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ISBN 92-9066-464-9 Order code IBE066 386-2003

DFID Department for International Development

Wealth Generation Through Chickpea Revolution

On-farm IPM of Chickpea in Nepal 3

International Crops Research Institute for the Semi-Arid Tropics
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Citation: Pande S, Bourai VA and Neupane RK. 2003. Wealth Generation Through Chickpea Revolution. IPM of Chickpea in Nepal-3. Information bulletin no. 66 (In En. Abstract in En.) Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 36pp. ISBN 92-9066-464-9. Order code IBE066.

Abstract

The IPM of chickpea project is a sustainable development model implemented by ICRISAT/NARC in Nepal. The model brought about a positive affect on soil, income and health of people living below the poverty line. The four districts selected for the study are situated in central and midwestern hillside-*Terai* regions in Nepal. The study was conducted with the help of PRA techniques. The results show that IPM of chickpea brought about a revolution in the study villages. The empirical study of IPM of chickpea package including cultivars has shown that technology is an effective remedy for eradication of hunger in Nepal *Terai*. Starvation can be prevented by systematically recreating a minimum level of income and entitlements for those hit by changed agricultural economics in Nepal. The overall income of farmers increased from regeneration of chickpea crop and also improved soil health. The project succeeded in bringing about a change in the status of village women who are major players in the agriculture sector of Nepal. Intensification of the project in the *Terai* will change the entire livelihood pattern of poor peasants for better. This model can be applied elsewhere in the world, where similar agro ecological features are available, for alleviation of poverty.

Acknowledgments

This study was commissioned by ICRISAT and funded by the Department for International Development (DFID), UK. The project under study is on Integrated Pest Management (IPM) of Chickpea adoption and its impact on livelihood of farmers in Nepal. We thank scientists and field staff of Nepal Agricultural Research Council (NARC), Regional Research Station (RRS), Khajura, National Oil-seed Research Program (NORP), Nawalpur, and Grain Legumes Research Program (GLRP), Rampur, who helped in conducting the field surveys. Our specific grateful thanks to RN Chaudhary and TB Ghemeray of NORP and VK Dutta, Rameshwaran Maharjan, DN Pokherial and S Mahatto of RRS, Khajura, NARC, Nepal. Contribution to questionnaire development, along with timely logistical and technical support provided by Philip Stevenson of University of Greenwich is sincerely acknowledged. We shall remain thankful to the farmers who participated in this participatory research. The coordination of the production process by TR Kapoor is gratefully acknowledged.

About ICRISAT

The semi-arid tropics (SAT) encompass parts of 48 developing countries including most of India, parts of southeast Asia, a swathe across sub-Saharan Africa, much of southern and eastern Africa, and parts of Latin America. Many of these countries are among the poorest in the world. Approximately one-sixth of the world's population lives in the SAT, which is typified by unpredictable weather, limited and erratic rainfall, and nutrient-poor soils.

ICRISAT's mandate crops are sorghum, pearl millet, chickpea, pigeonpea and groundnut – five crops vital to life for the ever-increasing populations of the SAT. ICRISAT's mission is to conduct research that can lead to enhanced sustainable production of these crops and to improved management of the limited natural resources of the SAT. ICRISAT communicates information on technologies as they are developed through workshops, networks, training, library services and publishing.

ICRISAT was established in 1972. It is supported by the Consultative Group on International Agricultural Research (CGIAR), an informal association of approximately 50 public and private sector donors. It is co-sponsored by the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank. ICRISAT is one of 16 nonprofit, CGIAR-supported Future Harvest Centers.

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(This publication is an output from a research project funded by the United Kingdom Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID)

Contents

Preface

The livelihood impact study conducted in Nepal is a part of an on-farm IPM of chickpea study conducted by the Nepal Agricultural Research Council (NARC) and the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) in partnership with the Natural Resources Institute (NRI). The Crop Protection Program (CPP) of the Department of International Development (DFID), UK, has funded the study. This empirical study of IPM-chickpea shows that the technology is highly effective and provides remedy for eradication of hunger in hillside-*Terai* in Nepal and also provides opportunities for sustainable development. Starvation can be prevented by systematically ensuring a minimum level of income and entitlement for those who were hit by the changed agricultural economic conditions in Nepal. The authors have proved that a project in the short run can curtail nutritional starvation.

The study focused on village women who are the key agents of change. Women are the major actors in the agriculture scenario of Nepal and are thus most benefited by this project. This project has provided food and nutritional security to the farmers and their households.

The project is a solution to the poverty alleviation in the short run while creating sustainability of rice-based cropping systems in the long run. This will provide benefits to future generations by providing food and nutritional security. It is a valuable document for both researchers and research managers in the evaluation of research project proposals on chickpea and allocation of research resources.

William D Dar
Director General
ICRISAT

Executive summary

The goal of IPM of chickpea project in Nepal is to socially and economically uplift the poor marginal farmers and fulfill their basic minimum needs (BMNs) in the hillside-*Terai*.

Through a development partnership between National Agriculture Research Council (NARC), Nepal, and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, India, the project was operational over a period of three years (2000 – 2003). The project was funded by the Department for International Development (DFID), UK. It was tested on a basic rural network involving chickpea farmers in 'seed villages' and elsewhere in each of the four districts within 50 km radius surrounding the NARC stations located in western, central and eastern *Terai*.

A technological intervention methodology has emerged from the NARC-ICRISAT partnership on IPM of chickpea established earlier in several villages. The methodology is based on:

- Sustainable environment
- Soil health
- Human health
- Income generation

The focus is on village women who are the key agents of any change. They are the main players in the agriculture scenario in Nepal and as such are the most benefited by this project. This has provided food and nutritional security to farmers and their families. Further, easy availability of quality seed, a basic component of IPM, is spreading from farmer to farmer. This is also enhancing the biodiversity in the region.

Apart from increasing farmers' income, the chickpea crop has also helped in improvement of soil health, which was the hidden focus of the project.

The IPM-chickpea combination is creating sustainable agriculture development in the Indo-Gangetic Plain (IGP). Women and children are the biggest beneficiaries of the project. Children are going to good English medium schools.

Women are getting better returns for their hard work. There has also been an improvement in healthcare and hygiene. Adoption of IPM-chickpea has brought awareness about successful pest management of the other crops also. There has been a lot of understanding generated about improved variety of seeds for other crops.

The farmers now know that lost soil fertility can be restored by rotating chickpea with other crops. The project has also helped farmers to replace chemical fertilizers with organic ones. It has introduced the concept of grading of chickpea seed. Increase in income has also given a boost to the *pucca* house construction-related industry in the areas under study.

1. Introduction

The grain legume, chickpea, is commonly grown in rice-based cropping system in Nepal. Among pulses, chickpea was relegated to fifth place in order of preference due to biotic and abiotic constraints. To overcome these constraints, the Integrated Pest Management (IPM) approach was launched in the *Terai* region of Nepal jointly by ICRISAT/NARC in 1999-2000. The approach was introduced through farmer participatory methodology on a large scale. The study is focused on IPM of chickpea adoption and its impact on livelihoods and poverty alleviation.

Chickpea has the capacity to restore soil fertility and thereby increase paddy production in the following year. The crop can restore fertility back to the soil. In the Indo-Gangetic plains (IGP), chickpea has the highest nutritive value (360 cal/100gm) and is also known as the poor man's protein.

Nepal is the poorest country in south Asia (Fig 1). Its 50.30% population is living in abject poverty.

Rice is the staple food crop of Nepal. It occupies an area of 1.37 million hectares. In post *kharif* (rainy season) 0.26 million hectares of arable land remains rice fallow. This uncultivated area in *rabi* (postrainy) can help Nepal overcome the problem of food insecurity. Crops such as pulses and oil seeds are critical to attain food and nutritional security. Nepal is deficient in food grains, pulses and oil seeds. It imports huge quantities to meet the domestic demand.

According to an estimate, by 2020 grain production has to go up by 40% to meet the needs of increased population in the developing world.

The socio-economic features of midwestern and central region of Nepal show dismal situation (Table 1). While midwestern region has 28.79% of geographical area of Nepal, its share in population is low at 11.90% (density 63.88 person/sq km). The central region constitutes 18.62% area of Nepal while its

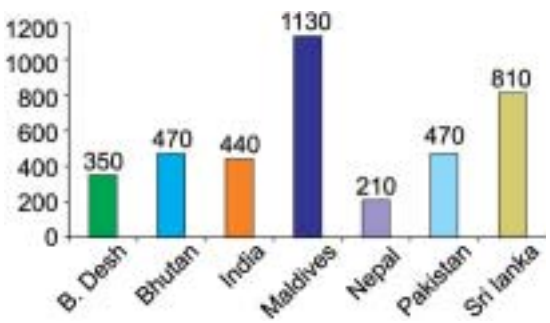

Figure1. Per capita income of SAARC nations.

Table 1. Socio economic features (%) of selected regions of Nepal

Description	Midwest region	Central region	Overall
Share of geographical area (2001)%	28.79	18.62	100.00
Share in population (2001)%	11.90	35.13	100.00
Density (2001) persons/sq.km	63.88	291.00	159.48
Literacy rate (2001)%(At 6 years of Age).	12.47	11.78	12.89
Population below poverty line (2000)%	NA	NA	50.30
Average size of land holdings 1992 (ha)	0.88	0.85	0.95
Share of agriculture in GDP (2000-01)%	NA	NA	38.10

Source: Statistical Pocket Book Nepal 2002. HM Government, National Planning Commission Secretariat: Central Bureau of Statistics, Kathmandu, Nepal.

share of population is 35.13% (density 291 persons/sq km). The socio economic characteristics show that the pace of transfer from agriculture to non-agriculture sector has been very slow.

Low productivity in agriculture gives rise to problems such as migration to cities and other agriculturally prosperous areas in search of employment. Problems of poverty, unemployment, illiteracy and malnourishment are acute in Nepal.

Land holdings are tiny, marginal or small. About 89% land holdings are economically not viable, 8.4% are medium and 2.6% are large. (Fig 2)

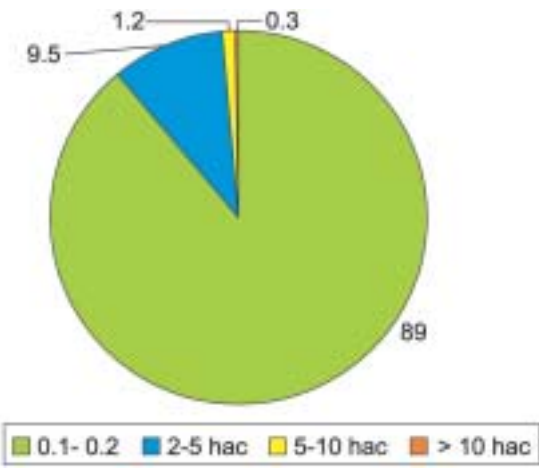

Figure 2. Size of land holding in Nepal 1991-92.
Source: Central Bureau of Statistics H.M.G. Nepal 2002.

Poverty scenario in Nepal

Nepal is one of the poorest countries in the world[1]. Limited natural resources and a high rate of population growth averaging at 2.6% per annum over the last decade have contributed to excessive poverty. Increasing population pressures on land have led to cultivation of marginal land and depletion of forest cover. This inturn has lead to the vicious circle of low productivity, environment degradation and poverty.

According to the Population Census Report (1991)[1], women constitute a little more than 50% of the total population. Of them, 46% aged 10 years and above are officially treated as economically active. Even among the poor, women are relatively more deprived because of discriminatory culture and social practices. Gender disparity starts right from birth. Generally, a male child is always preferred to a female one. This continues throughout her life in nutrition, healthcare, schooling, workplace and decision-making in family or legal practices.

To fulfill basic minimum needs (BMN's) and enhance the quality of life (QOL) of small land-holders, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Nepal Agricultural Research Council (NARC) and Natural Resources International (NRI) through funding from the Department of International Development (DFID), UK, are in the process of exploring ways to increase production of chickpea with the help of IPM technology and agro-economic interventions. Chickpea is promoted in midwestern and central region of Nepal with the help of IPM package under rainfed conditions during the *rabi* seasons of 2000-2003. As a consequence, the central region is experiencing a chickpea revolution. IPM has become an agent of sustainable agricultural development.

Objectives of the study were:

- Impact on the vicious circle of poverty in villages
- Impact of IPM of chickpea on livelihood of farmers
- Impact of IPM on sustainable development
- Quantification of IPM-chickpea benefits
- Macro impacts on the village economy.

[1] World Development Report, Washington DC, The World Bank 1991.

2. Methodology

2.1 Study sites

Nepal has 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 3 and Fig 4). The whole of Nepal *Terai* region adjoins the Indian *Terai* and is the most fertile and productive belt in Nepal. Agriculture in Nepal *Terai* is deteriorating in the absence of appropriate products and policy environment. This section provides an outline of the study area, sampling approaches and the data collection used in the study. Only midwest and central economic development regions are considered for the study. It is restricted to four districts: Bardia and Banke in midwest region and Mohatari and Sarlahi in central region.

Rice is the principal crop and is largely grown under rainfed conditions in the *kharif* season. In postrainy (*rabi*), large acerage of rice lands are left fallow (Table 2). Only two regions (midwestern and central) were selected out of the five administrative regions because of the following reasons:

- In December 2000, before commencement of the project, there was total absence of chickpea cultivation in central region.
- In midwestern region, farmers suffered 100% losses due to pod borer, botrytis gray mould (BGM) and wilt diseases.
- These regions constitute almost 52% of total cultivated land of the country.
- Financial constraints to conduct a large scale study to cover the entire Nepal.

Table 2. Estimates of rice fallow land in Nepal.

Eco-regions	Rice fallow (million ha)	Rabi fallow % of *kharif* rice area
Eastern	0.217	50.9%
Central	0.018	4.5%
Western	0.068	25%
Midwestern region	0.055	38%
Farwestern region	0.015	11.79%

Source: Climate and Crops of Nepal (Manandhar and Shakya 1996).

The districts selected for the impact on livelihood study are situated in central and midwestern region of Nepal *Terai*. The area of the *Terai* is 23% of Nepal, but it accounts for 52% of the total cultivated land. The *Terai* was originally forest land that composed of alluvial soil highly suited for agricultural activities. It is referred to as the country's breadbasket. Sarlahi lies in the central region and Bardia in the midwestern region of Nepal.

Chickpea is largely confined to the *Terai* region. More than 90% of the land is suitable for chickpea cultivation is in this region. To understand and diagnose the impact of chickpea cultivation on the livelihood of the people in *Terai*, two economic development regions (midwestern and central) were selected for the study. *Terai* and foothills region lie in the extreme south along Nepal-India border and varies in height from 60-750m. It is a narrow belt of 20 to 50 km in breadth, which stretches along the entire length of the country. The slope or gradient ranges from 2-10 m/kilometer.

2.2 Sampling

The data was recorded randomly from selected farmers of NARC/ICRISAT, on-farm IPM of chickpea project. Two groups were selected from villages where the IPM package was given by ICRISAT. In case non-

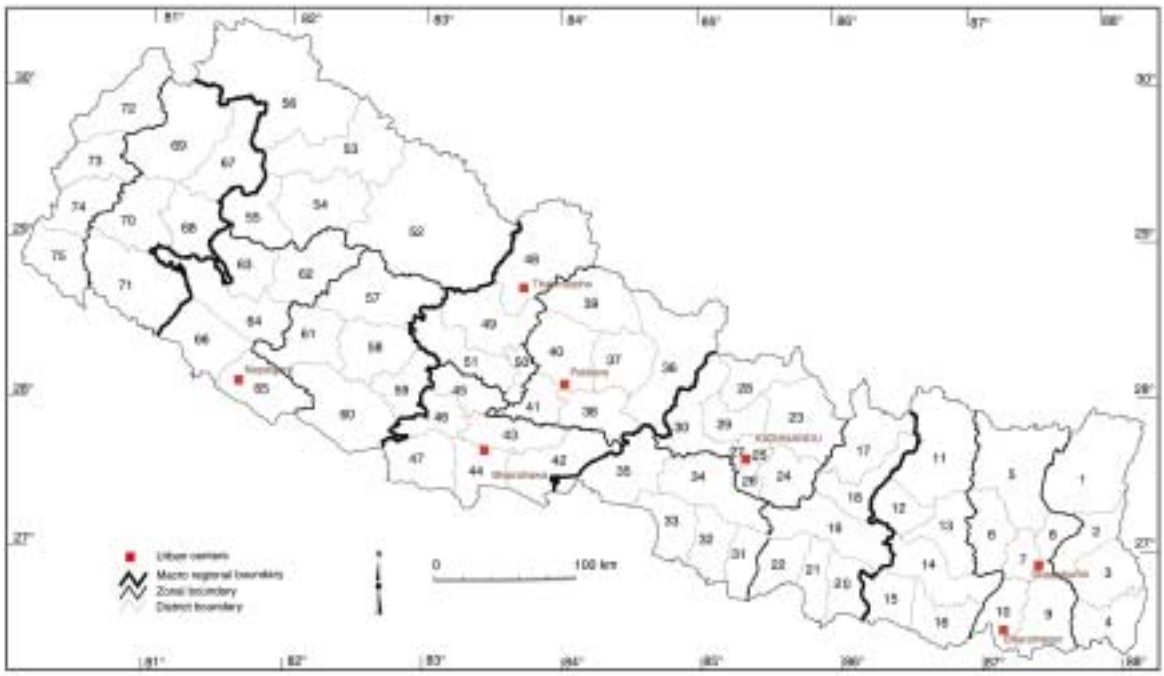

Figure 3. Administrative divisions (districts) and major urban centers in legume-growing areas of Nepal.

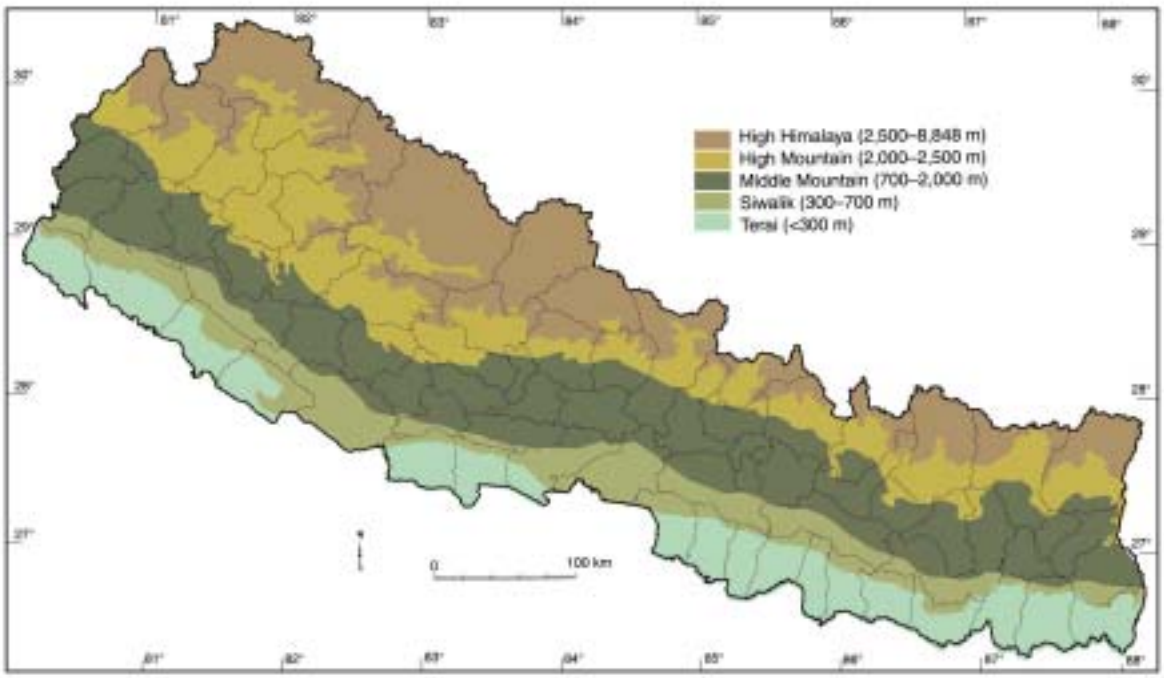

Figure 4. Physiographic regions of Nepal (Source: Topographic survey branch, Department of survey, His Majesty's Government, Nepal, 1983).

IPM farmers were not available in a village then in search of such farmers another village was selected.

The farmer study groups were:

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

Considerable time was devoted to each farmer to dig out 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, not using IPM) were also selected for the study (Table 3).

2.3 Data

The respondents were asked to fill in a constructed scheduled questionnaire pertaining to livelihood impact in an exercise of participatory learning (Appendix 1).

Selected respondents were involved in chickpea farming and took decisions on crop preference. Men and women participated in interviews, which was held mainly with the actual decision makers.

The questions quantified the impact of IPM technologies provided by ICRISAT/NARC on the livelihood of farmers.

Farmer participation was the key source of information. The research team, trained in PRA/RRA (Participatory Rural Appraisal/Rapid Rural Appraisal). worked on one to one basis (individual farmers) for data collection. Additional advantage was that the team members were well versed in Nepali.

2.4 Social characteristics of villages

The distance of villages from NARC establishments ranged between 2 and 35 kms (Appendix 2). Nepal is a country of many religions, languages, castes and creed (Appendix 3 & 4).

Based on land holdings, the respondents were divided into three economic classes: deficit, medium and rich. In midwestern (MWR) and central regions (CR), 15% and 16% contact farmers were deficit, 78% and 76% were medium. The number of rich

Table 3. Number of sample households in Nepal.

Eco-regions	Districts	Villages	Contact farmers	Non-contact farmers
Midwest Region	Bardia	Munal Basti	40	10
		Kurvanipur	18	—
		Kamalpur	—	10
	Banke	Betehni	6	—
		Dhaulaeri	—	10
		E-Gaon	2	—
		D-Gaon	32	—
Central region	Sarlahi	Lalbandi	52	—
		Jabdik	—	10
	Mohatari	Bardibas	50	10
Total			200	50

Source: Field survey 2003

farmers was 7% and 8%, respectively. In non-contact farmers' group, 50% were deficit in MWR and 48% in CR. The data for medium class farmers was 47% in MWR and 49% in CR. The rich among non-contact farmers were only 3% in both the regions (Appendix 5).

The literacy rate among the respondents was better than regional and national literacy averages. The percentage of those who had formal education was 40% in Bardia, 35% in Banke, 36% in Mohatari and 50% in Sarlahi. While the percentage of those who are mere literate was 52% in Bardia, 55% in Banke, 48% in Mohatari and 35% in Sarlahi. The illiterate respondents were 8% in Bardia, 10% in Banke, 16% in Mohatari and 15% in Sarlahi (Appendix 6).

2.5 Village and household characteristics

Sub-marginal, marginal and small farm agriculture is a noted feature of the selected villages. Some of these villages came into existence 30 years back when the HMG of Nepal allotted land to farmers after clearing the forests. In these villages, landless farmers were also identified. The maximum holdings in all villages under study was below one hectare. The average size of a family in Nepal (Bourai et al. 2002) is 6.89. Holding below one hectare of land for such a family size becomes economically non-viable.

The agricultural pattern of Sarlahi and Mohatari is rice-wheat/chickpea/lentil-rice. The pattern of Bardia and Banke is rice-wheat/chickpea/lentil/mustard-rice.

In villages, more than 95% of farmers have agriculture as the source of employment. A large number migrate for petty jobs to towns in Nepal and India. Temporary migration increases during *rabi* season and this causes scarcity of human labor in the sowing period.

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.

The size of land holding in Nepal when compared to other developing countries is small (Fig 2). Often these holdings are economically non-viable. The *Terai* region is relatively better off. Land holdings have been divided in the last 20-30 years making them economically non-viable in the process.

Across the region, the average land holding size is uneven. It ranges from 0.83 hectare in central region to 0.88 hectare in midwest region. There are reports that non-wheat and non-chickpea producers keep the land fallow in winter after the rice and maize crop.

The rice fallow land in Nepal *Terai* is 0.39 million hectares (Subbarao et al. 2001). According to another report, rice fallow is 0.26 million hectares (Bourai et al. 2002) (Table 2). The average cropping intensity of Nepal is about 200%. In general, most of the land under chickpea cultivation is upland and rainfed only.

3. Livelihood of farmers in Nepal

Farmers in the study area live in abject poverty. Their agricultural capital is below subsistence level and are unable to fulfill even their basic minimum needs.

The farmers use land on rent. The rent is often 50% of the agricultural output. The farmers defined their assets during PRA interviews. Their order of preference was

house, agricultural land, livestock and agricultural implements. CR was poor when compared to MWR. This region has high density of population at 291.44-persons/sq km while Nepal as a whole has only 154.48-persons/sq km. The average size of land holding in the area under study is also quite small at 0.85 ha, while the national average is 0.96 ha (Table 1). The average land owned in the study area of MWR is 1.86 ha while in central region it is 0.98 ha. An average farmer takes 0.64 ha land on rent in MWR and 0.88 ha in the central region (Table 4).

Table 4. Land ownership status/household.

	Average owned land area (ha)	Average land area on rent (ha)
Midwestern region	1.86	0.64
Central region	0.98	0.88

Source: Field Survey June 2003

3.1 Farmer assets

The peasants of these regions where the IPM-chickpea was implemented lived in thatched mud houses. They had few assets apart from utensils, traditional and uneconomic agricultural equipments. Many did not have ploughs and ox which are basic agricultural capital equipment. Agricultural land was the main source of livelihood in these villages.

3.2 Livestock

The quality of livestock in these areas was so poor that it made their ownership uneconomical. Poor farmers had to hire plough and ox from others. This increased the cost of production.

3.3 Agricultural infrastructure

Agricultural infrastructure was considered to be an important asset. The farmers were using traditional seed or seed distributed by ICRISAT/NARC. Pod borer, BGM and wilt reduced the sales of chickpea, the only source of income in *rabi* season. The farmers were so poor that they do not have enough capital for assured irrigation for alternative crops in *rabi*. In the selected area, there was no irrigation. Availability of improved seed was considered to be an important asset. But improved seed practices were not found in non-contact villages. Only 2% had tractors in the study areas.

3.4 Expenditure priorities

Expenditure priorities addressed by contact and non-contact farmers were almost the same. Food was the first preferred expenditure. Maximum reported that the crops they grow were sufficient to feed them only for six months in a year. Both contact and non-contact farmers reported expenditure on education as their second priority. The groups chose clothes as third priority and aricultural inputs as the last priority. Table 5 shows the order of preference for expenditure.

4. Economics of IPM

An Integrated Pest Management (IPM) package was developed to control diseases and insect-pests in chickpea crop. The package was developed in a farmers' participatory mode and was demonstrated in fields. ICRISAT/NARC transferred IPM technology to the farmers with various user-friendly techniques.

Table 5. Expenditure priorities

Farmer Groups	Food	Clothes	Education	Fertilizers	Chemicals
Non-Contact	1	3	2	5	6
Direct Contact	1	3	2	4	6

Source: Field Survey December 2002.

The package consisted of improved agronomic practices, adoption of available moderately resistance and high yielding chickpea varieties, judicious application of pesticides (fungicides and insecticides) and use of biocides. The details of IPM package are:

Improved chickpea seed — *Avrodhi*; seed treatment @ 2g kg^{-1} seed with a mixture of commercial fungicides, Thirum + Bavistin in 1:1 ratio; application of Rhizobium inoculums; diammonium phosphate (DAP) @ 3 kg/katha and need based foliar spray of pesticides (fungicides and insecticides) to control BGM and *Helicoverpa*, pod borer. The fungicide Bavistin @ 1g/litre of water (17 gm/17 litres of water/katha) was used to control BGM. Insecticide Thiodan @ 3 ml/litre of water (51ml in 17 litres of water/katha) was used against pod borer. The first prophylactic spray of fungicide was given during flowering to pod formation stage (60–70 days after sowing). Subsequent fungicide sprays were scheduled based on weather conditions like temperature, length of foggy hrs/day, number of days, percentage of humidity and cloudiness favorable for disease development. In general, spray schedules coincided with vegetative-flowering, pod-formation and development stages of the crop. Insecticide was sprayed once during flowering and twice during pod filling stage.

It was observed that the cost of IPM package was 13% higher than the non-IPM package. The returns of 13% higher cost were manifold. The net return with IPM package was NRs 1056/katha in contrast to NRs 310/katha without IPM package, a gain of about 240%. The unit cost of production estimated to be 62% lower on IPM farms than non-IPM (Pandey et al. 2000) (Fig 5).

Reduced cost of production per kg changed the price dynamics of chickpea and increased its profitability. Large-scale adoption in both the regions was due to its cost effectiveness.

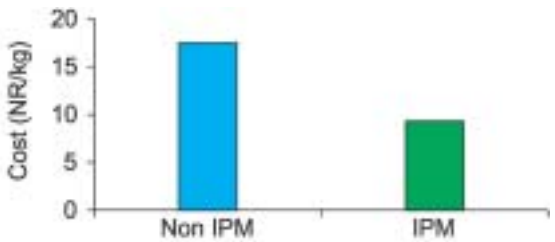

Figure 5. Unit cost of chickpea production with IPM and without IPM.

Chickpea is an additional source of income for Nepalese farmers. The IPM made chickpea a highly profitable crop in the study area. The main cause of its adoption was low cost of production and multiple high benefits (Table 6).

5. Impact of IPM of Chickpea

5.1 Family income

The use of IPM package changed the family income in both midwestern and central regions. The respondents on the lower level

Table 6. Economics of chickpea production with and without IPM (NRs/ha)

Particulars	Without IPM	With IPM	Change over without IPM (%)
Material cost	4252.00	4332.00	1.88
Operational cost	10540.00	11950.00	13.38
Interest on working capital	170.00	172.00	1.18
Total cost	14962.00	16454.00	9.97
Gross income	24120.00	35440.00	46.93
Net income	9158.00	18986.00	107.00
Unit cost of production (NRs/kg)	17.53	9.26	47.18

Source: Chickpea Production Constraints and Promotion of IPM in Nepal.

of income from agriculture, 0-20%, were 18% before IPM use. But this changed to 9% after IPM. Forty one percent respondents reported that their family income increased 80-100%, which was only 18% before IPM use. The coefficient of variation in both the regions before IPM and after IPM changed. In MWR, the coefficient of variation was 51.65% and after IPM it was 43.17%. This shows that more uniformity and consistency in income was achieved after the use of IPM. In CR, there was an uniformity in farmer incomes from agriculture. IPM redistributed income and wealth in the regions. The data (Table 7) shows that CR felt the impact of IPM more than the midwest region.

Family income from marketing crops also showed a considerable change in the study area. This was again due to the use of IPM. The impact on marketing crops is higher in central region. Its coefficient of variation was 64.64% before the use of IPM. This changed to 42.32%. IPM brought more uniformity in income of marketing crops (Table 8).

In MWR, the family income from chickpea before IPM use was 70% for farmers in the class 0-20%. In the changed scenario, 4% respondents' income increased to 80-100%. The coefficient of variation of chickpea income in midwest region was 83.35% before IPM and after IPM it stood at 68.33%. This shows that chickpea

Table 7. Family income from agriculture.

	Midwest 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%
Coefficient of variance	51.65%	43.17%	56.74%	32.42%

Source: Field Survey June 2003

redistributed income levels. Chickpea became a catalyst in the central region. It proved to be the solution for sustainable development (Table 9).

5.2 Impact on consumption

The dietary contribution of chickpea also showed positive results in the midwestern region. In approximately 80% respondents' intake of chickpea increased. In a focus group interview, a particular woman explained that chickpea became a part of their everyday diet. The intake of balanced diet increased in midwestern and central regions of Nepal. In central region, the coefficient of variation of dietary contribution of chickpea before IPM was 85.29%. But after use it was 38.89%. This shows that protein consumption became more extensive and intensive in central region (Table 10).

5.3 Impact on production

The respondents have also reported about crop preferences for production. In both regions, chickpea was the first choice. In CR, 85% farmers preferred it for production. In MWR, the second preference was pigeonpea while in CR it was vegetables (Table 12). Fifty eight percent respondents preferred it for its high

Table 8. Family income from marketing crops.

	Midwest region		Central region	
Class	Before IPM	After IPM	Before IPM	After IPM
0 - 20%	42%	33%	28%	13%
20 – 40%	26%	17%	33%	15%
40 – 60%	10%	13%	23%	25%
60 – 80%	16%	20%	08%	21%
80 - 100%	06%	17%	08%	26%
Coefficient of variance	79.72%	69.69%	64.64%	43.32%

Source: Field Survey June 2003

Table 9. Family income from chickpea.

	Midwest 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%
Coefficient of variance	83.35%	68.33%	80.90%	50.00%

Source: Field Survey June 2003

Table 10. Dietary contribution from chickpea.

	Midwest 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%
Coefficient of variance	55.48%	48.84%	85.29%	38.89%

Source: Field Survey June 2003

yield. Twenty seven percent in MWR preferred chickpea for its low cost of production while 15% did so in CR. In MWR, 23% respondents reported that it had low labor input cost while only 15% thought so in CR. In MWR, 23% respondents suggested that it improves soil health/fertility while in CR only12% farmers shared the same view (Table 11).

Table 11. Reasons for crop preference.

Reasons	Midwest region	Central region
Low labor input	23%	15%
Low cost input	27%	15%
High yield	27%	58%
Beneficial for soil/land	23%	12%

Source: Field Survey June 2003

5.4 Crop preference for profit

In MWR, rice and wheat were reported to be the most preferable crops (though not the most profitable because these cereals are staples). Among the five most important crops, chickpea was chosen to be the most profitable one. In CR, farmers chose chickpea as the most preferred and profitable crop. Even in the second preference, chickpea was at the top (Table 12). Farmers anticipated that price of chickpea would reduce because of increased supply. But their fears were falsified. Farmers, constantly have been getting a high price. In fact, Nepal is so underfed that the pent-up demand has kept the price stable (Table 12).

5.5 Crop preference for food

Chickpea was the second most preferred crop among maximum respondents. In CR, pigeonpea was preferred first and chickpea second (Table 13). After the introduction of IPM, many farmers began choosing chickpea crop. But before IPM, it was not anywhere among the choice of farmers.

5.6 Impact on housing

Chickpea cultivation caused a major impact on the housing sector. In MWR, 64% households had thatched mud houses. But after IPM this reduced to 44%. The percentage of brick and mortar houses before IPM was 38% but after IPM it went up to 60%. In CR, 82% had thatched mud houses, but after IPM the number came down to 67% (Fig 6A, B).

Table 12. Crop preference for profit.

	Preference (%) (Top 5)									
	Midwest 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
Lentil	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

Table 13.Crop preference for food.

	Preference (%) (Top 5)									
	Midwest 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	–
Lentil	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

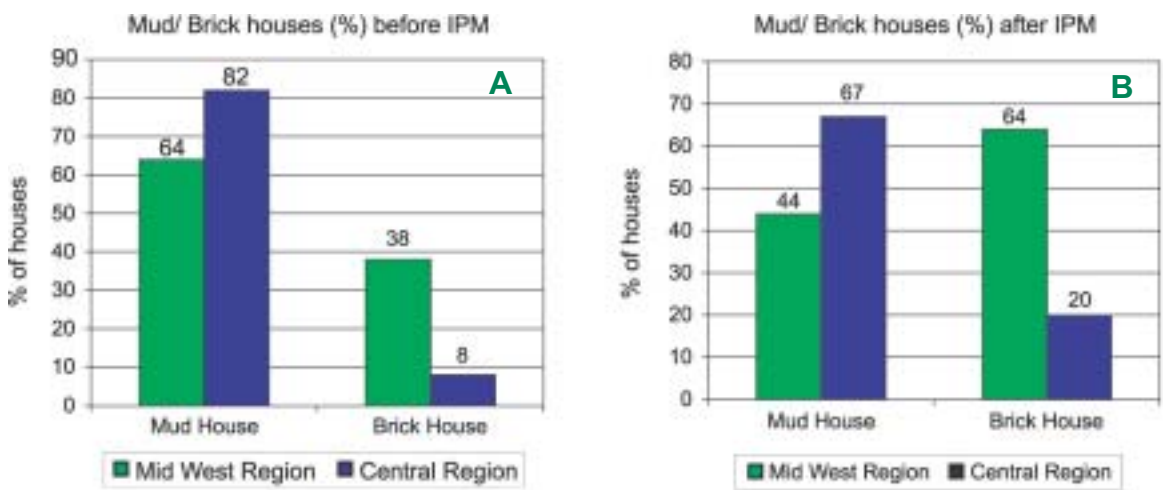

Figure 6. Mud/brick houses % change in study area.

5.7 Impact on labor use

The main occupation of majority of Nepalese is agriculture. Apart from agriculture, 2% farmers have also reported carpentry as their secondary means of livelihood while 31% worked as seasonal laborers. In MWR, there was a 5% increase in job opportunities as casual labor after IPM but the change in CR was 10%. Construction of houses changed labor pattern in both the regions. It shows that IPM has also generated non-agricultural jobs like mason, plumber and carpentry. It generated more demand for construction material and employment opportunities in the tertiary sector (Table 14).

5.8 Spending of chickpea earnings

Chickpea became a very important source of earning in MWR and CR. According to farmers, it fetches maximum profit in terms of cash. In MWR, 56% farmers have reported that they used the increased income 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 on medicines and healthcare. In CR, 26% farmers reported similar results. In MWR, 4% farmers have paid back their debts. In CR, 22% farmers were able to discharge their debts (Fig 7).

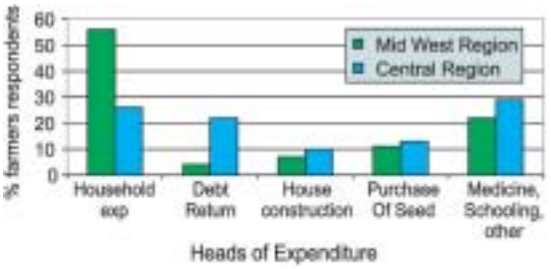

Figure 7. Spending of money earned from chickpea.

A success story

Krishna Bahadur Sreshta of Bardibas, a 50-year old farmer, had to support a family of six: five adults and one child. Being a sub-marginal farmer he did not have sufficient rice stock to last an entire year. But Integrated Pest Management of chickpea changed his life. He began selling chickpea for NRs 10,700. He bought sufficient quantity of rice and other provisions to last an entire year. Now, he has a happy family. In the absence of IPM-chickpea, Krishna Bahadur Sreshta would have sold a part of the land to feed his family. The IPM technology saved his family from hunger pangs.

In total, 7% respondents in MWR and 10% in the CR were able to construct new houses. The most important trend is 11% farmers in MWR purchased new improved chickpea seed called *Avrodhi* while 13% did so in CR with their enhanced income.

Table 14. Livelihood framework (human-income skills).

	Midwest region (%)		Central region (%)	
Human- income skills	Before IPM	After IPM	Before IPM	After IPM
Farming	100	100	100	100
Carpentry	2	2	2	2
Engineering	2	2	2	2
Plumbing, construction, others	31	36	33	43

Source: Field Survey June 2003

Seed entrepreneur

Sushila KC is a seed entrepreneur in D-Gaon. In 1999, she did not grow chickpea. But after the ICRISAT/NARC intervention she cultivated chickpea on two kathas. Seeing the results, she grew chickpea on 10 kathas. In 2003, she cultivated chickpea on 15 kathas. She is now marketing seed to farmers and NGOs. FORWARD, a national NGO of Nepal working on rice fallow lands, bought 500 kg seed from her. Sushila is happy and is able to spend NRs 15,000/pa on her children's education. Her family now also has access to better medicare.

Sushila said IPM project gave them knowledge of HYV seeds and taught methods of scientific cultivation. Use of chemical fertilizer for paddy has come down. In future, they plan to bring in more land under chickpea cultivation.

5.9 Change in household expenditures after IPM-chickpea use

The IPM technology has brought about a major change in expenditure pattern of the farmers. In CR, there has been 80% increase in expenditure on children's education, while it was 51% in MWR. Increase in expenses on wedding was 59% and 57% in central and midwest region, respectively. Expenditure on clothes increased by 49% in CR and 25% in MWR. Social family expenditure increased by 33% in CR and 66% in MWR. However, increase in expenditure on agriculture technology has been 23% in both the regions. The allocation for healthcare and medicine rose by 20% in CR and 30% in MWR (Table 15).

The cumulative increase was 45% in CR and 42% in MWR. Even if the average annual inflation rate was 5%, the farmers income and expenditure increased three-fold in three years (2000-2003). Finally, impact of IPM of chickpea can be summarized in IPM-chickpea sustainable development model (Fig 8).

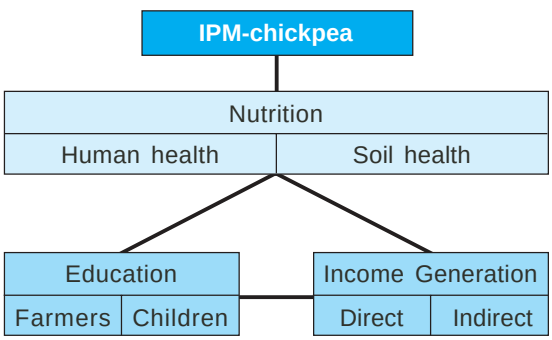

Figure 8. IPM-chickpea sustainable development model.

Table 15. Change in household expenditure after IPM-chickpea use.

Expenditures	% Change After IPM	
	Central region	Midwest 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

5.10 Impact on livestock ownership

Chickpea income has marginally changed the livestock ownership. In CR and MWR, 14% and 16% farmers bought oxen. In the same way 20% more in the former 10% in latter, have bought cattle and a few started small dairies. Possession of poultry and goats went up by 6% and 42% in CR and 30% and 11%in MWR (Table 16).

6. Impact of chickpea on wealth generation

Economic benefits for farmers can be calculated by using the following:

- Seed transaction benefits
- Sale of surplus product
- Consumption of chickpea grain
- Decrease in fertilizer use
- Increase in yield due to restoration of soil fertility

6.1 Seed transaction benefits

A benchmark survey in December 2000 found that CR had no improved varieties of chickpea. The ICRISAT/NARC joint program of IPM-chickpea reversed the vicious cycle of poverty in the area. In village D-Gaon of MWR, average household seed transaction is about 127 kg of *Avrodhi* seed. Farmers are selling seed to other farmers and also to national NGOs @NRs 27/kg. If only 10% of the chickpea farmers transacted the above said amount, the seed economics in the villages would generate benefits equaling to NRs 68,580.00. If the seed spreads at the same speed then chickpea cultivation has the potential to change the economy leading to wealth generation.

6.2 Sale of surplus product

Chickpea farmers sell the surplus chickpea to others. The average of three years shows that per katha output of chickpea is 50 kg. On an average, the land holding of 10 kathas translates to 500 kg/farmer. If farmers sell half of their produce at NRs 27/kg, then 5000 kg chickpea generates additional 1.35 lakh rupees in the village economy.

6.3 Consumption of chickpea

An average grower retains 50 kg of chickpea for family consumption. It is equivalent to a saving of NRs 1500/family. If only 10% families are taken into account then they can save NRs 30,000 per year.

Table 16. Impact on livestock ownerships.

	% Change in purchasing of livestock in Nepal	
Livestock	Central region	Midwest region
Oxen	14	16
Cattle	20	10
Poultry	6	30
Goats	42	11

Source: Field survey 2003

6.4 Reduced burden of fertilizers

The farmers have reported that use of chemical fertilizers has gone down due to chickpea cultivation.

After a chickpea harvest, 24 man-days of labor/ha is saved on FYM input in the next paddy crop. This is because of nitrogen fixation, which leads to a savings of NR 1200/ household. The total FYM saving in the village is equal to NRs 8000, on urea it is NRs 3133 and on DAP it is NRs 2286. The total fertilizers savings is equal to NRs 13,419 (Fig 9).

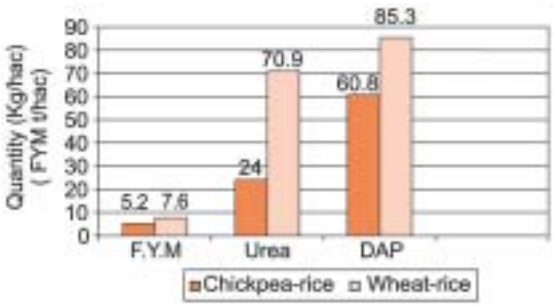

Figure 9. Consumption of fertilizers in rice under different rotations.

6.5 Increase in yield due to restoration of soil fertility

The crop rotation with chickpea increases yield of paddy by 7.71quintal/ha. This fetches additional income of NRs 5397/ household. For 20 families (ie, 10%), it is NRs 1,07,940 of additional income.

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

The example is deliberately taken from a low profile village called D-Gaon (Table 17) to make sober estimates; otherwise impact on CR is more spectacular, sometimes bordering on incredible. If the same method of calculation is used for the entire study area, it has generated NRs 21,20,853 of additional wealth and 1000-man days of more seasonal employment in the study villages (Fig 10).

Table. 17 Total benefits (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 in yield due to restoration of soil fertility	35,980
Total	2,82,979

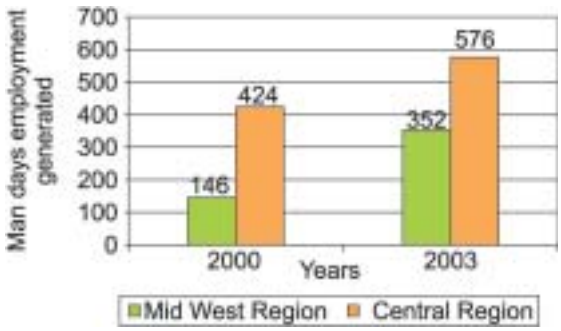

Figure 10. Employment generation in study area.

The IPM of chickpea cultivation is generating additional employment in the study area. In comparison to 2000, employment increased mainly due to chickpea production (Fig 10). Utilization of fallow lands is likely to generate substantial income and employment opportunities for thousands of small holders in the region in future. Chickpea cultivation is assumed to generate additional NRs 8000/ha^{-1} (Pandey et al. 2000).

An estimate indicates that chickpea cultivation on rice fallows generates almost 50 man-days of employment per hectare. If at any given point of time 10% of the *rabi* rice fallow land is brought under cultivation, it would generate approximately 1.29 million-

man days of employment per annum. Likewise, 30% of the *rabi* rice fallow would add another 3.88 million man-days of employment.

6.6 Impact on biodiversity

The IPM-chickpea impact can be seen through the seed spread of improved varieties. Farmers are transacting the seed in the region and across the country. Figure 11 shows the presence of various chickpea varieties in the study area.

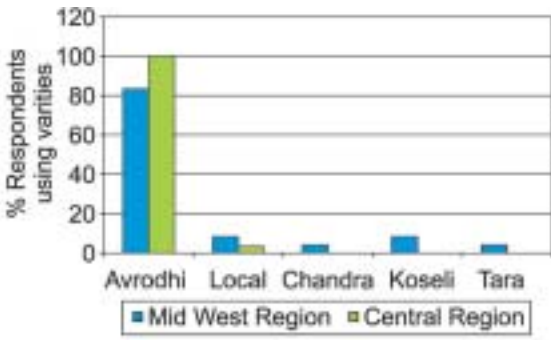

Figure 11. Presence of chickpea varieties in the study areas.

Avrodhi has maximum spread in the study areas. The chickpea farmers in MWR reported 83.33% *Avrodhi* seed transaction while in CR the number is 100%. The use of local traditional variety is insignificant at 8.3% in MWR and 3.3% in CR. Only non-contact farmers are using local varieties on 0.5 to 1 katha in a few locations. Some other improved varieties reported in circulation in MWR are *Chandra* (4.1%), *Koseli* (8.3%) and *Tara* (4.1%). However, many are preferring *Avrodhi* to other varieties.

6.7 Seed transaction

Bardibas is identified as a chickpea seed village. Here farmers reported a number of seed transactions with relatives, friends, NGOs, NARC and traders. The seed has been transacted far and wide in villages like Sitapur (10km), Sarlahi (45km), Sabila (40 Km), Onkar (35 km), Jaleshwar (37 km) and Dhalkewar (15 km). In all these villages, *Avrodhi* has spread due to seed quality, tolerance to wilt, high yield and response to available IPM technology (Fig12).

Lalbandi is another very important seed village from where self-generated demand of *Avrodhi* is spreading to villages like Sisna (3 km), an unnamed village (1 km) and local market (1km) (Fig 12). The traders are also spreading the seed to a number of recorded destinations. The velocity of *Avrodhi* with IPM technology is accelerating in the study areas of Nepal (Fig 12).

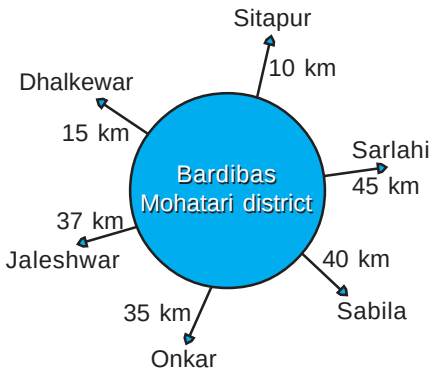

Figure 12. Seed spread from the seed villages.

The average amount of seed transaction is 127 kg/household in MWR and 279 kg/household in CR. In both these regions, its price is @ NRs27 and NRs 33/kg respectively (Table 18).

Table 18. Average amount and price of seeds in transaction.

	Midwest region	Central region
Average amount (in kg)	127	279
Average price (in NRs)	27	33

The IPM-chickpea contact farmers in the study areas were able to produce and store

chickpea seed. In MWR, 62% farmers were able to produce their own *Avrodhi* seed, 4% procured from other farmers and 20% got from cooperatives. In CR, 94% produced their own seed, 14% bought from other farmers and only 2% bought from commercial sellers. (Table 19).

Seed transactions are taking place in various ways. In MWR, 83% farmers are selling seed to other villages, traders and NGOs like FORWARD and LIBARD. Four per cent farmers gifted them to relatives and 12% reported other methods of transactions. In CR, 73% farmers sold chickpea seed, 19%

Optimum use of technology

Krishna Kumari Shreshta of Lalbandi a woman farmer is making optimum use of the technology. Being a skilled chickpea producer, Krishna Kumari Shreshta started production only on 3 kathas. Right now she is cultivating on 22 kathas and markets chickpea in the following ways:

- *After grading best chickpea is sold as seed.*
- *She gives seed to farmers of other villages on double barter next season.*
- *The second best are sold to the traders.*
- *Chickpea's of the lowest grade is used as animal feed.*

Her family income from agriculture has almost doubled in these years after IPM use. Her son gets education in an English medium school. Forty percent of chickpea income is spent on a healthcare emergency. In 2002, she was awarded by NARC for her record yield of chickpea.

Local seed *Marketing seed*

Animal feed *Seed*

Table 19. Seed source.

	Midwest region				Central region			
Source of seed	Chickpea	Rice	Wheat	Pigeonpea	Chickpea	Rice	Wheat	Pigeonpea
Self produced	62	77	56	53	94	92	62	82
Other farmers	4	18	18	13	14	4	10	8
Commercial seller	–	4	9	–	2	2	4	–
Farmers coop	20	9	9	2	–	–	–	2

gave in barter, 32% in gift and 8% chose other methods of seed transaction (Table 20).

Table 20. Types of transactions.

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

6.8 Demand and supply estimates

In Nepal, pulses are in short supply. This offers opportunities to increase pulse production by bringing fallow land under cultivation. Table 21 shows chickpea demand projections for 2010. The short supply of chickpea is attributed to its shift in production from favorable to marginal areas. In favorable regions, coverage of wheat and rice has increased at the cost of coarse cereals, pulses and oil-seeds.

Table21. Chickpea demand projections in 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

Lack of technology to improve pulse yield and thereby less profitability paved way for cultivation of less risky and comparatively profitable rice and wheat crops. In the immediate future, the possibilities that pulses will regain their lost area are slim. The hope to raise pulse production lies in marginal areas like rice and maize fallow lands (Table 21). In these fallows, chickpea is the most suitable crop that can double the income of the resource-poor farmers.

Further, if IPM technology is disseminated to 5% marginal and sub-marginal farmers in the same way then the estimated supply of chickpea in Nepal in 2010 will be 3,99,000 tons. Probably, Nepal will become self sufficient in chickpea production. The demand and supply gap will exist despite continuous efforts of ICRISAT/NARC. In India, demand for chickpea is quite high. So the excess chickpea production will not depress its price in Nepal. The production of chickpea will lead to higher yield of paddy, restoration of soil health and fertility, increase nutrition, less consumption of fertilizers, import substitution, export promotion, reduction in poverty, equitable distribution of wealth and social justice, besides creating sustainable development for farmers in Nepal. Technological intervention is required to achieve sustainable development without problems in market mechanism up to 2009 (Table 22).

Following are the assumptions for supply estimates:

- 0.26 million ha rice fallow land is suitable for chickpea production
- The extension of chickpea will automatically take place on rice fallow/ maize fallow
- The extrapolation of land use is calculated on the basis of land area increase per year of chickpea coverage
- The margin of profit will remain the same up to 2010.

Table 22. Output income projections.

Years	Average chickpea Land area (ha)	Average chickpea output/katha	Average total chickpea output (kg)	Actual total output (t)	Chickpea price (million NR)
2000	0.18	50	277	5.55	1.66
2001	0.20	50	307	6.15	1.89
2002	0.26	50	385	7.70	2.31
2003	0.36	50	535	10.71	3.21
2004	0.53	50	784	15.69	4.70
2005	0.80	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	3.00	50	4399	87.99	26.39
2010	3.90	50	5775	115.50	34.65

Extrapolation formula used to calculate output income projections (see Table 22).

$$Y_3 - 3Y_2 + 3Y_1 - Y_0 = 0$$

$$Y_4 - 4Y_3 + 6Y_2 - 4Y_1 + Y_0 = 0$$

$$Y_5 - 5Y_4 + 10Y_3 - 10Y_2 + 5Y_1 - Y_0 = 0$$

$$Y_6 - 6Y_5 + 15Y_4 - 20Y_3 + 15Y_2 - 6Y_1 + Y_0 = 0$$

$$Y_7 - 7Y_6 + 21Y_5 - 35Y_4 + 35Y_3 - 21Y_2 + 7Y_1 - Y_0 = 0$$

$$Y_8 - 8Y_7 + 84Y_6 - 56Y_5 + 70Y_4 - 56Y_3 + 84Y_2 - 8Y_1 + Y_0 = 0$$

$$Y_9 - 9Y_8 + 36Y_7 + 28Y_6 - 56Y_5 + 70Y_4 - 56Y_3 + 28Y_2 - 8Y_1 + Y_0 = 0$$

7. Resource utilization

In MWR, 91% respondents are utilizing rice fallow land for chickpea production. In CR, 75% respondents are using rice fallow land and 49% maize fallow land. The overlapp is due to a number of respondents cultivating both rice and maize fallow land (Fig 13). The rice fallow land is an important resource, which provides sufficient moisture to chickpea growth. If agronomic manipulations are made and short duration rice varieties are provided for uplands, the synergy will bring a boom in the region. The farmers report that short duration rice

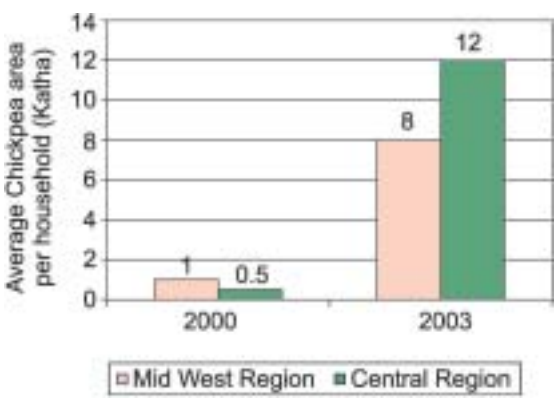

Figure 13. Average chickpea area changed/ household after IPM.

varieties can also help in chickpea revolution in Nepal. The chickpea average area/household has increased in MWR. The respondents of this region reported 8 katha/household under chickpea in 2003. It is 12 katha/household in the CR of Nepal. Before IPM it was hardly one katha/household in MWR and 0.5 katha/household in CR (Fig 14). Chickpea has utilized rice/maize fallow lands in Nepal.

Chickpea not only enhances soil fertility through nitrogen fixation but also provides ground cover, fodder and is a nutritious, high-value human food. Chickpea is an integral part of the diet. It is cooked as *dhal* 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.

Chickpea has the ability to give better harvest 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. Use of fertilizers is being promoted for raising the rice-wheat productivity and for maintaining soil fertility. The high cost of fertilizers, their non-availability at right time, and poor purchasing power of farmers have limited the use of fertilizers in Nepal. Besides, their excessive use is leading to environmental hazards and has led donors to reduce or to stop fertilizers aid (Pandey et al. 2000). Against such a backdrop, the IPM of chickpea is playing a vital role for a sustainable economic, environmental and ecological development.

7.1 Yield and price risk

Both the yield and price risk are higher for pulse production compared to cereal production. This is mainly due to conditions in areas where pulses are grown (marginal areas and rainfed conditions). Figure 15 shows that in study areas chickpea has crossed the barriers of yield and price risk.

The Nepalese farmers were not interested to cultivate chickpea in the last two decades because improved varieties were negligible. Improved varieties were limited to about 8% of all chickpea growing area in 1999-2000. Today maximum number of chickpea farmers are using new *Avrodhi* seed in *Terai*. In 1999-2000, farmers reported that there was:

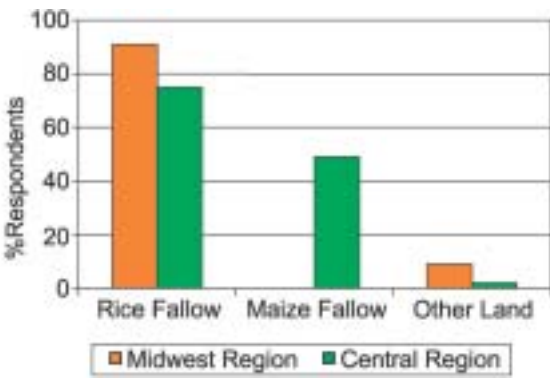

Figure 14. Utilization of fallow land.

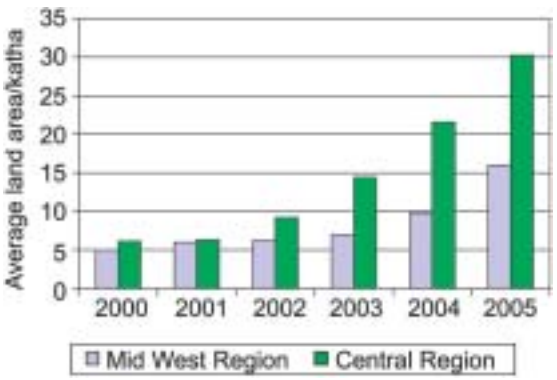

Figure 15. Increase in average land area of chickpea/household.

1. Non availability of improved varieties of seed
2. Lack of knowledge about improved varieties
3. IPM: virtually absent

Even today, where IPM has not reached, farmers have the same constraints in growing chickpea. Now the seed sector has considerably developed and technology has been transferred to the study areas. In Lalbandi (CR), every farmer is a seed producer and is providing seeds to farmers in other villages with a condition that the seed taker will return double the quantity in the following season.

In MWR, average amount of seed sold/ household is 127 kg, while it is 279 kg/ household in CR. The current price of seed is NRs27/kg in MWR and NRs33/kg in CR. The price of chickpea varies from NRs25 to NRs55/kg in both the regions.

8.Conclusions

The empirical study of IPM of chickpea cultivars has shown that technology is highly effective in eradication of hunger in hillside-*Terai* region of Nepal. It also provides opportunities for sustainable development. Chickpea produce improves farmers' ownership rights through production and trade.

Pod borer, BGM, wilt and abiotic stresses are associated with the loss of entitlements of one or more occupation groups in Nepal. The resulting starvation can be prevented by systematically recreating a minimum level of income and entitlements for those who are hit by changed agricultural economics in Nepal. The IPM of chickpea has proved that in the short run, miseries and starvation can be controlled.

With the introduction of Integrated Pest Management (IPM), many farmers are adopting chickpea regeneration. The success of adoption is due to various strengths of the project. The project was able to utilize rice fallow, maize fallow and other uplands. Chickpea is a highly remunerative winter crop. Additional income that farmers earned from chickpea production has seen them out of the clutches of usurers. The socio-economic emancipation of peasants is taking place due to its benefits reaching the poorest among the poor.

The IPM technologies are spreading far and wide in Nepal because of its economic value. The NARC has made market linkages, which have strengthened farmers' faith in technology. Farmers' knowledge too has been upgraded with the help of farmer-friendly technology.

In future, chickpea production cannot be threatened because IPM technology has shown that the crop can be grown efficiently with minimal labor cost in Nepal. The IPM of chickpea model can be applied else where in the world where there is the same agro ecological feature for alleviation of poverty.

The contact chickpea farmers' income went up considerably when compared to non-contact farmers in Nepal. The overall increase in income has positively changed the entire consumption pattern of villages.

Women and children are the key beneficiaries of the project. The project is a solution to the poverty alleviation in the short run while creating sustainability in the long run. This will provide benefits to the future generations by providing food and nutritional security.

The intensification of the project in hillside-*Terai* will change the entire livelihood pattern of poor peasants in Nepal.

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Acronyms

BGM	Botrytis gray mould
FORWARD	Forum for rural welfare and agricultural reform for development
HMG	His Majesty's Government
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics IPM Integrated Pest Management
NGO	Non government organization
NARC	Nepal Agriculture Research Council
NRs	Nepalese rupee
PRA	Participatory rural appraisal
RRA	Rapid rural appraisal
Ha	Hectare

Conversions

1hectare = 29.53 kathas
1hectare = 01.47 bighas
$1 = 77.00 NRs

Appendix

Appendix 1. Questionnaire: Livelihood impcat

1.Village and Household Information Schedule (Map Needed).

Farmers Group: Growing chickpea with IPM – 1,/ Growing chickpea without IPM – 2.

Date of Interview .....

Village	Block	District	State	Participants Gender	Caste Tribe

Distance from NARC: .....

Household head (Should at least be decision maker):
(Head of household – 1, Decision maker – 2, Other – 3.

Name ..... Sex: Male ..... Female .....

Age (years) .....Education (years of schooling) School Educated = 1,Literate = 2,Illiterate = 3

Religion: .....

Buddhist-1, Hindu-2, Muslim-3, Other-4

Language: .....

Nepali-1, Newari-2, Tamang-3, Maithili-4, Bhojpuri-5, other-6

Date of interview ..... Economic class
- a) Deficit ☐
- b) Medium ☐
- c) Rich ☐

State of Health
- a) Good ☐
- b) Moderate ☐
- c) Poor ☐

Family size:

a. Adult males ..... Adult female ..... Children .....Elderly people .....

Date of first experience with IPM project:————————————————————

2.Livelihoods Framework – analysis of household welfare and expenditure

Human

Income skills: i) May need to be suggested by farmers e.g. ii) How much for each?

Before IPM

Farming – 1,	Carpentry – 2,	Engineering – 3,

After IPM

Farming – 1,	Carpentry – 2,	Engineering – 3,

Physical
House:

Before IPM

Kaccha– 1,	Puccka– 2,	Rent House– 3,

After IPM

Kaccha– 1,	Puccka– 2,	Rent House– 3,

How and When Loans paid————————————

Before IPM
Agricultural:

Plough– 1,	Spray Pump– 2,	Tractors– 3,

Expenditure Per Year————————————————————

After IPM

Plough– 1,	Spray Pump– 2,	Tractors– 3,

Expenditure Per Year————————————

Before IPM
Livestock

Ox/Buff– 1,	Cow/Buff(dairy)– 2,	Chickens– 3,	Goats—4

After IPM

Ox/Buff – 1,	Cow/Buff(dairy)– 2,	Chickens– 3,	Goats—4

Natural:

Land: Land Area Owned =
Land Area Rented =

Seed source

Chickpea: Self – 1, Other farmer – 2, Commercial seller – 3, Farmer coop – 4.
Rice Self – 1, Other farmer – 2, Commercial seller – 3, Farmer coop – 4.
Wheat Self – 1, Other farmer – 2, Commercial seller – 3, Farmer coop – 4.
Pigeon pea Self – 1, Other farmer – 2, Commercial seller – 3, Farmer coop – 4.

House Hold Expenditure

Clothes: Medicine: Social/family/wedding:

Agric Technol: Child Schooling: Other:

3. Chickpea grown after rice harvest in the Kharif rice cropped area: Bigha/katha/hectare

Name of chickpea varities.	Area sown in 2003(ha)	Ecosystem			Source of seed (own, project, purchased)
		Upland	Mid up land	Rice fallow Land	

4.Details of Chickpea Seed Transaction

Tran.	Type				Variety name	Amount in Kg	Price	Name of receptient	Village of receptient	Distance from supply village	Relation to the supplier
	Sale	Barter	Gift	Others							
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

5.Crop Production and Income Generation

Total Family Income:

Family income from agriculture (%): 0 to 20 – 1, 20 to 40 – 2, 40 to 60 – 3, 60 to 80 – 4, 80 to

100 – 5 Before IPM ..... After IPM .....

(Or ask for an exact figure – also may need to ask this question before and after experience with IPM0

Family income from marketing crops (%): 0 to 20 – 1, 20 to 40 – 2, 40 to 60 – 3, 60 to 80 – 4, 80 to 100 – 5
Before IPM ..... After IPM.....
Or ask for an exact figure – also may need to ask this question before and after experience with IPM

Family income from chickpea (%): 0 to 20 – 1, 20 to 40 – 2, 40 to 60 – 3, 60 to 80 – 4, 80 to 100 – 5.

Before IPM ..... After IPM .....

Or ask for an exact figure – also may need to ask this question before and after experience with IPM

Dietary contribution from chickpea (%): 0 to 20 – 1, 20 to 40 – 2, 40 to 60 – 3, 60 to 80 – 4, 80 to 100 – 5.

Before IPM ..... After IPM .....

6. Crop Preference For Profit (Top 5)

Rice – 1, Wheat – 2, Maize – 3, Pigeon pea – 4, Chickpea – 5, Lentil – 6, Black Gram – 7, Grass Pea – 8, Vegetables – 9, Other – 10.

Crop Preference For Food (*Not Cereals*) (Top 5)
Pigeonpea - 1, Chickpea - 2, Lentil - 3, Black Gram - 4, GrassPea - 5, Vegetables - 6, Other – 7

7. Crop Preference for Production

Pigeonpea - 1, Chickpea - 2, Lentil - 3, Black Gram - 4, GrassPea - 5, Vegetables - 6, Other – 7

Why? Low labour input – 1, Low cost input – 2, High yield – 3, Beneficial for soil/land – 4.

Household Arable land in RabiChickpea area in 2000Chickpea area in 2001Chickpea area in 2002 Chickpea area in 2003

8. Specific questions on chickpea production.

i)What is your chickpea production in

a. kg/katha .....

b. in total .....

vi) How much money do you make with chickpea .....

ii) How or on what do you spend the money? .....

iii) Do you employ staff to help with chickpea production? .....

Yes – 1, No – 2;

How many in 2000?

How many in 2003

iv)Do you store seed?

v)What approaches do you use to protect crop? (what has been learned?)

Appendix 2: Study area

Districts	Village name	Distance from NARC (in kms)
Bardia	Munalbasti	20
Bardia	Kurminpur	15
Banke	Batahani	35
Banke	E-Gaon	6
Banke	D-Gaon	2
Mohatari	Bardibas	35
Sarlahi	Lal Bandi	4

Source: Field Survey June 2003

Appendix 3: Religion

Religions	Midwest region (%)	Central region (%)
Buddhists	7	10
Hindu	87	90
Muslim	2	–
Others	4	–

Source: Field Survey June 2003

Appendix 4: Languages

Languages	Midwest region (%)	Central region (%)
Nepali	85	65
Newari	–	4
Tamang	13	4
Maithili	–	43
Bhojpuri	–	–
Other	2	8

Source: Field Survey June 2003

Appendix 5: Economic class

	Contact farmers		Non contact farmers	
Economic class	Midwest region	Central region	Midwest region	Central region
Deficit	15	16	50	48
Medium	78	76	47	49
Rich	7	8	3	3

Source: Field Survey June 2003

Appendix 6: State of literacy in study area

Eco regions	Districts	School education (%)	Literate (%)	Illiterate (%)
Midwest region	Bardia	40	52	8
	Banke	35	55	10
Central region	Mohatari	36	48	16
	Sarlahi	50	35	15

Source: Field Survey June 2003