizer-aid altogether. Against such a backdrop, IPM-chickpea is playing a vital role for a sustainable economic, environmental and ecological development.

Yield and price risk

Risks with regard to yield and prices are higher for pulses production compared to cereals (Byertlee and White 2000), mainly due to conditions in which pulses are grown ie, in marginal areas and under largely rainfed conditions. Fig. 15 shows that in study areas chickpea has crossed these risk barriers.

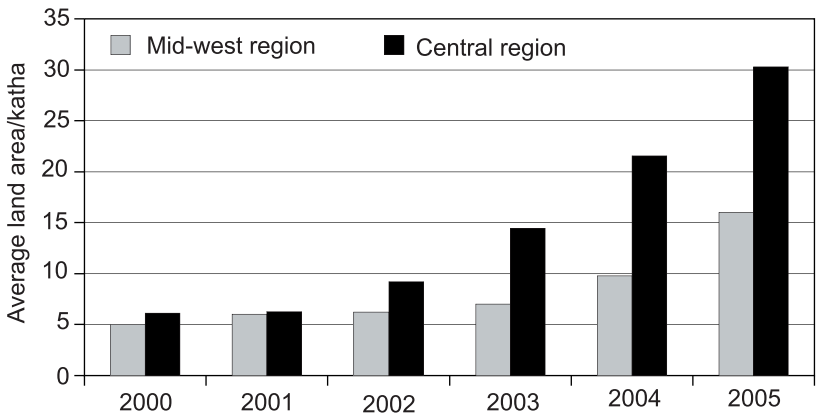

Fig. 15. Increase in average land area of chickpea/household.

Nepali farmers were turning their backs on chickpea in the last two decades, and adoption of improved varieties was negligible – about 8% of all chickpea growing area in 1999-2000. Today many numbers of chickpea farmers are using new Avarodhi seed in Nepal Terai. The seed sector has also been considerably developed, and technology has been transferred to the study areas.

In Lalbandi (CR), every farmer has become a seed producer, providing seed to farmers in other villages with a condition that the seed taker will return double the quantity in the following season.

Conclusion

The empirical study of IPM-chickpea cultivars shows that the technology is effective and provides a tool for eradication of hunger in Nepal. IPM-chickpea enhances peasants' entitlements, since biotic and abiotic stresses were associated with the loss of entitlements.

IPM-chickpea has proved that in the short run something highly effective can be done to remove miseries and starvation. Usually, it is taken for granted that nothing much can be done to remedy these desperate situations at least in the short run.

The success of chickpea adoption is due to various strengths of the project. The project is able to utilize rice fallows, maize fallows and other uplands. Chickpea is a highly remunerative winter crop. The additional income earned from it frees poor farmers: its benefits are reaching the poorest among the poor and it seems to be a farmer-friendly technology.

The IPM-chickpea model can be applied as a tool of poverty eradication anywhere in the world where the same agroecological conditions exist.

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