

People, Community Dynamics and Perceptions in the Watershed

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1. INTRODUCTION

The main hypothesis behind the socio-economic research is that resource degradation occurs within a social and economic context. To understand why farmers choose different management and cultivation practices it is necessary to appreciate the intricacies of the system within which they are operating. The surveys were conducted as a learning exercise to compile information from the farmers about their constraints (social, economic and physical) and their aspirations (individual, household and village-wide). A semi-structured interviewing approach based on the Rapid Rural Appraisal methods (Khon Kaen University, 1987) was utilized. Informal discussions were conducted with farmers to encourage a free speaking environment. The main purpose of the interviews was to gather information about the farming-household system, thus, the selection of respondents was biased towards the decision-makers within the farm household and towards equal representation of men and women farmers. Simultaneous and separate man / woman farmer interviews were conducted to account for the typical division of labour between men and women farmers and to incorporate a cross check system. In most cases, the interviewing was conducted at farmers' homes with the women (female Nepali interviewer and the woman farmer) holding the discussion indoors and the men (male Nepali interviewer and the man farmer) talking outside in the courtyard. Discussions with key informants and group interviews were also conducted.

A number of questionnaires were conducted between 1988 and 1994 (Table 1). The focus of the questionnaires included farming systems, soil fertility, indigenous knowledge, irrigation systems, agricultural practices and forestry. The Panchkhal, Rabi-Opi and Baluwa regions were surveyed in 1988/89 and again in 1992. The 1992 vegetable production survey re-interviewed 31 families and questions from the 1988/89 surveys were incorporated. The 1994 household survey conducted in Bela-Bhimsenthan region again repeated many of the questions from the 1988/89 surveys. The location of all households surveyed was denoted on the aerial photographs and transferred into the GIS system so that spatial relationships could be determined.

This paper will concentrate on the surveys related to farming systems in the Panchkhal, Rabi-Opi, Baluwa, Dhulikhel and Bela-Bhimsenthan regions (Figure 1). Population dynamics, non-farm activities, agriculture, livestock and forestry, and farmers' perceptions and expectations will be discussed.

2. POPULATION DYNAMICS

A population survey was conducted in the watershed for 1947 and 1990 by counting all of the houses on the available topographic maps and aerial photographs. The 1990 population was determined by counting all houses on the enlarged 1:5,000 scale aerial photographs and multiplying the number of houses by the average family size determined for each village through surveys and interviews. The population for 1947 was obtained from the number of houses on the original topographic map and the average family size determined from historic census data (HMG). The population dynamics between 1947 to 1990 are shown in Figure 2. The

estimated population has increased from 8,971 people in 1947 to 32,956 people in 1990. This represents a 3.1% growth rate per annum or a doubling of the population every 25 years. However, this number should be interpreted with caution since increases in the population in the past 10-15 years are likely greater than changes 40-50 years ago.

Table 1. Questionnaires conducted between 1988 and 1994.

Focus	Location	Date	# Respondents
Farming Systems	Bela-Bhimsenthan	1994	85 households (men & women farmers)
Soil Fertility	Bela-Bhimsenthan	1993	230 farmers
Indigenous Soil Classification	Bela-Bhimsenthan	1993 1992	11 farmers 15 farmers
Irrigation	Bela-Bhimsenthan	1992/93	41 farmers
Soil & Water Management	Bela-Bhimsenthan	1992	21 farmers
Vegetable Production	Rabi-Opi Panchkhal Baluwa	1992	16 households (men and women farmers) 24 households (men and women farmers) 24 households (men and women farmers)
Household	Dhulikhel	1990	631 households (50 detailed)
Forestry	Dhulikhel	1990	136 farmers
Agriculture	Dhulikhel	1990	119 farmers
Farming Systems	Baluwa Rabi-Opi	1989	31 households (men and women farmers) 31 households (men and women farmers)
Farming Systems	Panchkhal	1988	33 households (men and women farmers)

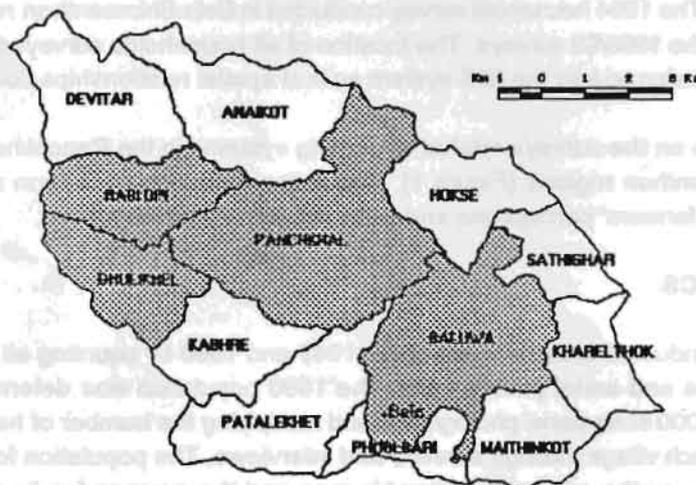


Figure 1. VDC map showing regions surveyed.

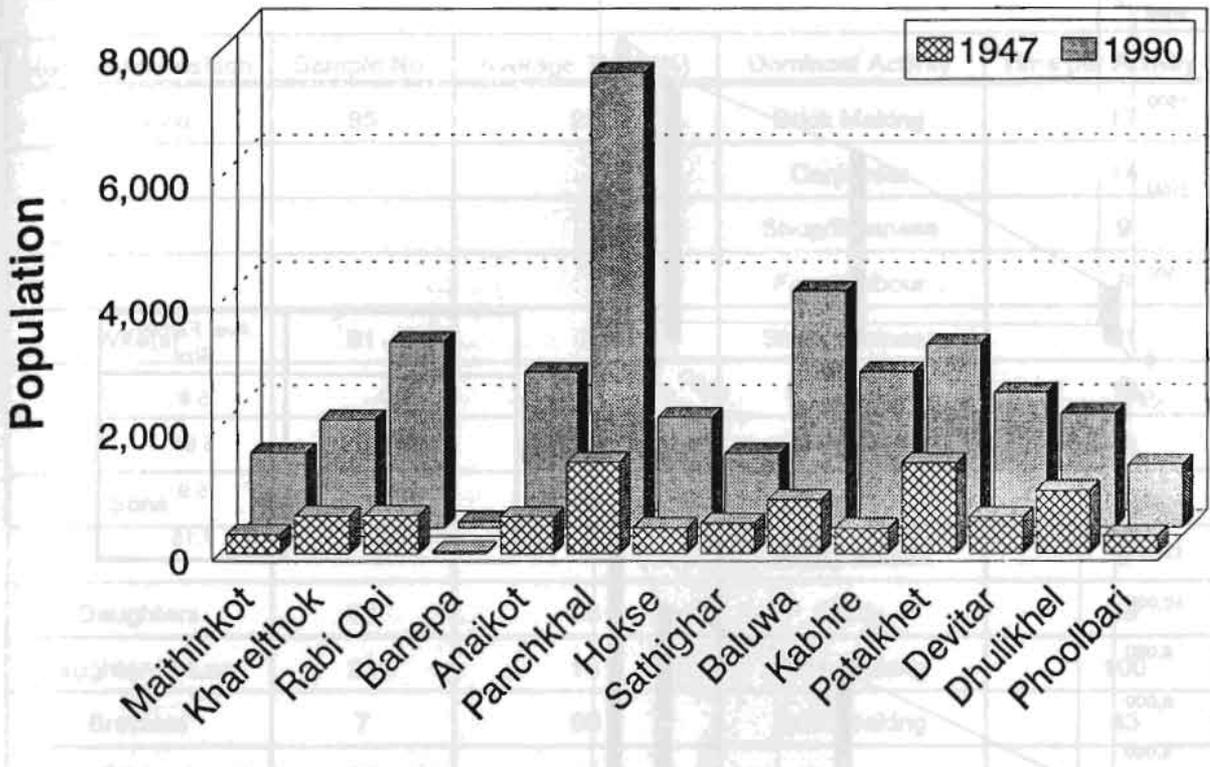
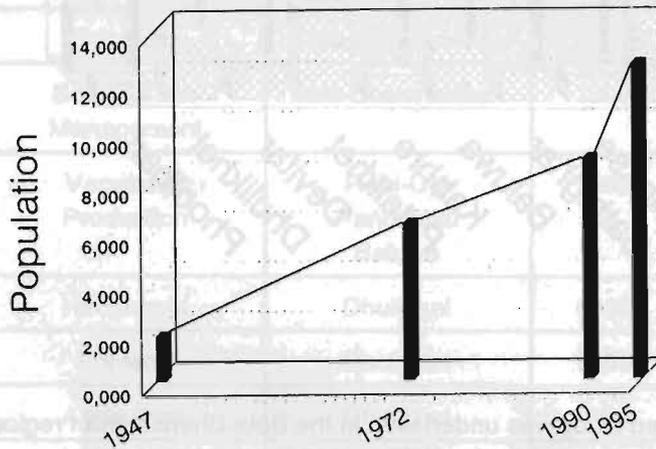
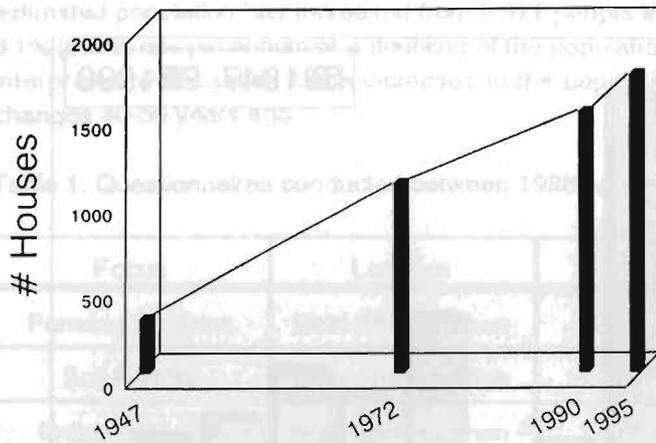


Figure 2. Jhikhu Khola population dynamics.

To evaluate the recent population dynamics a detailed study was undertaken in the Bela-Bhimsenthan region for 1972, 1990 and 1995. The number of houses were counted on the 1972 and 1990 aerial photographs and were compared to the number of houses observed in the field in 1995. Population numbers were calculated from the number of houses and the average family size, determined from census data and field surveys. The number of houses in the region increased from 1516 in 1990 to 1723 in 1995 (Figure 3a). This increase is due to both population growth and immigration; a number of young families from nearby communities are currently building houses in the region. The average population growth rate was 1.9% per annum for the 1972-1990 period and 7.4% per annum for the 1990-1995 period (Figure 3b). This growth rate is likely overestimated due to the larger family size obtained by recent household surveys.

3. NON-FARM ACTIVITIES

Non-farm activities are an important source of family income. Non-farm activities in the Bela-Bhimsenthan region in 1994 are shown in Table 2. The average person in the region spends thirty-five percent of their time in non-farm activities. Husbands typically spend 20% of their time off-farm and the dominant activities are brick making / masonry (17%) and carpentry (14%). Wives usually spend less time off-farm (7%) and the main activities are shop / business and household labour. Sons and daughters spend a large portion of their time studying, but brick making / masonry activities are also noted. The daughter-in-laws involved in off-farm activities all worked in brick making, and 43% of the off-farm activities of the brothers was also brick making / masonry work. This contrasts the 1988 Panchkhal survey where 52% of the respondents worked as farm labourers and no brick making activities were noted. There were only 35 brick making units in 1981/82 in the Kathmandu valley but 142 in 1991/92 (Mishra, 1995).



Year	Ave. Family Size
1947	5.8
1972	5.68
1990	5.9
1995	7.15

Figures 3a and 3b. Population dynamics 1972-1995 Bela-Bhimsenthan region.

4. AGRICULTURE

4.1 Land

The main agricultural assets of farmers in the area are land and livestock. The amount of khet and bari land owned by the households vary dramatically both across and within ethnic/caste groups. For example, in Panchkhal (1988) the average amount of khet land farmed is 8.6 ropani per household, but the distribution across different size categories of land farmed by the sample households (Table 3) clearly indicates that access to khet land is unequally distributed. Fifty-one percent of the households cultivate only 8.5% of the khet land, with holdings of four ropani (ha) or less. Only 15.1% of the sample households farm 54.2% of the khet land and have holdings between 17 and 47 ropani (ha).

Land ownership is also unequally distributed by caste/ethnic groups. For example, in the Bela-Bhimsenthan region (1994) the average khet land per household is 4.8 ropani, while the average bari holding is 16.1 ropani (Table 4). Land holdings vary by caste from 0 to 6.1 ropani of khet land, and 8.2 to 25.0 ropani of bari. Brahmin, Newar and Tamang families have the largest holdings. Ninety-four percent of the households sampled own bari land, while only 76% own khet land.

Table 2. Non-farm activities in the Bela-Bhimsenthan region, 1994.

Household Position	Sample No.	Average Time (%)	Dominant Activity	Time per Activity (%)
Husband	85	20	Brick Making	17
			Carpenter	14
			Shop/Business	9
			Farm Labour	6
Wife(s)	91	7	Shop/Business	31
			Household	15
			Farm Labour	15
Sons	112	62	Study	78
			Brick / Mason	5
Daughters	83	56	Study	99
Daughter-In-Law	23	14	Brick Making	100
Brothers	7	60	Brick Making	43
Others	26			
Average		35		

Table 3. Khet land farmed by parcel size in Panchkhal, 1988.

Parcel Size (ropani)	Amount Khet Land (ropani)	% Khet Land	# Households	% Households
0 - 4	24	8.5	17	51.5
5 - 8	42	15	6	18.2
9 - 12	19	6.7	2	6.1
13 - 16	44	15.6	3	9.1
17 - 47	153	54.2	5	15.1
Total	282	100	33	100

4.2 Production

Farmers were asked if the land that they farmed generated enough food and income to meet their family's basic needs. The results shown in Figure 4 indicate that 21 to 50% of the households surveyed reported that they were not sufficient, with the Panchkhal region being the most sufficient and Rabi Opi the least. In the Bela-Bhimsenthan region, 42% of households sell crops and 46% buy additional food.

Table 4. Land ownership by ethnic/caste group in the Bela-Bhimsenthan region, 1994.

Caste	Sample No.	Average Khet / Household (ropani)	% Owning Khet	Average Bari / Household (ropani)	% Owning Bari
Brahmin	46	6.1	85	18.8	100
Newar	13	4.5	77	12.6	100
Tamang	7	6.1	71	14.3	100
Danuwar	9	1.7	67	8.2	89
Chhetri	5	0	0	9	90
Others	10	2.4	100	25	100
Average	85	4.8	76	16.1	94

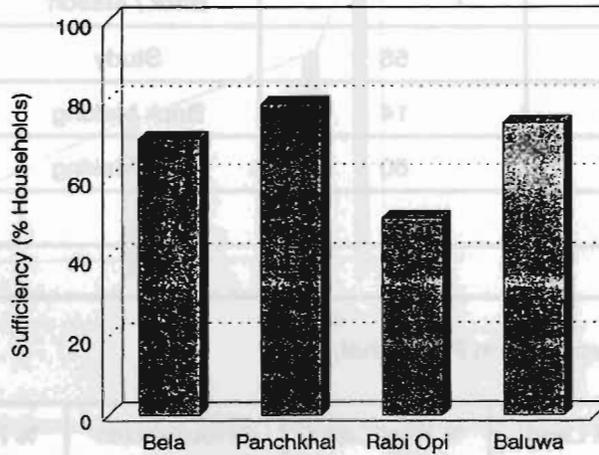


Figure 4. Food sufficiency for four districts.

Farmers were also asked: "What is the biggest problem preventing you from increasing your yields?" The results shown in Table 5 consistently list irrigation as a constraint. The 1994 survey in the Bela-Bhimsenthan region found that uncertainty related to the timing and input requirements of new cropping sequences was a significant problem. Fertilizer (availability, type and cost) and disease problems were also important.

5. LIVESTOCK

Livestock play an integral role in farming systems in Nepal. Every household surveyed owned some livestock. The typical mix (for families with abundant livestock) is a bullocks (oxen), a cow (and possibly a calf), a female buffalo (possibly a calf,) a few goats and a few chickens. Bullocks are used as draught power for land preparation. Cows are kept primarily for cultural / religious purposes and manure production. Female buffalo are kept for milking purposes and for manure. Male buffalo are not used for draught power due to the small terraced plots in the area but are raised and sold for meat. Many families require goats for religious sacrificial purposes. Goats are also sold for meat. Poultry is raised for meat and eggs; however, Brahmins have traditionally not eaten eggs or poultry. A few households raise pigs and ducks.

Table 5. Production constraints.

Region	Constraint	% Responses
Bela-Bhimsenthan	Cropping Pattern	44
	Irrigation	34
	Chemical Fertilizer	12
Panchkhal	Irrigation	57
	Inputs	22
Rabi Opi	Irrigation	36
	Disease	30
	Fertilizer	10
Baluwa	Irrigation	37
	Fertilizer	35
	Disease	12

Source: Male Farmers

The livestock holdings for the Bela-Bhimsenthan region for 1989 and 1994 are shown in Figure 5. There has been an overall 18% decrease in the average number of animals per farm in the last five years. This may be related to difficulties in obtaining fodder and reduced communal grazing areas. Fifty-five percent of farmers reported fodder shortages in 1994, and 98% of those were in the winter. The fodder situation, shown in Figure 6, indicates that the majority of fodder comes from crop residues (51%) and terrace risers (26%), while purchasing fodder (11%), private trees (7%) and community or government forests (5%) provide additional sources. Seventy percent of households responded that it was significantly easier to obtain fodder from all sources five years ago, especially from the forest.

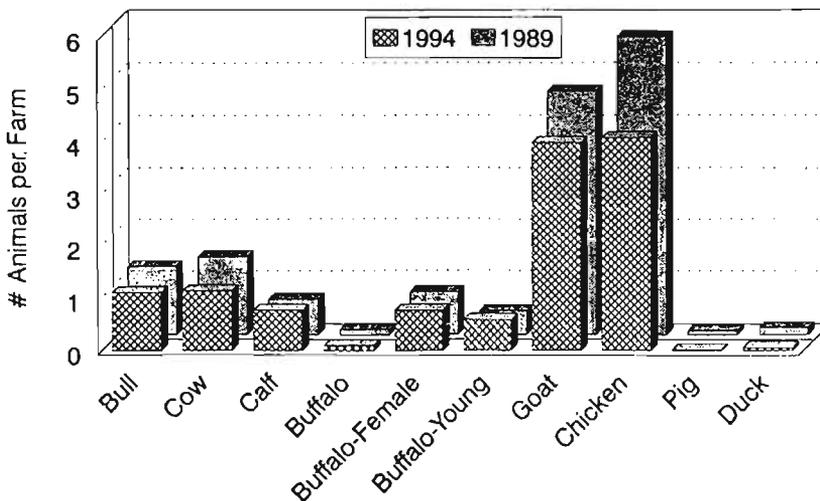


Figure 5. Livestock holdings (Bela).

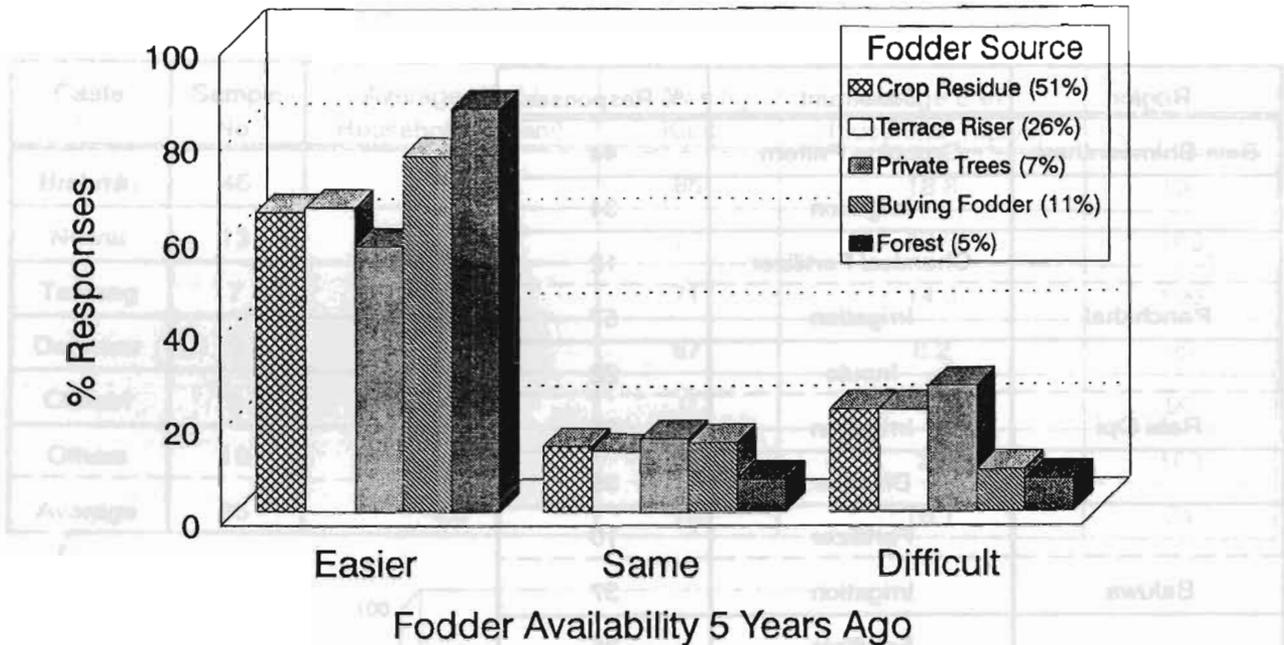


Figure 6. Fodder supply (Bela).

Over the last five years, there has been a substantial decrease in chickens, goats and cows but the average number of male and female buffalo per farm has remained constant, and the number of young buffalo has increased slightly (Figure 5). This is indicative of increased dairy activities and new dairy collection centres in the region. Sixty percent of households were producing milk in 1994. Of the milk produced, 100% of cow milk was consumed, while 55% of buffalo milk was sold. Note that buffalo produce a higher quality and quantity of milk than local cows. Milk production over the last five years from cows and buffalo (Figure 7) has increased by 15 and 23 percent respectively. This increase is largely due to new operations (farms producing milk for less than 5 years) rather than increased production.

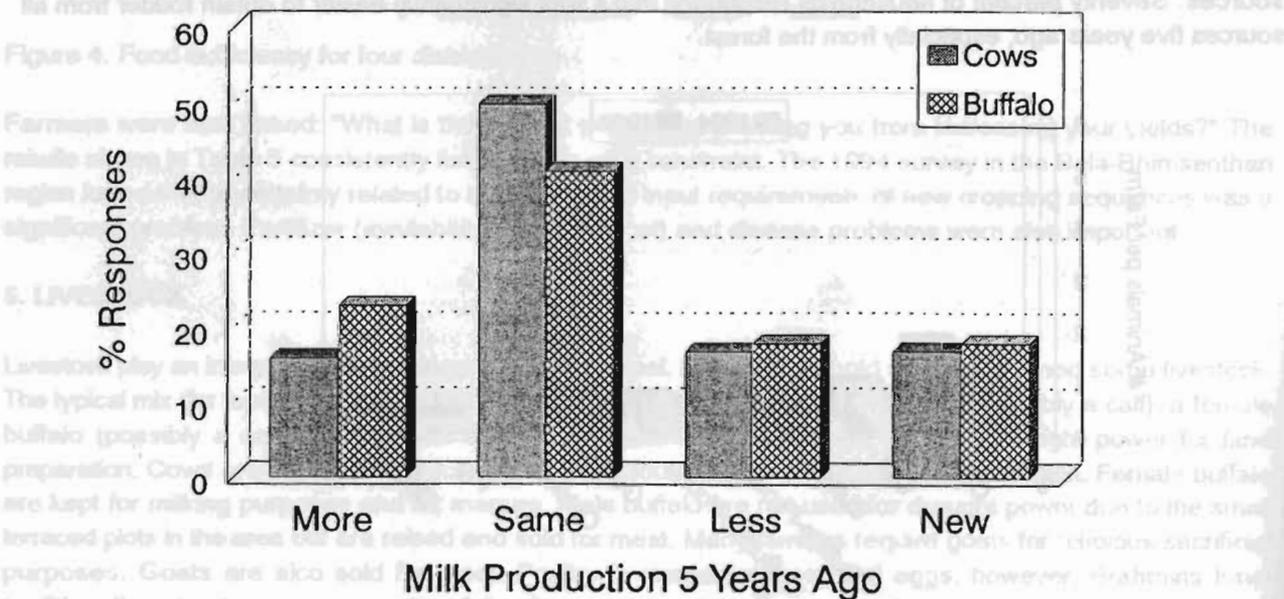


Figure 7. Milk production (Bela).

6. FORESTRY

The forest provides fuelwood, fodder and animal litter, and is an integral part of the farming system. Forest product collection for the Bela-Bhimsenthan region is summarized in Tables 6 and 7. The majority of the collection of forest products is conducted by women in the household. On average, wives, daughters and daughter-in-laws collect 86% of forest products for the household (Table 6). An average household makes 2.1 trips per week to collect fuelwood, 7.6 trips per week to collect fodder, and 4.1 trips per week to collect litter. The average return trip takes 2.9 hours, and up to 38 hours per week may be spent by a household in the collection of forest products.

This is confirmed by identifying all houses and forest sites used by each household on the enlarged aerial photos (scale 1:5000), transferring the information into GIS, determining the aerial distance between the household and forest sites, and walking the trails to determine average times to cover the daily trip to the forest. In the case of the Dhulikhel village the average fodder collection distance was determined to be 341 m, for fuelwood 480 m, and for forest litter 633 m. This translated into average time commitment of 50 minutes for fodder collection, 70 minutes for fuelwood collection and 95 minutes for litter collection. Since women do most of this work such time commitment places additional burden on the already overworked female labour force.

Table 6. Forest product collection by household position in the Bela-Bhimsenthan region, 1994.

Product	% Responses			
	Wives	Daughters	Daughter-In-Law	Sum
Fuelwood	49	21	18	88
Fodder	43	21	19	83
Litter	50	19	19	88

Table 7. Forest product collection frequency in the Bela-Bhimsenthan region, 1994.

Product	Frequency (trips / week)	Time / Trip (hours)	Time Spent (hours / week)
Fuelwood	2.1	3.2	6.7
Fodder	7.6	2.5	19
Litter	4.1	3	12.3
Total	13.8	8.7	up to 38

The number of privately owned trees (on-farm) are summarized in Figure 8. Over the last five years there has been a 32% increase in the average number of private trees per farm. The largest increase has been in fruit trees, reflective of increased horticultural activities, but timber and fuelwood trees are the greatest in number.

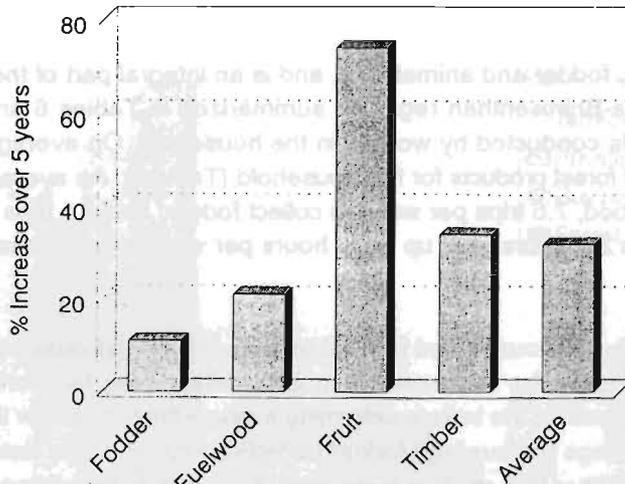


Figure 8. Number of on-farm trees (Bela).

7. IMPLICATIONS

From the compilation of population data, we have learned that the population pressure is far greater than previously indicated and this has a widespread impact on the resource conditions. The farmers are acutely aware of some but not all of the constraints.

The decline in available water resources and the stagnation of biomass production are the most serious and readily visible problems. The interconnections between forests, agriculture, livestock and water resources are obvious but the recycling of nutrients and reallocation of the nutrient pool from the forest and grazing land into agriculture is not as obvious over the short term. However, the long term implications are of great concern. Off-farm employment is not diversified and is dominated by brick making. This also has detrimental effects on the environmental conditions, because it uses up valuable soil and firewood resources and produces significant air-pollution problems. It does not improve the economic diversity since little value is added by brick making although shelter is provided for the growing population. Based on the collected socio-economic information it is clear that unless the economy can be diversified the resource conditions will likely deteriorate.

8. FARMERS' PERCEPTIONS AND GOALS

The village development needs as perceived by men and women farmers in the Bela-Bhimsenthan survey (1994) and the Panchkhal, Rabi Opi, Baluwa surveys (1988/89) are given in Table 8. The top four priorities of both men and women farmers are the same, however, the order of priorities differs between men and women and between 1988/89 and 1994. Drinking water (supply and quality) and electricity (supply) are the highest overall priorities. Irrigation and transportation are also important and reflect the increasing importance of market oriented production (transportation to market and irrigation required for cash crops).

Farmers were asked: 'If you had some extra money, what would you buy?' Their individual goals are listed in Table 9. The highest priorities were land, banking or finance, housing, livestock operations, agricultural inputs and small business. The priorities between men and women were similar but differed in order, and priorities in Bela-Bhimsenthan 1994 were similar to Panchkhal, Rabi-Opi and Baluwa 1988/89.

Table 8. Village development needs.

Bela 1994		
Priority	Women	Men
1	drinking water (39)	irrigation (46)
2	electricity (36)	drinking water (45)
3	irrigation (26)	road / transportation (38)
4	road / transportation (23)	electricity (22)
Panchkhal, Rabi Opi, Baluwa 1988/89		
Priority	Women	Men
1	electricity (43)	drinking water (54)
2	road / transportation (34)	electricity (40)
3	drinking water (13)	irrigation (40)
4	irrigation (10)	road / transportation (30)

N.b. numbers in () are number of responses (also for Table 9).

Table 9. Farmer goals (ways to spend extra money).

Bela 1994		
Priority	Women	Men
1	bank / finance (62)	land (40)
2	land (45)	shop / business (28)
3	housing (18)	bank / finance (25)
4	livestock (18)	agricultural inputs (25)
5	shop / business (17)	livestock (25)
Panchkhal, Rabi Opi, Baluwa 1988/90		
Priority	Women	Men
1	land (54)	land (41)
2	bank / finance (45)	livestock (38)
3	cloth / clothes (20)	agricultural inputs (34)
4	livestock (10)	shop / business (14)
5	housing (9)	housing (14)

9. CONCLUSIONS

Both from the overall and the detailed surveys, it is evident that the population growth rate has been very rapid, reaching levels of 6 % per annum in the last 5 years. This is the result of both high reproduction rates and immigration into the watershed. This increase is placing enormous stress on the environmental conditions in both agriculture and forestry.

About one third of all activities are in non-farming occupations, with the adult male having the highest share. The demand for brick production both within and outside of the watershed is the greatest source of non-farm employment and is a direct result of population increases. Associated with this are high demands for selective firewood.

Average land holdings are very small but there is great variability between families and castes. A few families (15%) own more than half of all agricultural land and this will likely cause difficulties in the future.

Between 20 and 50% of the farmers indicated insufficient food production, insufficient irrigation water and nutrient inputs were identified as the major problem limiting increases in biomass production.

Livestock numbers have declined significantly over the past 5 years and the lack of feed is cited for the reduction. However, milk production has increased and is becoming a new source of income.

The use and management of the forest is primarily in the domain of women. The lack of forest productivity is placing a large burden on the women since they spend more than half of their working time collecting fodder, firewood and forest litter.

These findings clearly show that rapid population growth has placed demands on the resources that are difficult to meet even with transformation of land use and crop intensification. The farmers are finding that it is increasingly difficult to meet their basic demands, and the general perception of the inhabitants is that drinking water supplies and the introduction of electricity are of highest priority. The main desire is to improve the irrigation systems and transform the infrastructure to create more market access. The pressure to increase production is placing constraints on the environmental conditions, and water shortages and limited nutrient inputs are the major challenges facing the farmers in the watershed.

10. REFERENCES

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