CROPPING PATTERN, PRODUCTION STATUS AND FARMER'S INDIGENOUS PRACTICES OF LOCAL CROPS IN HUMLA DISTRICT, NEPAL

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ABSTRACT

A study was carried out in the Humla district during 2078 B.S. to examine the local cropping pattern, production status, and indigenous practices of crops. To gather information, a semi-structured questionnaire was used to survey 52 households, and two focus group discussions were conducted. The study found that the major indigenous crops were summer crops that were sowed in the months of Baisakh and Jestha and harvested in Ashoj and Kartik. These crops required less water. On the other hand, winter season crops such as naked barley and wheat (pabai) required more than seven months for harvesting. Beans, buckwheat, potato, and finger millet were the major crops produced in the study area. Beans, buckwheat, and barley were cultivated by a higher number of households, while buckwheat, potato, and beans had high crop production. The majority of farmers practices a two-year crop rotation. Additionally, the study found that socio-economic factors such as gender, farmer's age, caste, family size, and total crop production had a significant relation on maintaining on-farm crop diversity. The study concluded that local farmers in Humla district continue to rely on traditional practices for crop management, which are well-suited to the local agro-climatic conditions. However, it is necessary to give greater emphasis to increasing cropping intensity through the introduction of new technology and innovation, suitable crop management methods, and the protection of indigenous crops to enhance food security and agricultural sustainability in the region.

Keywords: Cropping pattern, cropping practices, on-farm crop diversity.

INTRODUCTION

Agriculture landscapes is a bio-diversity reservoir in Nepal (Joshi *et al.,* 2020). We can find several crops being cultivated or grown naturally in the agricultural landscapes. Indigenous crops are those that have been cultivated or naturally grown since ancient times in our agricultural landscapes. These crops, grown in the natural ecosystems, are the source of food and medicine for all generations. Diversity in the diets of these crops can become a powerful source of nutrients (IIED, 2020). In the mountainous region of the country, agriculture is dominated by local and indigenous crop varieties like barley, buckwheat, millet, beans, foxtail millets, amaranths, rice, etc. In this region, farm households manage seeds for production through informal seed networks, local informal markets, and community exchanges (Gauchan *et al.,* 2020). It is necessary to grow as many crops as possible, and diversification in crop cultivation leads to improving food security and commercialization, along with the judicious utilization of water, land, and other available resources (Chappell & LaValle, 2011; Meemken & Qaim, 2018). Any crop that is locally available and has a greater comparative advantage over others will lead to an increase in the income of people

and alleviation of poverty (Sharma, 2001). As there are variable climatic conditions in Nepal in different ecological zones, we can grow varieties of commodities.

Traditional and indigenous crops are rich in genetic diversity, and are essential part of the global biodiversity for the development of new varieties required for the future world. Traditional crop varieties may yield less than commercial varieties, but they are better suited to marginal lands, socioeconomic conditions, various crop stresses, insects, and diseases, and require fewer inputs than modern varieties, lowering production costs (Ficiciyan *et al.,* 2018; Jarvis *et al.,* 2011). In the present situation, food security is dependent on a limited number of crop varieties. Overreliance on a few varieties over time may lead to vulnerability (Magar *et al.,* 2020). A condition like the situation of food insecurity may occur when the farmers become unable to apply the required inputs and hybrid seeds are unavailable. At the same time, due to over reliance on intensive agriculture, traditional crops like finger millet, naked barley, Amaranths, Foxtail millet etc. may become extinct.

Despite having these larger benefits, there are also several glitches associated with the production of local indigenous crops. The production trend of indigenous crops is decreasing gradually, due to the unavailability of local crops in the market owing to a decrease in production area and people parting with the cultivation and production (Mbhenyane, 2017). According to Kanagasabapathi and Sakthivel (2016), production associated with local crops is poor access to seed, low yield, low rainfall, less effective marketing of produce, exploitation of middlemen in product marketing, poor agricultural knowledge, no required support from extension workers, etc. Post-harvest management of the crops and various methods used in disease and pest management are not effective, whereas farmers have already forgotten the traditional practices of crop management (Aryal *et al.,* 2017; Ghimire *et al.,* 2017). The migration of individuals seeking a better life has resulted in a decline in crop cultivation in the mountainous region, leaving only elderly people, women, and children to tend to the land. Thus, it is necessary to study the farmers' practice of indigenous crop cultivation in higher elevation regions so that crop production can be increased with an increase in productivity and crop cultivation areas. Indigenous cultivation practices and cropping patterns of local crops followed by farmers need to be addressed to get rid of the associated problems. With this upbringing, this paper highlights the production status of indigenous crops, the trend of cropping patterns and farmers' indigenous cultivation practices in upper region of Humla district.

METHODOLOGY

Study area:

Humla district is situated in the north-western part of Nepal and is the second-largest district in Nepal, covering 5,655 km (DAO Humla, 2022). Simikot Rural Municipality (RM) and Namkha RM of Humla districts were purposively selected as a study area. The altitude of these rural municipalities is higher than 3000 meter above sea level and predominantly farming of local crops.

Data collection:

The primary data was collected through the reconnaissance survey. Data were collected from the households of 52 farmers from Namakha RM ward 1 and Simikot RM ward 3, 4, and 7. The respondents were interviewed face-to-face, and the timing of interview was primarily

based on the farmers' convenience. Regular checking and validation of the data collected were done immediately after the completion of the interview with each of the respondents. Two focus group discussions were also completed for the collection of additional information and to validate the data collected. The secondary information was obtained by reviewing the different publications related to cropping patterns and value-added practices of major commodities from the District Agriculture Office, Humla, and other web portals.

Methods and techniques of data analysis

The collected data was organized and analysed using the computer software packages STATA-14 and MS Excel. Quantitative and qualitative data analysis methods were used in the study. Under quantitative analysis, descriptive analysis and inferential analysis were done.

Multiple linear regression

Multiple linear regression has been used as a tool to study the socio economic factor responsible for on-farm crop diversity (Maru *et al.,* 2022).

A multiple linear regression equation can be written as;

$y = \beta0 + \beta1x1 + \beta2x2 + \beta3x3 + ... + \beta nxn + \varepsilon$

where y is the dependent variable, x1, x2, x3, ..., xn are the independent variables, β0 is the intercept, β1, β2, β3, ..., βn are the coefficients for each independent variable, and ε is the error term.

Here, dependent variable is richness of on-farm crop (number of local crops), independent continuous variables are; age of respondent, family size, irrigated land, total production, total income and independent categorical variables are; gender (Male=1, Female=0), Caste (Chhetri=1, Ethnic=0) and family type (Joint=1, Nuclear=0).

RESULT AND DISCUSSION

Land holding

In terms of land holding size, the average land holding was 6.95 Ropani per household out of which 2.23 Ropani of land were irrigated as shown in Table 1. It means that most of the land remains unirrigated for some months in a year.

Table 1. Details of land holdings of farmers

Land	Namkha	Simkot			Average Total
	1	3	4	7	
Average of total land *(in Ropani)*	11.22	9.8	6.04	2.36	6.95
Average area of Irrigated land *(in Ropani)*	1.44	3.8	2.47	0.82	2.23

Crop production

While analysing the result for agricultural production and sales of different crops, it was found that the most of the households cultivated beans followed by buckwheat, potato and barley respectively. Amaranths were the least cultivated item, followed by foxtail millet. In terms of production quantity, buckwheat had the highest production, followed by potato and beans. It indicates that the area for buckwheat production was highest in the study site.

But the study showed that potatoes were the most sold item, followed by beans and wheat. While, barley, finger millet and porso millet were least sold in the market, amaranths and foxtail millet were not sold at all by household of study site. The study revealed that local potato is most commercialized among the indigenous crops. Interestingly, the production of millet was also high and cultivated by many of them, but very few people sold them as shown, in Table 2.

Table 2. Crop production (average) details

Crops	No of respondents	Sum of total production (Kg)	Average production per HHs	Number of HHs selling	Sum of Selling amount (Kg)	Average selling amount (Kg)
Amaranth	2	65	33	0	0	0
Barley	49	8260	169	3	90	2
Beans	52	10360	199	22	1780	34
Buckwheat	51	14410	283	4	220	4
Finger millet	48	6115	127	4	90	2
Foxtail millet	4	160	40	0	0	0
Porso millet	43	4459	104	2	100	2
Potato	50	13375	268	19	2275	46
Wheat	48	8930	186	13	740	15

Cropping pattern

Local indigenous crops were rotated with the local crops and other major crops in the farmer's field. The study showed that the unique characteristic of cropping pattern in the study area is the production of single crop in a year due to the frost winter. Only few farmers were started to adopt plastic house for production of leafy vegetables in winter season. The crop rotation and cropping pattern of indigenous crops were found to be as following table (Table 3).

Table 3. Crop pattern and rotation of major crops

SN	Crop	Crop Rotation
1		Finger millet + foxtail - Wheat/Barely - Fallow- Finger millet (2 yrs)
	Finger millet	Finger millet+ amaranth - Fallow - Finger millet/ Buckwheat (1.5 years)
2		Buckwheat - Wheat/barley - Fallow- Buckwheat (2 years)
	Buckwheat	Buckwheat- Fallow- Foxtail (1.5 years)
3		Foxtail millet + amaranth - wheat/Naked Barley- Fallow- foxtail (2 years)
	Foxtail millet	Foxtail millet - Fallow- potato (1.5 years)
4		Potato +Raddish +bean- wheat/barley- Fallow –potato (2 years)
	Potato	Potato +Raddish +bean- Fallow - Bean (1.5 years)
		Bean –Wheat/Naked barley - fallow-Bean(2 years)
5	Bean	Bean- Fallow - Amaranth
		Amaranth + Finger millet - wheat/barley- Fallow- Amaranth (2 years)
6	Amaranth	Amaranth- Fallow -Porso millet
		Porso millet - Wheat/barley - Fallow- Porso millet (2 years)
7	Porso millet	Porso millet –Fallow- potato (1.5 years)
	Wheat/ Naked	wheat/Naked barley - Fallow - potato + Radish/foxtail/buckwheat/finger millet/ porso millet/Amaranth (2 years)
8	Barley	Wheat/Naked barley/Barley - Buckwheat- Wheat/Naked barley/Barley (1.5 year)

From the study, most of the local crops were found to be cultivated in the months of Baishak and Jestha and harvested in the months of Bhadra and Ashwin. A similar result was observed by Ghimire *et al.* (2017) because most of the crops are rainy season and summer crops. Due to lack of year-round irrigation facilities and appropriate temperatures in mountain areas, extensive cultivation is not feasible. Moreover, due to frost winter, the planted wheat and naked barley overwintering under soil and overcome from soil surface with melting snow in spring and finally ready to harvest in month of Jestha- Shrawn.

Wheat (*pabai*) was found to be the crop with the highest crop duration (300-320 days), followed by Naked barley (195-210 days). The lowest crop duration days were found in buckwheat (90-110 days) (Table 4). The period for crops to grow in mountain regions takes longer time for crops to mature (Paudel, 2016).

Table 4. Sowing and harvesting time of crops

Crop	Sowing time (month)	Harvesting (month)	Crop Duration: *Days*
Summer crops			
Finger millet	Chaitra- Baishakh	Ashoj- Kartik	160-180 days
Foxtail millet	Baishakh-Jestha	Ashoj- Kartik	140-160 days
Porso-millet	Baishakh-Jestha	Ashoj- Kartik	140-160 days
Amaranths	Baishakh-Jestha	Bhadra -Ashoj	120-130 days
Bean	Baishakh-Jestha	Ashoj- Kartik	110-120 days
Potato	Baishakh-Jestha	Ashoj- Kartik	95-120 days
Buckwheat	Jestha-Ashar	Ashoj- Kartik	90-110 days
Winter crops			
Naked Barley	Kartik- Mangsir	Jestha-Ashar	195-210 days
Wheat (*pabai*)	Kartik- Mangsir	Shrawan-Bhadra	300-320 days

Cultivation practices

Seed management practices

Ninety-eight percent of people were found to be using local seed treatment methods, and 96 percent were using only high-quality seeds for sowing. Only 8% of respondents admitted to using drought-tolerant seeds in their fields, despite the fact that 75% of people used local seeds for sowing. There were no cases of people using chemicals for seed treatment, and also no practice of exchanging seeds or purchasing good seeds from the market after a few years of continuous use (Table 6).

Chemicals for seed treatment are either prohibitively expensive or unavailable to Nepal's resource-poor farmers (Amgai *et al.,* 2009). There was no practice of using chemicals for seed treatment and seed replacement. Almost all the people were using local methods for seed treatment. When compared to chemical treatments, these local methods are similarly successful (Singh & Singh, 2000).

Agronomic management

According to the survey results, 98 percent of people use seed broadcasting methods, hand weeding methods, and local seed as an agronomical management practice. Only 6% of the people were found to have adopted roughing practices, while 8% had adopted line sowing practices. No one was found to have used mulching practices, or neither of them followed cover crop cultivation practices. All of these three practices come under traditional

farming practices (Table 5). Broadcasting and hand weeding were done along with mixed farming as an agronomic practice. The majority of farmers are using traditional technology in their production systems due to a lack of investment capacity, infrastructure, and market opportunities (Shrestha, 2012).

Table 5. Seed management and Agronomical practices

Seed managements	Response (%)	Agronomical practices	Response (%)
Seed treatment by local method	98	Seed broadcasting	98
Use of drought tolerant seeds	8	Line sowing	8
Use of cold tolerant seeds	83	Hand weeding	98
Use of local seeds	75	Use of local seeds	98
Use only goods seeds (sorting)	96	Practice roughing	6

Nutrient management

Only five practices were found to be used: FYM (96%), compost manure (2%), green manure, crop rotation practices, and the use of locally prepared manures. In total, 96 percent of the people used FYM for nutrient management, with 94 percent also using crop rotation practices. 2% used compost manure, 4 used locally prepared manure, and 6% used green manure (Table 6). In Nepal's subsistence upland farming system, FYM and compost are the major sources of plant nutrients and organic matter for the soil (Shrestha, 2009). Due to manpower shortages and decreased pasture lands and landholdings, the availability of FYM and compost has been steadily decreasing (Paudel & Thapa, 2001).

Water and moisture management

It was found that only 3 sources were available for irrigation. 83 percent of the people were using rivers and streams for irrigation sources, followed by 6 percent of the people using household wastewater, and 4 percent were using drip irrigation as shown in Table 6.

Table 6. Nutrient and Water Management practices

Nutrient Management Practices	Response (%)	Water Management Practices	Response (%)
Use of FYM	96	Canal method	0
Use of Compost manure	2	Rive/steam	83
Use green manure	6	Ponds	0
Crop rotation	94	Drip irrigation	4
Use manure prepared in local level	4	Use household waste water	6

Insect pests and post-harvest management

Crop rotation was found to be used by 90% of people for controlling insects and pests. Similarly, 29 percent of people used cow urine to control insects and pests, and another 15 percent picked insects and pests by hand. None of them were found to have used bio-pesticides, insect repellent plants or chemical pesticides to control insects and pests. For the post-harvest management, 96 percent of the people sun-dried the products for preservation and 94 percent buried agricultural products under soil. Only 10% of people used Bhakari for grain storage. Only 2% of people used chemicals to reduce storage damage (Table 7).

Table 7. Pest management practices and Post-harvest management practices

Pest Management Practices	Response (%)	Post-harvest management Practices	Response (%)
Use of Lure	4	Use chemical for storage	2
Use of bio-pesticide	0	Use plastic bags	6
Use of cow urine	29	Buried in soil	94
Use of repellent plants	0	Use Bhakari to store	10
Crop rotation	90	Use traditional methods	6
Use chemical pesticides	0	Sun drying before storing	96
Hand picking	15		
Use insect net	2		

For the reduction of post-harvest losses, people used storage drums or bins for the storage of beans, while some other agricultural products, such as buckwheat, barley, Foxtail millet, Porso millet, finger millet, potato, and wheat, were found to have been buried under soil for long-term preservation. Storage accounts for the most losses among post-harvest processes (Mobolade *et al.,* 2019).

Determinants influencing on farm crop diversity

To identify the factor influencing the diversification of on-farm crop of Humla district, the multiple linear regression model was used. The R^2 value shows 44.4% of the outcome is explained by the selected variables. The value Prob>F= 0.0007 indicates model is significant at 1% level as shown in table 8. The multiple linear model showed five variables statistically significant for richness of on-farm crop. Gender, farmer's age, caste, family size and total crop production were found statistically significant at 1% level of significance.

Gender of the farmer and on-farm crop diversity has positive relation which indicates that male have higher role in maintaining on-farm crop diversity it might be due to farming experience and traditional knowledge. Farmer's age and on-farm crop diversity has positive relation with increasing of age, people gains more experience about the farming practices. Caste and on-farm crop diversity has negative relation which indicates that the on-farm crop diversity is higher on ethnic group compared to chhetri group which is also suggested by Pandey (2015) that ethnic groups maintain higher crop diversity. Family size and on-farm crop diversity has positive relations as family members support in different intercultural operations which is also suggested by Maru et al. (2022) & Gauchan et al. (2020). Total crop production and on-farm crop diversity has positive relation which indicates that higher crop diversity leads to higher crop production which is also suggested by Stefan *et al.* (2021).

Table 8. Factor determining richness of on-farm crop diversity

Variables	Coefficient	Standard error	p-value
Gender	0.612**	0.237	0.014
Farmer's Age	0.019**	0.008	0.027
Caste	-1.205**	0.284	0.000
Family type	0.505	0.538	0.353
Family size	0.092**	0.040	0.028
Irrigated land	-0.033	0.027	0.235
Total crop production	0.0004**	0.0001	0.000
Total income	0.0002	0.0004	0.491
Constant	5.790	0.602	0.000
Number of observations	52		
Prob> F	0.0007		
R-squared	0.444		
Adj R-squared	0.34		

CONCLUSION

From the study, it can be concluded that most of the farmers from the study area are small farmers and grow different crops like beans, buckwheat, porso millet, finger millet, potato etc. as major crops in their localities. Their major sources of income from the crops were found to be beans, potatoes, and buckwheat. Their food production was also not enough for them, and they had to find other alternatives for their survival. These things need to be addressed by the responsible governmental bodies and other like-minded organizations working in those areas. In the study area, cropping pattern shows that only one crop production in a year is possible. Which result in low cropping intensity and ultimately low income for the farmers. Thus, agriculture programs show focus on increasing cropping intensity by introduction of new technology or innovations to sustain the on-farm crop diversity. From the study report, it can be concluded that farmers are not familiar with modern seed management practices and are still following traditional agronomic practices. The pest management practices of the farmers are also found to be poor. Crop rotation at some levels can reduce pest infestation, but what they are adopting is by default. It has happened unknowingly. Thus, it is important to provide them with extension services related to crop management agronomic practices along with pest management. Since the Karnali province has been declared an organic province, they should be given the safest techniques for crop agronomic practices and pest management.

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