Users' and Gender Perspectives of Maize Production at Darbar Devisthan and Simichaur Research Sites in Gulmi District of Western Hills of Nepal: *Findings of a Baseline Socioeconomic Survey*

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Summary

The paper presents the findings of a baseline socioeconomic survey conducted at two of the project research sites, namely Darwar Devisthan and Simichaur in Gulmi District. The study focuses mainly on maize farming and discusses on characteristics of maize-growing households, user and gender perspectives of maize production and utilization, and their implication to the research activities. Darbar research site includes Wards 2, 3 and 5 of Darbar Devisthan Village Development Committee (VDC) consists of 73 farming households. Similarly, Simichaur research site includes Wards 2, 3, 4, 5 and 6 of Simichaur VDC and consists of 279 farming households

The study has used a combination of survey methods to collect relevant information. These methods include: a) focus-group discussions (FGDs) conducted during participatory rural appraisals, b) participatory gender analysis, c) household baseline survey undertaken at Darwar and Simichaur research sites at the inception of the project, and d) interview of additional households for survey of breeding knowledge.

Characteristics of maize-growing households

- Brahmin, Chhetri and Jogi (BCJ) ethnic category represents major ethnic groups at both the sites, constituting about 80% of the total households. The male to female ratio is 1:0.86. The average family size is 6.7±0.4 which is higher that the national average of 5.6. About 81% of households are male headed while only 19% are female headed.
- About 19% of the household heads are illiterate while a majority (47%) them are just literate. Similarly, 47.3% of the spouses of household head are illiterate and 40.9% are either just literate or have attended primary schooling.
- Farming is the main occupation with 90.3% of the households engaged full time in farming. Despite this, about 86% of the farming households experiences food deficits for 3 to 11 months of the year, and the average length of food self-sufficiency is only about 7 months.
- The off-farm activities are the major sources of cash income of which, job outside the village, mostly in India, is the single most important source of cash income. About 72% of the households have reported to have, at least, one family member migrated seasonally for off-farm work outside their village.
- *Bari* is the main cultivated land type, constituting 81.5% of the total cultivated land. *Bari* is owned by 95% of the surveyed households while *khet* is owned only by 29%. All the farming households own land but their holding is with average *bari* holding of 0.4±0.04 ha and *khet* holding of 0.3±0.04 ha. The *bari* land holding is relatively more scattered with 2.3±0.1 parcels per household than that of *khet* with 1.8±0.2 parcels per household.
- Livestock forms an important and integral part of the farming system and about 97% of households have reported to own one or more kinds of livestock. The average livestock unit per household is 2.8.
- The difference in access to resources across wealth, ethnicity and gender is significant only for land holding and livestock ownership. The differences in *bari* land holdings are highly significant across wealth categories ($p < .000$). Similarly, the variation in number of parcels of *bari* land per household is also significant ($p < .05$) across wealth categories. The difference in the distribution of livestock unit is significant across wealth ($p < .000$) and ethnic ($p < .01$) categories.

Maize production and utilisation

- Maize is the main livelihood crop for the farmers, however, the production is subsistence-oriented largely for self-consumption. Only 10.4% of the households sell maize. About 61% households purchase maize to offset their food-grain deficit. The difference in the proportion of households purchasing maize is only significant ($p <$ .000) across wealth categories. There is virtually no market influence on farmers' choice of maize varieties.
- Maize in the area is largely grown in inter-cropping system and is mixed with a variety of summer legumes, such as cowpeas, ricebean, soyabean and other beans; and vegetables, such as pumpkin and cucumber; and fingermillet.
- Maize varieties are broadly categorised into two maize types, locally called *thulo makai* (large type maize) and *sano makai* (small type maize). A majority of the farmers grow large-type maize, and it covers about 88% of the total maize area. Among the large varieties, *Thulo piyanlo* alone covers about 80% of the area planted to this type.
- A higher proportion of poor households grows one variety of maize, compared to rich and average households. The ANOVA result shows that the difference in the number of maize varieties grown at household level is significant ($p < .05$) across wealth categories but not significant across ethnic categories and between male- and female-headed households.
- Women use some specific and additional criteria in choosing their maize varieties. They look for maize varieties that are suitable for inter-cropping with legume and vegetables and that have high bio-mass for use as animal fodder.
- Steamed grit (*makai ko bhat*) is the most common preparation of maize, and 77% of the total production is used for this purpose. Farmers, therefore, prefer maize varieties that have high grit recovery. Users' and gender differences in the choice of variety, therefore, do not appear to be influenced by differences in their use other than grit recovery trait.
- Only 13% of the farmers grew improved varieties of maize last year. About 37% have changed their maize varieties over last five years. Similarly, about 39% of the households reported exchanging their seeds during last five years with other farmers. The users' and gender analysis showed that access to new maize seeds is statistically not different across all wealth categories.
- The use of animal manure (farm yard manure) is the major source of plant nutrients for maize in the area. The use of external inputs such as, chemical fertilisers and pesticides is quite limited, both in number of farmers using and quantity used. The use of these inputs in maize production is below optimal.
- Farmers have difficulty in estimating dry grain yield of maize as maize cobs are shelled in batches as and when required for consumption, sale or seed. According to an estimate based on the response of a limited number of farmers, the yield of large type (*Thulo*) maize is just over 2.0 t/ha while that of small type (*Sano*) maize is about 1.9 t/ha.

Access to information and other services

- Only about 8% of the maize-growing households reported participating in agriculture-related training, and 6% participated in educational tours. Likewise, about 15% of the households reported receiving information on improved technology for maize production.

- A chi-square analysis shows significant differences ($p < .05$) in access to information on improved technology for maize production across wealth categories. Similarly, only BCJ households reported having participated in agricultural training and tours or receiving information on improved maize production. The proportion of female-headed households participating in agricultural training and tours and receiving information on improved maize production is low.

Seed management and breeding knowledge

- A majority of the households (more than 90%) separates seed and grain in advance, but the seed selection is almost entirely done from the cobs, and generally right after the harvest. Farmers virtually do not practice seed selection on standing crops.
- Farmers' knowledge on the more technical side of breeding, such as identification of male and female plants/parts and their functions, was found to be very poor. There is good scope and a need for sharing scientific breeding knowledge prior to the inception of a participatory plant breeding program in order to enhance farmers' confidence and thereby increase their interest and participation.

Gender differences in roles of men, women and children

- Women supersede men in their involvement in all three major functions of maize production and utilization: namely, (1) production, (2) household utilization and marketing, and (3) seed management.
- Women are the prime decision makers in the family and their contribution to decision making in activities related to maize production and utilization is higher than that their male counterparts in the family.

The users' and gender analysis indicates that the differences among maize-growing households in regard to wealth, ethnicity, and gender do not have any significant influence on their choices for different maize varieties. This appears to be largely because a large number of varieties is difficult to maintain and manage in open-pollinated crops like maize. Farmers, however, use multiple criteria in selecting the maize varieties they grow and prefer to have as many traits of their preference as possible in one to two varieties. It is, therefore, important for the participatory breeding program to focus on developing fewer maize varieties with the multiple traits that farmers prefer. Women farmers have strong preferences about the quantity and quality of the fodder by-products of maize and the suitability of new maize varieties for inter-cropping with legumes. The research process, therefore, should allow farmers of different categories to use their criteria in developing and selecting new maize varieties.

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1. INTRODUCTION

1.1. Project background

Maize is the first most important food crop in the hills of Nepal in terms of both area and its contribution to household food security. It occupies about 0.8 million hectares (about 35% of the total cultivated area); 78% of this is in terraced hill farming, which produces over 1.3 million tonnes per annum (CBS 1999). The productivity of maize, however, is quite low (1.7 tonnes/hectare) and, as a result, there is high incidence of food-deficit households in the hills of Nepal. One of the major contributing factors to this low yield is the poor performance of farmer-maintained maize varieties. Farmers' access to new seeds and varieties is extremely poor and, at the same time, a majority of farmers tend to keep their own seed without replacing it for years. It is estimated that nearly 90% of the total seed requirements for cereals and other food crops in the country is met by the traditional seed-supply system (Cromwell et al. 1993; Joshi 1995). Since maize is an open-pollinated crop, even new varieties rapidly get contaminated with the undesired traits of local varieties. On the other hand, most of the new varieties developed so far neither fit well with local environments nor meet farmers' diverse needs. Therefore, it is increasingly being realized that breeding must be carried out in the target environment with the full participation of farmers so that the users' perspective is well reflected in the new varieties developed.

The environments where maize is produced in the hills of Nepal are very diverse in terms of topography, soil types, and use of production resources. There are also differences between farmers and farming communities in terms of access to resources (i.e., wealth) and food culture, which is governed largely by ethnicity. These differences exist not only between wider agro-ecological zones but also between farming families in the same village. For these reasons, farmers require a large number of varietal options to fit into diverse production niches and to meet the varied consumption requirements of the farming families. Similarly, because of differences in gender roles and gender needs, there are also requirements for different maize varieties within the same household. Previous studies (Acharya and Bennet 1981; Bajracharya 1994; Shrestha 1998) suggest that women play important roles in agricultural activities and are responsible for major farming decisions. Because of these gender differences, different family members usually have different varietal needs and behave differently toward new crop varieties. The consideration of users' and gender perspectives in the process of variety development, therefore, is vital.

Local Initiatives for Biodiversity Research and Development (LI-BIRD), in collaboration with the System-wide Program on Participatory Research and Gender Analysis (PRGA), is implementing a research project adopting a farmer-led participatory maize-breeding approach that incorporates users' and gender perspectives in developing farmers' preferred maize varieties. The title of the project is "Farmer-led Participatory Maize Breeding in the Middle Hills of Nepal" and its activities are implemented at two research sites, namely Darbar Devisthan and Simichaur, located in the Gulmi district of the western hills of Nepal. This paper presents the findings of a baseline socioeconomic survey conducted at these research sites. The study focuses mainly on maize farming and discusses on characteristics of maize-growing households, user and gender perspectives of maize production and utilization, and their implication to the research activities.

1.2. Research sites

The main features of Darbar Devisthan (referred as Darbar hereafter) and Simichaur research sites are presented in Table 1. These sites have been selected from 28 villages located in Palpa, Gulmi and Arghakhanchi districts to represent the middle hills of western Nepal. Both Darbar and Simichaur are located in Gulmi district (Figure 1). Darbar research site includes Wards 2, 3 and 5 of Darbar Devisthan Village Development Committee (VDC) consists of 73 farming households. Similarly, Simichaur research site includes Wards 2, 3, 4, 5 and 6 of Simichaur VDC and consists of 279 farming households (see Appendix 1 for ward-wise number of households). These research sites have been purposively delineated from the rest of the VDC to represents the rest of the middle hills of western Nepal in terms of farming systems, agro-climatic conditions and socio-economic situations as well as to facilitate researchers in effective management of the sites within the given resources. Maize is the main sources of food and livelihood at these sites and is cultivated mainly on the outward slopping terraces, locally called Bari land. The altitude of the maize-cultivated Bari land at these sites ranges from 800 to 1600 metres above sea level (asl). Both of these sites are moderately accessible and are within one hour's walk from the nearest fair weather motorable road joining Tamaghas, district headquarter of Gulmi with Tansen, district headquarter of Palpa.

Table 1. Main features of research sites.

Main features	Darbar	Simichaur
Village Development committee	Darbar Devisthan	Simichaur
Wards	2, 3 and 5	2, 3, 4, 5 and 6
Altitude range (metres asl)	800 - 1500	800 - 1600
No. of households	73	279
Access	45 minutes' walk from the nearest road head	1 hour's walk from the nearest road head

Source: PRA, 1999 and household baseline survey, 1999.

1.3. Objective of the baseline survey

The main objective of this baseline socioeconomic survey is to establish a benchmark information useful in planning, and monitoring and evaluation of the research activities of the project implemented at the two research sites. More specifically the survey aims to understand and document:

- characteristics of maize-growing farming households,
- maize production and utilisation systems in the area and
- users' and gender roles in and influence on maize production and utilisation.

2. METHODOLOGY

2.1. Farmers' differentiation

The farming households have been categorised into different gender, wealth and ethnic categories for the purpose of analysing users' and gender roles in and influences on maize production and utilisation. There were two categories under gender—male and female with children as separate categories used while analysing gender roles and decision making; three

categories under wealth—rich, average, and poor; and three categories under ethnicity—Brahmin/Chhetri/Jogi (BCJ), Gurung/Magar/Newar (GMN), and Kami/Damai/Sarki (KDS).

The wealth categorisation of farming households was done by the farmers themselves, using their own perceptions and knowledge about wealth of these households. The wealth ranking procedure involved writing names of household heads on separate cards and then asking a group of key informant farmers to separate these cards into rich, medium and poor wealth categories.

The ethnic categorisation of the farming households was done by researchers themselves on the basis of ethno-cultural similarities of these farming households. Brahmin, Chhetri and Jogi exhibit more or less similar ethnic culture, show more of a patriarchal behaviour, and have relatively restricted social interaction for their family members, especially women members. On the other hand, Gurung, Magar and Newar have some similarity in cultural norms and practices, show more of a matriarchal behaviour, and have relatively more freedom for social interaction for their family members. Kami, Damai and Sarki are quite low in the Hindu caste hierarchy and are still treated as untouchables in the rural communities. This ethnic category again have similar ethnic culture, show more of a patriarchal behaviour but have relatively less restricted social interaction for their family members. The farming households of KDS ethnic group are relatively poor in resources and disadvantaged in social power relation.

2.2. Survey methods and tools

The study has used a combination of survey methods to collect relevant information. These methods include: a) focus-group discussions (FGDs) conducted during participatory rural appraisals, b) participatory gender analysis, c) household baseline survey undertaken at Darwar and Simichaur research sites at the inception of the project, and d) interview of additional households for survey of breeding knowledge.

The focus group discussion was used to collect a more general information on maize production and utilisation systems in the area, maize varieties and their desirable and undesirable traits, reasons for growing more than one varieties and for wealth ranking of the farming communities. The information has been used in the report to complement the findings of the household survey.

The participatory gender analysis involved an analysis of gender roles and decision-making patterns in maize production and utilization prevalent in the area. A sample of 30 households, selected purposely to represent different wealth and ethnic categories, was facilitated in doing their own gender analysis by using a checklist (Appendix 2); a pictorial set of a man, woman, and child; and maize grains to indicate the magnitude of their roles and decision making. The household head and his/her spouse was asked to put maize grains (based on joint decision) on the picture of man, woman and child to indicate their contribution to different activities of maize production and utilization.

The household baseline survey was conducted to collect detailed and widely representative information, which also served as a major source of information for this report. It included a questionnaire survey of 100 households (40 at Darwar Devisthan and 60 at Simichaur) selected using a stratified random sampling technique. The stratification of the population

was based on wealth categories of the farming households. The sample size has been derived using the following formula (Parel, C.P., *et.al.*, 1973):

$$n = \frac{NZ^2P(1-P)}{Nd^2+Z^2P(1-P)}$$

where,

N = total number of sampling units (number of households) in the population;
d = maximum error deemed acceptable (value used in this case is 0.10);
Z = the normal variable (value used is 1.64 to correspond 90% reliability); and
P = proportion of the population growing improved variety of maize (value used is 0.5 i.e. 50% which is maximum value guessed to give largest possible sample size)

The sample size derived using the above formula was 35 for Darbar and 54 for Simichaur. However, to facilitate easy calculation the sample size was increased to 40 for Darbar and 60 for Simichaur. The proportionate random sample, drawn from each wealth stratum, is shown in Table 2. The actual sample size used in the final analysis of the survey data for different wealth strata is slightly different than the calculated sample size for these strata and this happened while discarding some of the unreliable and/or incomplete cases.

Table 2. Proportionate random sample for household socioeconomic survey.

Wealth categories	Population (No.of hhs)		Calculated sample size			Actual sample size		
	Darbar	Simichaur	Darbar	Simichaur	Total	Darbar	Simichaur	Total
Rich	29	87	16	19	35	16	19	35
Medium	18	94	10	20	30	11	19	30
Poor	26	98	14	21	35	13	22	35
Total	73	279	40	60	100	40	60	100

Source: Household baseline survey, 1999.

Information on farmers' knowledge on maize breeding is based on the survey data of 133 households. Of these, 100 households are those sampled for household survey and the additional 33 are those interviewed among the trainees participating in farmers' training on maize breeding.

2.3. Household survey

The household survey, at both of the research sites, was conducted in July-August of 1999. A survey questionnaire (interview schedule) was prepared and pre-tested in the target community for this purpose. The survey questionnaire consisted of sections on general household characteristics and their access to resources, maize production and utilisation systems, maize breeding and seed management, and access to information and technology for maize production (survey questionnaire in Appendix 3). To each of the sample household, the survey questionnaire was administered to the household head or his/her spouse by the project staff, trained on household survey skills. The surveyed questionnaires were checked for completeness and re-interviewed in cases where responses were not clear and/or confusing, and then sent for data analysis.

2.4. Data analysis

The analysis of the survey data was done using SPSSPC+ computer software. The data coding, entry and analysis was done by the computer expert specialising in using SPSSPC+. Descriptive statistics, such as frequency, percentage, mean and cross tabulations were produced for the report. Besides, Chi Square and ANOVA were also used to test whether gender, ethnicity and wealth categories have significant association with or influence on resource distribution and farmers' maize production and utilisation behaviour.

3. FINDINGS AND DISCUSSION

3.1. Characteristics of maize-growing households

3.1.1. Ethnic composition

The ethnic diversity is low in Darwar research site than in Simichaur. Simichaur has about nine ethnic groups, namely Brahmin, Chhetri, Jogi, Magar, Gurung, Newar, Kami, Damai and Damai while Darwar has only Brahmin, Chhetri and Kami ethnic groups. Brahmin, Chhetri and Jogi (BCJ) ethnic category represents major ethnic groups at both the sites, constituting about 80% of the total households (Table 3).

Table 3. Distribution of farming households by ethnic categories.

Ethnic categories	Darwar		Simichaur		Total	
	No	%	No	%	No	%
Brahmin/Chhetri	39	97.5	41	68.3	80	80
Magar/Gurung/Newar	0	0	10	16.7	10	10
KDS	1	2.5	9	15.0	10	10
Total	40	100	60	100	100	100

Source: Household baseline survey, 1999.

3.1.2. Family type and demographic features

Single families, with husband, wife and children are dominant at both Simichaur and Darwar research sites than the extended families that include parents, grandparents and/or uncles not separated from the family. The single families comprise of 78% of the total surveyed households and this figure for Darwar is 71.7% while for Simichaur is 87.5%.

The male to female ratio of the sample population is almost similar at Simichaur (1:0.87) and Darwar (1:0.86) and the combined for both the sites is 1:0.86. Despite majority of the households being single families, the average family size is 6.7±0.4 which is higher that the national average of 5.6 (CBS, 1999). The average family size of the farming families at Simichaur (6.7±0.4) and Darwar (6.5±0.6) is, however, similar. This bigger family size for a majority of the single families is explained by the fact that a large proportion (about 37%) of the family members are children of age below 15 years (Table 4). The proportion of family members in their active age of farming, i.e. between 16 and 60 years, is only 54.4%. Of this, the proportion of female member is about 5 percentage point higher than male. This is also reflected in relatively small number of family members - 2.5+0.2 and 3.4±0.2 in Simichaur - available for working regularly on farm (Table 5).

Table 4. Population distribution by age group and sex.

Age group (years)	Darwar (%)		Simichaur (%)		Total (%)		
	Male	Female	Male	Female	Male	Female	Total
0-12	25.8	31.1	29.8	23.3	26.3	26.3	27.4
13-15	5.8	6.7	9.9	12.9	8.3	1.5	9.4
16-60	54.0	55.5	50.0	58.5	51.8	57.3	54.4
61+	14.4	6.7	9.9	5.2	1.6	5.8	8.9
Total	100.0	100.0	100.0	100.0	100	100.0	100.0

Source: Household baseline survey, 1999.

Table 5. Mean family members working regularly on farm.

Family members	Darwar	Simichaur	Total
Male	1.4±0.2	1.3±0.1	1.3±0.1
Female	1.5±0.1	1.7±0.1	1.6±0.1
Children	1.2±0.2	1.7±0.1	1.6±0.1
Total	2.5±0.2	1.4±0.2	3.0±0.2

Source: Household baseline survey, 1999.

Household head of the family is responsible for making major farming decisions and is usually elderly member of the family. Of the total sample households surveyed, 81% are male while only 19% were female headed. Simichaur has more male-headed households (91.7%) than Darwar (65%). In female headed-households, the females are mostly *de facto* household heads, i.e., women have taken charge of managing the farm while men work off-farm away from home for several months, mostly in India. Only 5% of households have female as *de jure* household heads. The age distribution of the household heads is presented in Table 6. The majority of the household heads fall in the age group of 26-45 years and 46-60 years. The proportion of household heads falling in the age group of 26-45 years is more in Darwar (45%) than in Simichaur (18.3%). The age distribution of spouse of the household heads also follows similar pattern to that of household heads (Table 7).

Table 6. Percentage distribution of main farming decision makers of the family by age groups and sex

Age groups	Darwar			Simichaur			Total
	Male	Female	Total	Male	Female	Total	
16-25	0.0	0.0	0.0	13.3	0.0	13.3	8.0
26-45	20.0	25.0	45.0	18.3	5.0	23.3	32.0
46-60	17.5	10.0	27.5	35.0	0.0	35.0	32.0
60+	27.5	0.0	27.5	25.0	3.3	28.3	28.0
Total	65.0	35	100	91.7	8.3	100	100

Source: Household baseline survey, 1999.

Table 7. Percentage distribution of spouse of household heads by age groups and sex.

Age groups	Darwar			Simichaur			Total
	Male	Female	Total	Male	Female	Total	
16-25	0.0	6.1	6.1	3.4	8.5	11.9	9.8
26-45	3.0	33.3	36.4	8.5	28.8	37.3	37.0
46-60	18.2	24.2	42.4	8.5	30.5	39.0	40.2
Above 60	3.0	12.1	15.2	5.1	6.8	11.9	13.0
Total	24.2	75.8	100	25.4	74.6	100	100

Source: Household baseline survey, 1999.

3.1.3. Education status

The education status of the household of the family is regarded to influence his/her farming decisions and/or his/her behaviour towards a new technology. The survey reveals that 19% of the household heads are illiterate while a majority (47%) them are just literate, i.e. can either simply read and write or some of them have attended primary schooling (Table 8). These figures are slightly higher at Simichaur than in Darwar. The education status is even poor in case of the spouses of the household heads (Table 9). Of the total spouses of household heads, 47.3% are illiterate and 40.9% are either just literate or have attended primary schooling.

Table 8. Education status of household heads of the family (figures in percentage).

Education status	Darwar	Simichaur	Total
Illiterate	15.0	21.7	19
Just literate/primary schooling	42.0	51.7	47
Secondary Schooling	22.5	20.0	21
University education	22.5	6.7	13
Total	100	100	100

Source: Household baseline survey, 1999.

Table 9. Education status of spouse of household heads of the family (figures in percentage).

Education status	Darwar	Simichaur	Total
Illiterate	45.5	48.3	47.3
Just literate/primary schooling	48.5	36.7	40.9
Secondary Schooling	0	13.3	8.6
University education	6.1	1.7	3.2
Total	100	100	100

Source: Household baseline survey, 1999.

3.1.4. Occupation, Wealth, food sufficiency and cash income

Farming is the main occupation of the people living in the project research site. Of the total surveyed households, 90.3% of the households are engaged full time in farming while the rest are also engaged in non-farming occupation, such as in job and small businesses. The percentage of households engaged mainly in agriculture is higher in Simichaur (95%) than Darwar (81.8%). The farmers' perceived wealth categories of the farming households are presented in Table 10. The distribution of surveyed households in rich (35%), medium (30%)

and poor (35%) wealth categories is almost similar. Darwar, however, has higher number of households in rich wealth categories within the research site as well as than in Simichaur.

Table 10. Distribution of surveyed households by wealth categories (figures in percentage).

Wealth categories	Darwar	Simichaur	Total
Rich	40.0	31.7	35
Medium	27.5	31.7	30
Poor	32.5	36.6	35
Total	100	100	100

Source: PRA, 1999 and household baseline survey, 1999.

Despite the fact that farming is the main occupation for a majority of the households in the project research sites, the farm produce is not sufficient to feed the family throughout the year. About 86% of the farming households experience food deficits from less than one to 11 months of the year, and the average length of food self-sufficiency is only about seven months. Of the total surveyed households, 52% have food production sufficient only for less than six months and only 3% of the households have surplus food production (Table 11). For the remaining period of food deficit months, most of the households purchase grains to meet their family food requirements.

Table 11. Distribution of households by food sufficiency categories (figures in percentage).

Food sufficiency	Darwar	Simichaur	Total
0-3 months	10	13.3	12
3-6 months	47.5	35.0	40
6-9 months	20	16.7	18
9-12 months	20	31.7	27
>12 months	2.5	3.3	3

Source: Household baseline survey, 1999.

The cash to purchase food and for other household requirements comes from various sources. The on-farm cash sources, at both Darwar and Simichaur research sites, are limited and their contribution to cash income is generally (Table 12). Of these sources, sale of livestock and livestock products and forced sale of food grains are important ones. The off-farm activities are the major sources of cash income of which, job outside the village, mostly in India, is the single most important source of cash income, followed by pension and wage labouring. Seasonal migration for work outside the village is the one of the main characteristics of the farming households at both Darwar and Chimichaur. 72% of the households have reported to have, at least, one family member migrated seasonally for off-farm work outside their village. This figure is slightly higher in Simichaur (73.3%) than in Darwar (70%). Of the total family members migrating seasonally for work, about 94% are male (Table 13).

Table 12. Major on-farm and off-farm sources of cash income (figures in rank scores).

Sources	Weighted mean score for multiple ranks*		
	Darwar	Simichaur	Total
On-farm sources:			
1. Livestock	0.3	6.4	6.7
2. Milk and ghee	0.3	3.2	3.5
3. Food grain	0.8	2.4	3.2
4. Crop by-products	0.2	1.5	1.7
5. Fresh vegetables	0.0	1.7	1.7
6. Fruits	0.0	0.2	0.2
Off-farm sources:			
7. Job	7.8	13.1	20.9
8. Pension	2.5	3.7	6.3
9. Wage labour	1.3	3.8	5.1
10. Small-scale business	1.3	1.2	3.0

*Note: Weighted mean scores have been derived from the number of households ranking for different sources of cash income.

Source: Household baseline survey, 1999.

Table 13. Family members involved in seasonal migration outside their village.

Family members	Darwar		Simichaur		Total	
	Number(%)	Mean ± SE	Number(%)	Mean ± SE	Number(%)	Mean ± SE
Male	40 (93.0)	1.48±0.2	72 (92.3)	1.64±1.30	112 (94.1)	1.58±0.10
Female	3 (7.0)	1.50±0.5	4 (7.7)	1.33±1.33	7 (5.9)	1.40±0.24
Total	43 (100)	1.54±0.2	76 (100)	1.73±1.14	119 (100)	1.65±0.11

Source: Household baseline survey, 1999.

3.1.5. Access to farm resources

The land ownership pattern existing in the project research site is presented in Table 14. Farmers mainly possess four categories of land, namely *khet, bari, kharbari* and private forest. *Khet*[1] and *bari*[2] constitute cultivated land while *kharbari* is used to grow forage grasses for livestock as well to produce thatch-grass. *Bari* is the main cultivated land type in the project research sites, constituting 81.5% of the total cultivated land. Similarly, *bari* is owned by 95% of the surveyed households while *khet* is owned only by 29%. All the farming households own land but their holding is with average *bari* holding of 0.4±0.04 ha and *khet* holding of 0.3±0.04 ha. The *bari* land holding is relatively more scattered with 2.3±0.1 parcels per household than that of *khet* with 1.8±0.2 parcels per household. The practice of renting-in land also exists in the research sites and is reported by 18% of the surveyed household. The average rented-in land per household is 0.18±0.04 ha and is reported by more households in Simichau (25%) than in Darwar (97.5%).

[1] *Khet* refers to irrigated cultivated land, where irrigated rice is grown.
[2] *Bari* refers to unirrigated cultivated land, where maize-based cropping systems are dominant.

Table 14. Distribution of land under different uses.

Land type	Households (%)	Total area (hectare)	% of total area	Mean area (hectare)	Mean parcel (hectare)
Darwar:					
Khet	27.5	2.53	10.46	0.23±0.07	1.89±0.20
Bari	87.5	8.89	36.76	0.25±0.02	2.32±0.22
Kharbari	95.0	12.11	50.08	0.32±0.04	1.55±0.48
Private forest	22.5	0.65	2.83	0.07±0.02	1.13±0.13
Simichaur:					
Khet	30.0	6.03	11.8	0.34±1.0	1.75±0.27
Bari	100.0	28.95	56.6	0.48±0.1	2.34±0.17
Kharbari	78.3	14.68	28.75	0.31±0.1	2.58±0.30
Private forest	11.7	1.4	2.80	0.20±0.5	1.50±0.34
Combined:					
Khet	29.0	8.6	11.4	0.30± 0.04	1.80±0.2
Bari	95.0	37.9	50.3	0.40± 0.04	2.30±0.1
Kharbari	85.0	26.8	35.5	0.30± 0.03	3.10±0.3
Private forest	16.0	2.1	2.8	0.10± 0.13	1.30±0.2

Source: Household baseline survey, 1999.

Livestock forms an important and integral part of the farming system and, among other things, provides a major source of nutrients (i.e., manure) for crops. Buffalo, cattle, goats, and chickens are the main kinds of livestock in the area. Of the total surveyed households, 97% have reported to own one or more kinds of livestock. The livestock ownership pattern is similar at Darwar (owned by 97.5% households) and Simichaur (owned by 96.7% households). The average livestock unit per household is 2.8.

3.1.6. Gender, wealth and ethnic differences

The differences in characteristics of maize-growing households due to gender, wealth and ethnic differences of the surveyed households in the project research sites are presented in Table 15, 16 and 17. The family size is relatively smaller in the average and poor wealth categories and in the KDS and GMN ethnic households than in other households. This implies that the family labour available to these households is less than in other households. The percentage distribution of households, with seasonally migrated family member for off-farm work, is similar across wealth categories and male- and female-headed households. The percentage of households with family members engaged in off-farm activities, however, is slightly higher in the GMN and KDS households than in the BCJ households.

The degree of food deficiency varies among the different household categories. The average period of food self-sufficiency is lower in average and poor households, in BCJ and KDS ethnic households, and in female-headed households. This variation is, however, statistically not significant.

The average holding size and the number of parcels of *bari* land decrease with the wealth of the farming household. The differences in *bari* land holdings are highly significant across wealth categories ($p < .000$). Similarly, the variation in number of parcels of *bari* land per

household is also significant ($p < .05$) across wealth categories. These differences in *bari* land holdings and the number of *bari* parcels per household are, however, not statistically significant across either ethnic categories or male- and female-headed households.

The average livestock unit is highest among households in the rich and BCJ categories and lowest in poor and KDS households. This difference is significant across wealth ($p < .000$) and ethnic ($p < .01$) categories. Similarly, the female-headed households have lower livestock units per household than the male-headed households, but this difference is not statistically significant. The resource analysis thus indicates that BCJ households have most resources, followed by GMN households, while KDS households have least resources. Similarly, the female-headed households are comparatively less resourceful than male-headed households. Table 15, 16 and 17.

3.2. Maize production and utilisation

3.2.1. Maize production systems

Maize is the main livelihood crop for the farmers of the project research sites. The maize production in the area is, however, subsistence-oriented and production is largely for self-consumption. Only a small proportion of the households (10.4%) sells maize. The proportion of households selling maize is similar across households of different ethnic categories but is lower in the average and poor households and in male-headed households. A high proportion of the households (61%) purchases maize to offset their food-grain deficit. The differences in the proportion of households purchasing maize are highly significant ($p < .000$) across wealth categories but not significant across ethnic categories and across male- and female-headed households. There is virtually no market influence on farmers' choice of maize varieties (see Tables 18, 19 and 20 for detail).

The summer season maize is the main maize crop in the project research sites and is grown entirely on *bari* land. The spring maize grown on *khet* land is quite negligible. The maize production systems discussed in this report, therefore, refer to that of summer maize. The summer maize is sown between 2nd week of *Chaitra*[3] (4th week of April) to 1st week of *Jestha* (3rd week of May) depending on the arrival of rain. Two weedings are applied. First weeding about one and half month after sowing, i.e. between 4th week of *Baisakha* (2n week of May) to 2nd week of *Asadha* (4th week of July), and second weeding near tasseling stage, i.e. between 2nd and 3rd week of *Shrawan* (1st and 2nd week of August). During the first weeding, maize plants are manually lodged by digging one side of the plant and pushing it towards the soil surface in order to produce lodging tolerant plants. Harvesting takes place between 3rd week of *Shrawan* (2nd week of August) to 2nd week of *Bhadra* (4th week of August). Ploughing is done by animal (bullock) drawn wooden plough and all other farming operation for maize is done manually.

Maize in the area is largely grown in inter-cropping system. Maize is inter-cropped with a variety of summer legumes, such as cowpeas, ricebean, soyabean and other beans; and vegetables, such as pumpkin and cucumber; and fingermillet. Legumes and vegetables are sown thinly together with maize. Fingermillet is transplanted inside the standing maize between 2nd week of *Asadha* (4th week of July) to 4th week of *Shrawan* (2nd week of

[3] Months in italics are months in Nepali calender.

August). The PRA exercise conducted in the research sites has revealed following major cropping patterns followed by the farmers in the area.

- Maize+legumes-wheat or barley+mustard or rape or peas or lentil or chickpea
- Maize+legumes+vegetable- wheat or barley+mustar or rape or peas or lentil or chickpea
- Maize/fingermillet- wheat or barley+mustard or rape or peas or lentil or chickpea
- Maize+ginger or taro or turmeric
- Maize+legumes-potato

Maize and legume inter-cropping is the main cropping pattern at both Darwar and Simichaur and covers more than 85% of the total maize area. Maize and fingermillet inter-cropping is relatively smaller in area and covers about 10-15% of the maize area. Of the two major winter crops grown after maize, wheat covers about 75% and barley about 25% of the total maize area.
Tables 18, 19 and 20.

3.2.2. Maize varieties and their uses

Farmers of Darwar and Simichaur research sites grow a large number of maize varieties (Table 21). These varieties are broadly categorised into two maize types, locally called *thulo makai* (large type maize) and *sano makai* (small type maize). *Thulo makai* has tall plants, big cobs, large grains and long maturity duration, while *sano makai* has short plants, small cobs and grains, and short maturity duration. A majority of the farmers grow large-type maize, and it covers about 88% of the total maize area. Among the large varieties, *Thulo piyanlo* alone covers about 80% of the area planted to this type, which reflects that, although farmers grow a large number of varieties, a large portion of the maize-growing area is covered by relatively a small number of varieties. Farmers' trait characterisation of these varieties is presented in Appendix 4.

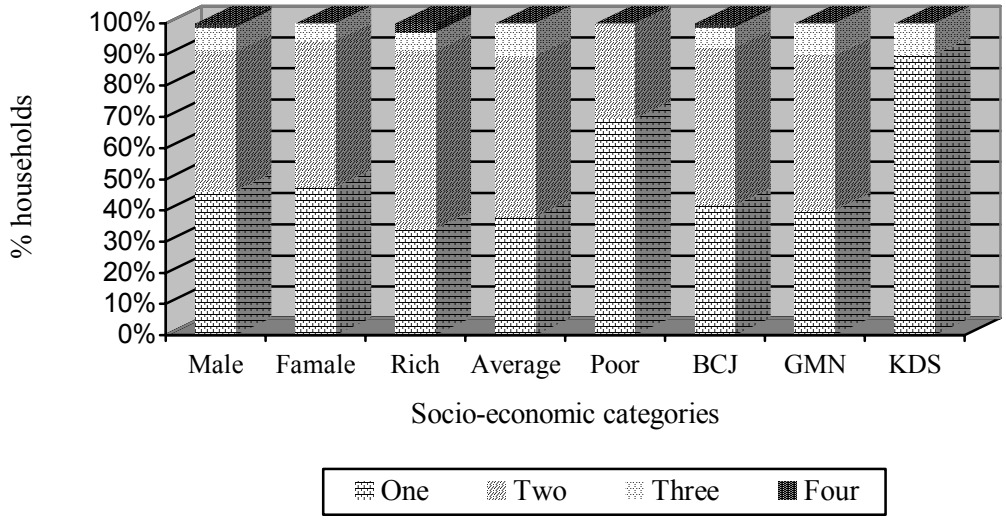
Table 21. Maize varieties grown at Darwar and Simichaur research sites.

Varieties	Darbar	Simichaur
1. Thulo piyanlo	***	***
2. Sano piyanlo	*	**
3. Thulo seto	***	***
4. Sano seto	*	**
5. Paise piyanlo	*	*
6. Paise seto	*	**
7. Kaude	*	*
8. Putali makai	*	*
9. Rato dathe	*	*
10. Chawali (Sathidine)	-	*
11. Katere	-	*
12. Gaurikhutte Rato	-	*
13. Kumaltare piyanlo	**	**
14. Manakamana seto	**	*
15. Manakamana piyanlo	-	*
16. Hetauda composite	*	-
17. Bikashe sano	-	*
18. Bikase piyanlo	-	*

Note: *** = Maize variety grown by a large number of farmers
* = Maize variety grown by a small number of farmers
Source: FGD conducted during PRA, 1999.

The information related to uses of and reasons for growing maize at Darwar and Simichaur research sites are presented in Tables 18, 19 and 20. A majority of the households grow one to two varieties of maize (46.5% to 45.5%, respectively) in a season. Only about 8% of the total maize-growing households grow more than three varieties per season. The varietal diversity maintained at household level, therefore, is low (Figure 2). The ANOVA result shows that the difference in the number of maize varieties grown at household level is significant ($p < .05$) across wealth categories but not significant across ethnic categories and between male- and female-headed households. A higher proportion of poor households grows one variety of maize, compared to rich and average households. This is contrary to the currently held view that small farmers maintain significant amounts of crop genetic diversity (Jarvis et al. 1997) and agrees with the findings of other studies (Rana and Kadayat 1999). Similarly, though not significant, a very high proportion of KDS households (90%) grows only one variety of maize.

Figure 2. Number of maize varieties grown per household across gender, wealth and ethnic categories



Farmers who grow more than one variety mentioned various reasons for this: to prepare different food items, to harvest at different times, to suit different land types, to use as animal feed, and to meet fodder requirements. However, a majority of the farmers (67.9%) grow to suit different types of land, and this is true across all wealth and ethnic categories and between male- and female-headed households. The ANOVA result suggests that the number of maize varieties grown at household level is not significantly related to the size of the *bari* land but is highly significantly related to the number of parcels of *bari* land the farmer is planting to maize ($p < .000$). This indicates that with the increase in the number of parcels of *bari* land, the number of maize varieties grown at household level also increases. This also confirms the PRA finding that farmers in the area grow large-type maize on more fertile land while small-type maize is grown on less fertile soil. The number of *bari* parcels, therefore, appears to be the strongest determining factor in deciding the number of maize varieties to be grown per season. It is, however, true that farmers use multiple criteria to select maize varieties for their household production.

The gender differences in the use of some criteria to choose maize varieties are striking. A large proportion of female-headed households (more than three times the number of male-

headed households) mentioned growing more than one variety to meet fodder requirements for their livestock. This is also confirmed by the PRA findings. During the focus-group discussions, women farmers strongly expressed their preference for tall varieties of maize like their local varieties because taller varieties produce more fodder than short varieties. Women appear to be more concerned with this issue because managing livestock fodder is largely their responsibility. Similarly, women farmers are very particular about the suitability of maize varieties for inter-cropping, especially with legumes (cowpeas and beans), because these help them meet the vegetable and pulse requirements of their families. The latter sometimes leads to conflicts with their male counterparts because inter-cropping with cowpeas and beans makes maize plants vulnerable to lodging and can cause big losses in the maize yield.

Maize is the staple food for farming households in the study area. Different preparations of maize are made for household consumption, of which steamed grit (*makai ko bhat*) is the most common preparation, and 77% of the total production is used for this purpose. Farmers, therefore, prefer maize varieties that have high grit recovery. They perceive that yellow grain maize has higher grit recovery and, therefore, prefer coloured varieties over the white ones. The white grain maize has high flour recovery than grit. The food preparation of maize is similar across households of different wealth, ethnic, and gender categories, and a majority of households use it in grit form. Users' and gender differences in the choice of variety, therefore, do not appear to be influenced by differences in their use of maize. Rather the choice of maize varieties is influenced largely by the difference in grit recovery of different varieties of maize.

The analysis discussed above indicates that farmers' choices for maize varieties are not greatly influenced by their differences in wealth, ethnicity, and gender, i.e., different categories of farmers have preferences for similar types of maize varieties. Farmers across all wealth, ethnic, and gender categories grow only one or two maize varieties per household and, therefore, their varietal needs are not very diverse. However, farmers use multiple criteria in selecting the varieties they grow. They prefer to have as many traits of their preference as possible in one to two maize varieties. In this way, they are able to maintain and manage the variety of their preference for a long duration. Since maize is an open-pollinated crop, a large number of varieties are difficult to maintain and manage. This analysis is also confirmed by the findings of the PRA conducted at the project research sites. The participatory breeding program, therefore, should focus on developing fewer maize varieties with multiple traits that reflect farmers' preferences. Priority should be given to the maize varieties that have higher grit recovery, grow well under different land conditions, produce high biomass for use as fodder, and allow good inter-cropping with legumes.

3.2.3. Maize production inputs and yield

The access farmers have to improved maize varieties suitable to local environments and their own needs is quite limited (Table 18, 19 and 20). Only 13% of the farmers reported to grow improved varieties of maize last year. The percentage of such farmers is higher at Darwar (26.7%) than at Simichaur (5.5%). However, farmers at these sites know the value of changing their old varieties and seeds. Of the total surveyed households, 30.6% (28.9% at Darwar and 31.7% at Simichaur) reported to have changed their maize varieties over last five year. The major reasons for changing varieties are: declining production (43.3% of farmers changing maize varieties), prone to insect infestation (23.3%), interested to grow new

varieties (23.3%), varietal mixture (13.3%) and seed loss due to storage pests (13.3%). The proportion of household changing old seeds is even higher. About 39% of the households reported exchanging their seeds during last five years with other farmers. The percentage of such farmers is high at Simichaur (43.6%) than at Darwar (20.0%). The major reasons for changing old seeds are: declining production (51.8% of the farmers changing old seeds), prone to insect infestation (33.3%), seed loss due to consumption (18.5%) and seed loss due to storage pests (14.8%).

Farmers' access to sources of seed for changing their old seeds is quite limited. Neighbours, relatives and grain retailers in the nearby market are the only sources of seed reported by the surveyed farmers. Of the total farmers reported to change seeds, 96.3% get seeds from their neighbours. These farmers also get seeds from their relatives (29.6%) and grain retailing shops (7.4%). Exchanging seed for seed or grain and purchasing with cash are major mode of obtaining seeds reported by 63.0% and 59.3% of the total farmers reported to change seeds. Some of these farmers (18.5%) also receive seeds from their neighbours and relatives free of cost as seed help.

The users' and gender analysis showed that access to new maize seeds is similar across all wealth categories. However, GMN and KDS households have a complete lack of access to new maize seeds, and a lower proportion of male-headed households reported cultivating improved varieties than did female-headed households. The proportion of households changing seeds over the last five years, however, is greater in the poor wealth category, suggesting that farmers in this category change seed more frequently than do the others. Since these households are also highly food deficit, they may be consuming the seed and, therefore, borrowing seeds from other farmers. The proportion of households changing maize seeds is, however, similar across ethnic categories and between male and female-headed households.

The use of animal manure (farm yard manure) is the major source of plant nutrients for maize in the area. Almost all farmers use animal manure for maize production at the rate of about 16 tonnes/hectare. The rate of animal manure application is slightly higher at Darwar (19 t/ha) than Simichaur (15 t/ha). The use of external inputs such as, chemical fertilisers and pesticides is quite limited, both in number of farmers using and quantity used. Of the total surveyed households, 38% have reported to use chemical fertilisers (32.5% at Darwar and 41.7% at Simichaur). Urea is the main chemical fertiliser used by about 92% of the farmers (about 85% at Darwar and 96% at Simichaur). Other chemical fertilisers such as, DAP (Di-ammonium phosphate) and MOP (Murate of potash) have been reported to have used by only two and one farmers respectively. The total urea used per unit of maize-cultivated *bari* land comes to about 21 kilograms/hectare (about 19 kg/ha at Darwar and 22 kg/ha at Simichaur). Use of pesticides is negligible reported by only one household at Simichaur and none at Darwar.

Farmers have difficulty in estimating dry grain yield of maize as maize cobs are shelled in batches as and when required for consumption, sale or seed. Farmers usually remember number of *doko* (a bamboo basket used for carrying good in the hills) loads of harvested cobs and/or size of *suli* (piles of maize cobs hanged on a wooden/bamboo frame) of maize cobs. They rarely shell all the maize cobs and store as shelled grains. Only few farmers were able to estimate yield of maize of few varieties (Table 22). According to this estimate, the yield of large type (*Thulo*) maize is just over 2.0 t/ha while that of small type (*Sano*) maize is about 1.9 t/ha.

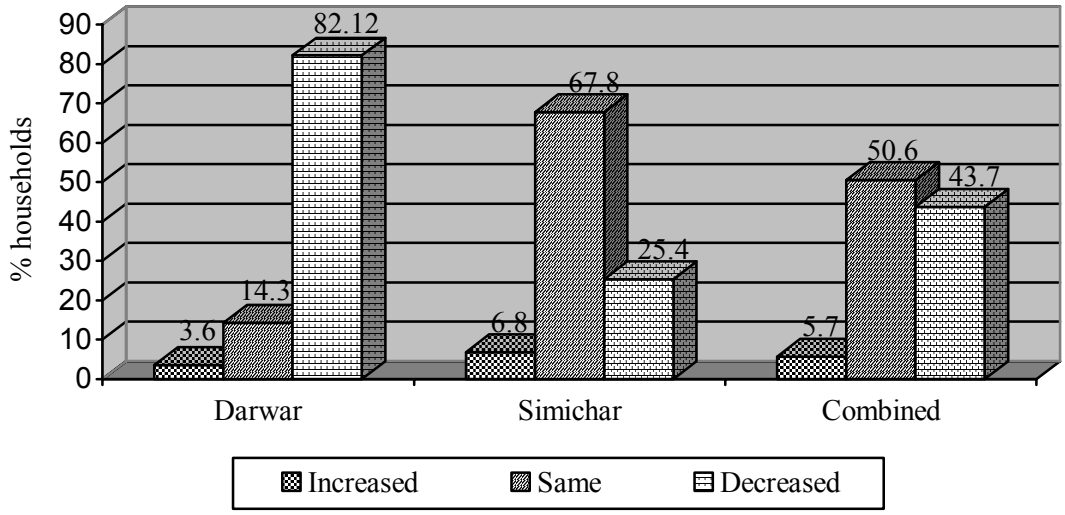
Table 22. Farmers' estimated yield of some common local maize varieties (combined for Darwar and Simichaur research sites).

Maize varieties	Yield (t/ha)	No. of farmers used for estimation of yield
1. *Thulo piyanlo*	2.15±0.23	29
2. *Thulo seto*	2.03±0.49	5
3. *Sano piyanlo*	1.91±0.87	2
4. *Sano seto*	1.90±0.72	11

Source: Household baseline survey, 1999.

Regarding the productivity trend of maize over last three years in the area, about 44% of the surveyed farmers perceive to have their maize yield declined, about 51% have perceived to have same yield while about 6% have perceived to have declined maize yield (Figure 3). A large number of farmers have perceived a declining maize yield at Darwar (82.1%) than at Simichaur (25.4%).

Figure 3. Productivity trend of maize yield at Darwar and Simichaur reserach sites.



One of the major constraints to maize production reported by farmers is lodging of the maize plants largely due to tall plant height of the local maize varieties. The plant height of *Thulo piyanlo*, a most widely grown variety of maize, is more than three metres with cobs located much higher than farmer can reach with their hands. In years when farmers experience lodging of their maize plants, about 48% of the farmers have reported to suffer yield loss in the range of 50-75% (Table 23).