Research Article:

DETERMINANTS OF FOOD SECURITY AMONG CHEPANG HOUSEHOLDS IN CHITWAN, NEPAL

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ABSTRACT

Chepang, a marginalized indigenous community in Nepal, faces significant socio-economic challenges contributing to food insecurity and malnutrition. This study assesses the food security status and its socio-economic determinants at household level of Chepang community in Ichchhakamana Rural Municipality, Kalika Municipality, and Rapti Municipality of Chitwan. A total of 87 samples were selected using purposive and random sampling techniques with 29 from each selected local level. A mixed-methods approach was used, combining quantitative surveys and qualitative methods including household surveys with semi-structured questionnaire, key informant interviews, and focus group discussions. Data were analyzed using descriptive statistics, food consumption scores for assessing food security status and an ordered logistic regression model to quantify food security based on socio-economic determinants. The results reveal that 23% of households experience food insecurity, 59% are in vulnerable position and only 18% are food secure. Family size, household head education level and annual household income contribute positively and significantly to food security. Coping strategies are mainly relying on wild edibles (41.4%) and wage labor (26.4%). The findings underscore the need for targeted interventions addressing education, income diversification, infrastructure development and land rights to enhance resilience in this socio-economically disadvantaged community. Tailored government programs addressing these areas can significantly improve food security among the Chepang community and contribute to sustainable food systems.

सारांश

नेपालको एक सीमान्तकृत आदिवासीको रुपमा परिचित चेपाङ समुदायले खाद्य असुरक्षा र कुपोषण निम्त्याउने महत्वपूर्ण सामाजिक तथा आर्थिक चुनौतिहरूको सामना गरिरहेका छन्। यस अध्ययनले पारिवारिक तवरबाटै चितवन जिल्लाका तीन स्थानीय तहः कालिका नगरपालिका, इच्छाकामना गाँउपालिका र राप्ती नगरपालिकामा अवस्थित चेपाङ समुदायको खाद्य सुरक्षाको स्थिति र यसका सामाजिक-आर्थिक कारक पत्ता लगाउन खोजेको छ। हरेक स्थानीय तह बाट २९ ओटा नमूना उद्देश्यपूर्ण तरिकाले कुल ८७ नमूना पुर्‍याइएको छ। मिश्रित विधि अन्तर्गत परिमाणात्मक विधि र गुणात्मक विधिको समिश्रण प्रयोग गरियो जसमा घरधुरीको अर्धसंरचित प्रश्नावलीद्वारा अन्तर्वार्ता, समूह केन्द्रित छलफल र मुख्य सूचनादाताको अन्तर्वार्ता समावेश गरिएको थिए। विस्तारात्मक तथ्यांकको प्रयोगबाट संकलित तथ्यांकको विश्लेषण गरियो । खाद्य सुरक्षा स्थितिको आँकलन गर्नको लागि खाद्यान्न खपत प्राप्ताकहरू र सामाजिक-आर्थिक निर्धारकको लागि अर्डरड लजिट मोडेलको प्रयोग गरी विश्लेषण गरिएको थियो । यो अध्ययनको नतिजाले २३% घरपरिवारले खाद्य असुरक्षाको अनुभव गरेको, ५९% जोखिममा रहेको र केवल १८% मात्र खाद्य सुरक्षित रहेको देखाएको छ। परिवारको आकार, घरमूलीको शिक्षा स्तर र वार्षिक घरपरिवारको आम्दानीले खाद्य सुरक्षामा सकारात्मक र उल्लेखनीय योगदान पुर्‍याउँछ । खाद्य असुरक्षा सामना गर्ने रणनीतिहरू मुख्यतया जंगली खाद्य पदार्थको खपत (४१.४%) र ज्यालादारी श्रम (२६.४%) मा निर्भरता रहेका छन्। यस सामाजिक-आर्थिक रूपमा विपन्न समुदायमा लचिलोपन बढाउन शिक्षा, आय विविधीकरण, पूर्वाधार विकास र भूमि अधिकारलाई सम्बोधन गर्ने लक्षित हस्तक्षेपको आवश्यकतालाई जोड दिनु पर्ने देखिन्छ। यी क्षेत्रहरूलाई सम्बोधन गर्ने अनुकूलित सरकारी कार्यक्रमहरूले चेपाङ समुदायको खाद्य सुरक्षामा उल्लेखनीय सुधार गर्न र दिगो खाद्य प्रणालीमा योगदान पुर्‍याउन सक्ने विश्वास राख्न सकिन्छ।

INTRODUCTION

Food security is needed to ensure people have access to sufficient, safe, and nutritious food for a healthy and active life with availability, accessibility, utilization, and stability being necessary conditions (FAO, 1996; Ville et al., 2019). Food security is essential for countries to meet the Sustainable Development Goals (SDGs) as it negatively affects human development and planetary health. Significant advancements have been made, yet food insecurity remains a critical global issue impacting millions (Mc Carthy et al., 2018; Pérez-Escamilla, 2017). There is still a lack of access to sufficient nutritious and safe food for billions of people. Global hunger persists as a serious concern with 8.9 to 9.4% of the global population experiencing undernourishment in 2023. Asia has the largest number with 384.5 million people affected (FAO, IFAD, UNICEF, WFP and WHO, 2024). Household food insecurity is a serious public health concern in some developed countries, affecting 8 to 20% of the population (Pollard & Booth, 2019). Two major causes of food insecurity in advanced nations are economic inequality and neoliberalism (Long et al., 2020). Inequality is closely associated with household food insecurity, and current social protections are inadequate (Pollard & Booth, 2019). Food insecurity is negatively associated with health outcomes, such as an increased likelihood of poor health and an increased likelihood of asthma in children and seniors (Gundersen & Ziliak, 2015). Female-headed households, the poor, and the less formally educated suffer more food insecurity during the COVID-19 pandemic (Dasgupta & Robinson, 2021).

Nepal is predominantly an agrarian country where diverse ecological belts and cultural practices shape food security and subsistence patterns (Chemjong & Yadav, 2020). Food security has improved for much of Nepal's population. Though 13% still face moderate to severe insecurity with higher rates among rural residents at 16% compared to 11 % in urban areas (MoHP, 2022). Nepal has a moderate level of hunger with a Global Hunger Index (GHI) score of 14.7 in 2024 ranking 68th among 127 countries (Grebmer et al., 2024). Food insecurity among low-income and disadvantaged families in Nepal increased during the COVID-19 pandemic, affecting their health and well-being (Singh et al., 2021). Food insecurity in Nepal is a primary factor driving malnutrition particularly affecting vulnerable groups like children and pregnant women (Koirala et al., 2024). Food insecurity indicates a heightened vulnerability to various consequences including psychosocial issues in children, family-related problems, and overall poor health at the household level (Chemjong & Yadav, 2020). Transitioning between food security and food insecurity has a significant and lasting effect on cognitive function and behavior in children (Gallegos et al., 2021). Food insecurity and poor dietary diversity among lactating mothers in Nepal are associated with higher odds of dietary monotony and lower monthly family income (Singh et al., 2020). A suite of policy tools tailored to local contexts may be more effective in addressing food insecurity in Nepal than broad-brush national policies (KC & Race, 2019). Connecting food-insecure households to existing social services and multi-sector partnerships can help reduce food insecurity (Joshi et al., 2019). A household's food security status is influenced by factors like the education of the household head, household head's gender, the annual income of the household, and inflationary pressure (Mahmood et al., 2023).

Chepangs also known as *Praja* are one of the primitive communities of Tibeto-Burman ethnic groups living on highlands with rugged terrain at the elevation of 800-1500 meters (Rijal, 2010). Malnutrition remains a historical issue for the Chepang, escalated by rising populations, limited arable land, and scarce irrigation options, despite access to forest supplements (Adhikari, 2023). The Chepang are primarily settled in Central Nepal, mainly in Makwanpur, Dhading, and Chitwan of Bagamati Province, as well as in the Gorkha district of Gandaki Province, totaling a population of 84,364 (Adhikari, 2021). The majority of the Chepang population totaling 35,637 (42.24%), resides in the Chitwan district (NSO, 2023). Over the past century, Chepang's

livelihoods have evolved from a hunting-based lifestyle to shifting cultivation and, ultimately to settled subsistence farming (Piya & Joshi, 2018). Climate change is causing more frequent disasters and erratic, heavier rainfall, making livelihood management increasingly difficult for Chepang and other marginalized communities. Chepangs are facing significant chronic food security challenges and living in areas prone to various shocks and risks. Their own produce Maize and Millet suffice only for 6 months due to less productive land and inadequate farming knowledge (Chetry et al., 2018). With insufficient agricultural produce to sustain them year-round, they frequently forage for edible fruits in nearby forests (Sharma & Aryal, 2016). Their adopted key coping strategies include engaging in unskilled wage labor, gathering, consuming, and selling forest foods and products, selling livestock, borrowing funds, and adjusting consumption habits (Gurung, 2022). Approximately 68.2% of Chepang households endure food insufficiency for about six months each year (Ghimire, 2018). Female-headed households are more food insecure than male-headed households in the Chepang community (Joshi, 2016). Growing cereals and legumes alongside livestock improved food availability and nutrition for Chepang women and children. Only a few Chepang households are fully self-sufficient (Gurung, 2022). Additionally, the livelihoods of Chepang communities have been endangered due to forest policies that impose limitations on the use of forests (Bhattarai, 2022).

Being food-secure improves health, enhances economic stability and livelihoods, fosters social cohesion, and builds resilience against climate change impacts. While the food security dynamics in Chepang livelihoods have been explored (Gurung, 2022; Shrestha, 2019), there is limited empirical evidence on the household level food security and the socio-economic variables influencing it, which this study seeks to address. In this regard, this study was conducted with two-fold objectives. First is to determine the household food security status and second is to identify the drivers of food security along with the coping strategies at household level of Chepangs. Gaining knowledge of food insecurity drivers of Chepang households will help to develop strategies and policies at the household level to ensure food security. Awareness campaigns, community-led initiatives, and other interventions will be strengthened.

RESEARCH METHODS

Study area

The research was conducted in the Chitwan district, indeed located in the southwestern corner of Bagamati Province, Nepal, positioned approximately at 27°35′N latitude and 84°30′E longitude. It has an area of 2,218 km² with a population of 719,859. One ward from each of the three local levels in Chitwan district was selected for the study, based on the predominant Chepang population in the northern hilly region: Ward 7 of Ichchhakamana Rural Municipality, Ward 9 of Kalika Municipality, and Ward 10 of Rapti Municipality. Most of their settlements are located at elevations exceeding 800 meters above sea level (masl), reaching up to 1,920 masl (Piya et al., 2013). Fig. 1 depicts the map of Nepal including the study area.
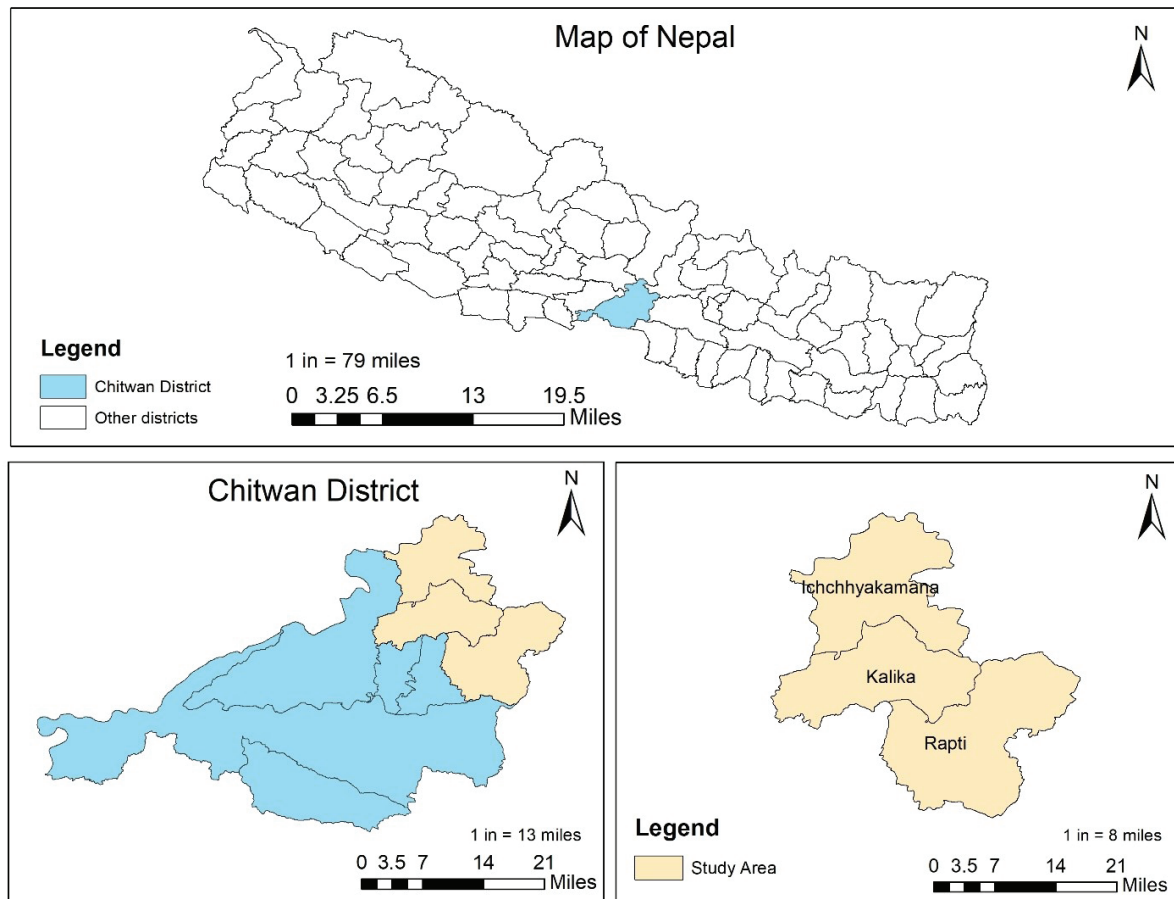
Source: Arc GIS 10.8

Fig. 1. Map showing the study area within the Chitwan district of Nepal

Sampling procedure

In this research, purposive sampling technique was employed to effectively capture the diverse experiences of the Chepang community in the Chitwan district. The study first identified Chitwan as the focal area due to its significant Chepang population. It was followed by selecting two municipalities (Kalika and Rapti) and one rural municipality (Ichchhakamana) known for their predominant Chepang demographics. Chepang-dominant wards were identified within these local levels, and dense clusters of settlements within those wards were chosen. This approach ensures that various subgroups of the Chepang community are adequately represented, minimizing sampling bias and enhancing the reliability and validity of the research findings.

Sample size

The formula given by Cochran (1963) was employed to estimate the sample size for this study i.e.

$$n = \frac{Z^2 pq}{e^2} \quad (1)$$

Here, n is the estimated sample size, Z is the Z-value giving the desired confidence level, p is the estimated population proportion with the characteristic, and e is the error margin. Since most of the population in selected wards falls within the Chepang community, this formula is appropriate for determining the sample size.

A 95% confidence level with a population proportion of 0.5 and a margin of error of 0.105 was chosen to ensure reliable results while keeping the sample size feasible given the small and hard

to reach geographically scattered indigenous Chepang population. The sample size was then calculated as follows:

$$n = \frac{1.96^2*0.5*0.5}{(0.105)^2}$$

$$= 87$$

After estimating a sample size of 87 to represent the Chepang community across the local levels of Rapti, Kalika, and Ichchhakamana, an equally representative sample of 29 participants from each level was allocated in a disproportionate manner. A simple random sampling method was used to select the sampled household for the interview schedule.

Source of information
Both primary and secondary sources were used as information sources. The interviews were conducted from February to April 2024. Primary data was collected through a household survey using a semi-structured questionnaire administered via the Kobo Collect mobile application, which was pretested on 10 % of the sample (9 samples). One Focus Group Discussion (FGD) and one Key Informant Interview (KII) were conducted at each level of three local bodies. The KIIs provided important insights from key stakeholders while the FGDs served to validate the collected data.

Secondary data for this research was sourced from government publications, academic journals, and NGO reports, providing relevant insights into the community's socio-economic conditions and food security status.

Data analysis
The qualitative and quantitative data collected from Household Surveys, Key Informant Interviews (KIIs), and Focus Group Discussions (FGDs) were entered into MS Excel, followed by data sorting, cleaning, and coding. Stata (v 17) was used to analyze the final data using both descriptive statistics and inferential statistics tools.

Food security assessment
The Food Consumption Score (FCS) serves as a valuable metric for evaluating the variety of food groups that households consume within a specific timeframe. This measure is commonly utilized by the World Food Programme (Mujeyi et al., 2021) and plays a crucial role in assessing dietary diversity as part of food security evaluations. It assesses dietary diversity and food frequency through a 7-day recall method, where respondents report the consumption frequency of eight food groups: cereals, pulses and nuts, vegetables, fruits, meat and fish, dairy products, sugar and honey, and fats and oils.

Table 1. Food group classification and corresponding weights for FCS calculation

Food Groups	Weight
Main staples (cereals, tubers)	2
Pulses (beans, lentils, peas)	3
Vegetables	1
Fruits	1
Meat and fish (including poultry, and eggs)	4
Milk and dairy products	4
Sugar	0.5
Oils and fats	0.5

Source: World Food Programme (WFP, 2015)

Each food group's frequency is multiplied by a designated weight, and the total scores are summed to generate the FCS (Carletto et al., 2013). This score is then categorized using standard cutoff values to indicate food security levels.

$$FCS = \sum y_i f_i \ (2)$$

where,
FCS = Food Consumption Score
y_i = food groups
i = assigned weight reflecting each group's nutritional value
f = frequency with which households consumed these food groups over the previous week

Table 2. Decision table for food security status based on Food Consumption Score (FCS)

Food Consumption Score (FCS) range	Profiles	Food Security Status
0-21	Poor food consumption	Food Insecure
21.5-35	Borderline food consumption	Vulnerable
> 35	Acceptable food consumption	Food Secure

Source: World Food Programme (WFP, 2015)

Only the acceptable food consumption profile having households was considered food secure while the rest of the profiles were categorized as food insecure in this study.

Specification of the empirical model

Food security status resulted to the ordered variable outputs based on food consumption scores (categorized as (0 - Food Insecure, 1- Vulnerable & 2 – Food Secure) for which an ordered logit model (proportional odds model) was employed to identify the key determinants affecting it. The model specification for likelihood of being in food secured level following (Agresti & Natarajan, 2001) is represented as follows:

$$\Pr\left(Y = \frac{C}{X_i}\right) = F\ (CX_i\ \beta)\ (1)$$

where Y is the food security status output, F denotes the standard logistic cumulative function and X refers to set of independent variables. In this study, 7 independent variables were used to estimate ordered logit model using the formula as follow:

$$PY_i > j = \frac{\exp(x_i\ \beta - j_j)}{1 + [\exp(x_i\ \beta - j_j)]}, j = 1, 2 \ldots M\text{-}1, \text{ implying}$$

$$P(Y_i = 1) = 1 - \frac{\exp(x_i\ \beta - j_j)}{1 + [\exp(x_i\ \beta - j_j)]}\ (2)$$

$$P(Y_i = j) = \frac{\exp(x_i\ \beta - j_{j-1})}{1 + [\exp(x_i\ \beta - j_{j-1})]} - \frac{\exp(x_i\ \beta - j_{j-1})}{1 + [\exp(x_i\ \beta - j_{j-1})]}, j = 2, \ldots M\text{-}1, \text{ which implies}$$

$$P(Y_i = M) = \frac{\exp(x_i\ \beta - k_{m-1})}{1 + [\exp(x_i\ \beta - k_{m-1})]}\ (3)$$

When M=2 is used, these equations become:

$$P(Y = 0) = \frac{1}{1 + [\exp(z_i - k_j)]}\ (4)$$

$$P(Y = 1) = \frac{1}{1 + [\exp(z_i - k_2)]} - \frac{1}{1 + [\exp(z_i - k_j)]}\ (5)$$

Using the Z value and assuming a logistic distribution for the error term, the ordered logistic model can estimate the probabilities that the latent variable Y^* falls within specific threshold intervals (Williams, 2016). Equation (1) as seen above can be empirically specified as below in equation (6).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_i X_i + \varepsilon \quad (6)$$

where,

Y = food security status

X = independent variables (explained in table 3)

β_0 is the intercept term,

$\beta_1, \beta_2 \ldots \ldots \beta_i$ are the coefficients associated with each predictor variable $X_1, X_2 \ldots \ldots X_i$

= error terms

Table 3. Variables with their expected signs

Variables	Description	Value	Expected sign
Predicted variable			
Food Security Status	Level of Household food security	Ordinal scale (0-food insecure, 1- vulnerable, 2- food secure)	±
Predicted variables			
HHAge	Age of household head	Years	
HHGender	Gender of the household head	1= Female, 0= otherwise	±
HHEducation	Education level of the household head	0 = Illiterate (base), 1 = Primary level, 2 = Secondary level	±
lnIncome	Income of the household	Log form	±
Family size	Number of family members within household	Number	±
Land size	Total land holdings	Kattha (1 hectare = 29.53 kattha)	±
Monthly savings	Savings of the household per month	1 = Yes, 0 = otherwise	±

Brant test for parallel regression assumptions

The ordered logistic regression model is based on the parallel regression assumption which means that the relationship between the independent and dependent variables is assumed to be the same across all categories. Brant test is used to test whether this parallel regression assumption holds (Brant, 1990).

$$\eta_j = \begin{cases} 1, \; if \; y > j, \\ 0, \; if \; y \leq j, \end{cases} \quad j = 0,1,2 \quad (7)$$

with success probability $\pi_j = P_r[\eta_j = 1] = 1 - \Upsilon_j$ satisfying logit $(\pi_j) = -a_j + \beta x'_i$

RESULTS AND DISCUSSION

Assessment of Chepang household food security status

The frequency of household consumption of food groups over the past week as recorded on the interview day was multiplied by their assigned weights to calculate the food consumption score. The data collected on the Food Consumption Score (FCS) across 87 households provides a measure of food security status and reveals important insights within the study population. The summary statistics for FCS show a mean score of 27.10 indicating moderate dietary diversity among households. It ranges from a minimum score of 11 to a maximum of 45, highlighting

disparities in food security and nutritional quality within the population warranting further investigation into contributing factors. Based on these scores, households were categorized into three FCS groups as shown in Table 4.

Table 4. Household food security status assessment using Food Consumption Scores (FCS)

FCS range	Frequency	Profiles	Food Security Status
0-21	20 (22.99)	Poor food consumption	Food Insecure
21-35	51 (58.62)	Borderline food consumption	Vulnerable
> 35	16 (18.39)	Acceptable food consumption	Food Secure

Note: Figures in the parentheses indicate the percentage

The majority of Chepang households (59%) remain in a vulnerable position regarding food security, highlighting that a significant portion of the population faces inadequate food access. Additionally, 23% of households are food insecure indicating severe challenges in meeting their food needs. These findings are in line with the study conducted by Getaneh et al. (2022). Food insecurity was most severe among resource-poor households, disadvantaged groups, and those with limited land and income (Karki et al., 2021). In contrast, only 18% of households are considered food secure reflecting that a small minority maintains an acceptable level of food consumption. Food crisis was more prevalent in the Chepang community, with only 36.65% having food self-sufficiency, compared to the non-Chepang community (Ghimire, 2018). Sharma and Aryal (2016) also reported that only 18.8% of the Chepangs has food suffice for all year around.

Socio-economic characteristics of the sampled households
A majority of households (70.11%) are headed by males, with females heading only 29.89% of households, indicating a gender disparity in leadership roles (Table 5). The average age of household heads is 44.32 years. In terms of religion, the population is almost evenly split with 54.02% identifying as Christian and 45.98% as Hindu.

Table 5. Description of categorical variables

Socio-economic variables	Frequency
Household Head Gender	
Male (0)	61 (70.11)
Female (1)	26 (29.89)
HHAge (years) (Mean ± SD = 44.32 ± 10.77)	
below 34 years	14 (16.09)
34-44	30 (34.48)
44-55	25 (28.74)
above 55 years	18 (20.69)
Religion	
Christian	47 (54.02)
Hindu	40 (45.98)
House-made with	
Bamboo	22 (25.29)
Mud and Stone	20 (22.99)
Mud + Bamboo	27 (31.03)
Concrete	18 (20.69)

Note: Figures in the parentheses indicate the percentage

The average age at marriage of household heads is 15.62 years, and the average family size is 5.40 members. The mean age of marriage of women in Chepang community is reported to be 16 years which is in line with this finding (Poudel & Khanal, 2020). On average, households own 6.31 kattha of land (including both legal and non-legal holdings) and have 1.47 employed family member. On average, near about 2 children from each household aged 6-18 have dropped out of school, primarily due to poverty, highlighting educational challenges within the community (Table 6).

Table 6. Description of continuous variables

Descriptive Variables	Mean
Household Head Age at marriage	15.62 (2.16)
Family size	5.40 (1.86)
Land size (kattha)	6.31 (3.33)
Number of family members employed	1.47 (0.71)
Annual Household Income (NRs.)	361931 (132441.6)
Monthly savings (NRs.)	7181.81 (3983.73)
Children dropout (6-18 age)	1.53 (1.60)

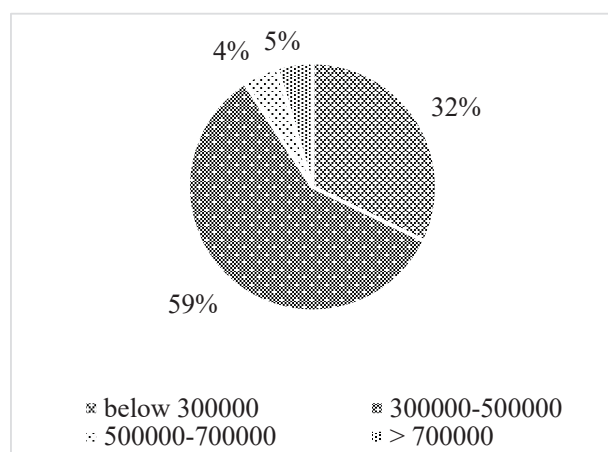Note: Figures in the parentheses indicate the standard deviation
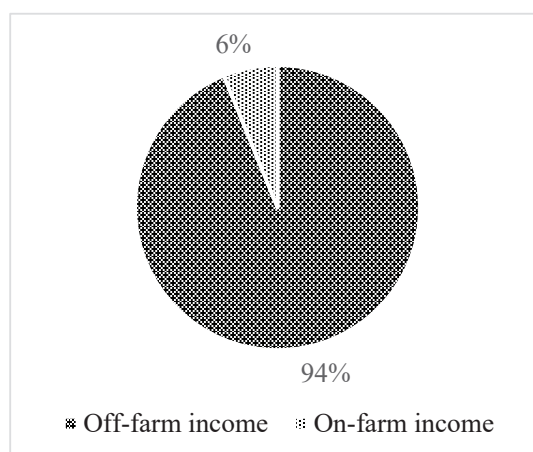

Fig. 2. Annual income of the household

Fig. 3. Annual income type

The annual income distribution of households shows that the majority (59%) earn between 500,000 and 700,000 per year, followed by 32% with incomes between 300,000 and 500,000. This distribution indicates that most households fall within the middle-income range, with fewer in the extreme income brackets. 94 % of the households reported it to be the off-farm income whereas only 6% claimed it to be the on-farm income source.

Distribution by education and land holding

This shows the distribution of household head educational attainment, with the majority (68.97%) being illiterate, followed by 22.99% with primary education, and only 8.05% reaching the secondary education level (Fig. 4). This indicates a significant prevalence of low educational attainment. Fig. 5 highlights household landholding types, with the majority (57.47%) having Ailaani land, meaning they lack proper legal ownership documents. This is followed by 27.59% with both types of land holding and only 14.94% possessing land with appropriate legal documentation.
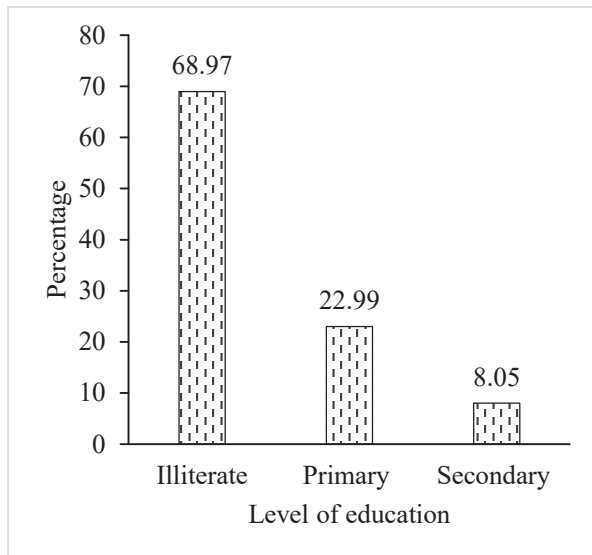
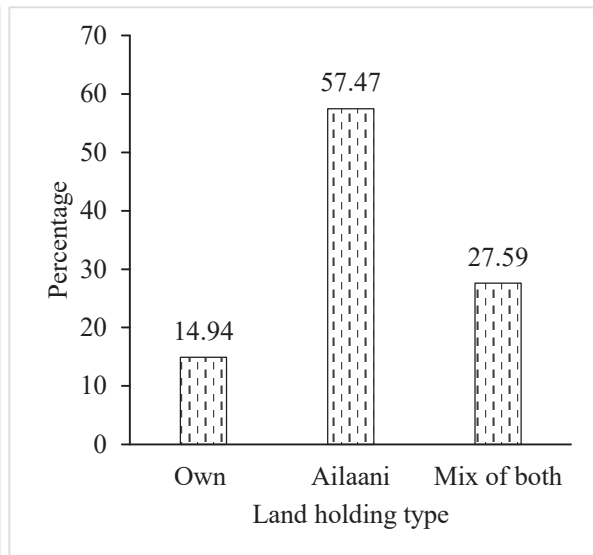**Fig. 4. Household head by education level**

Fig. 5. Households by land holding type

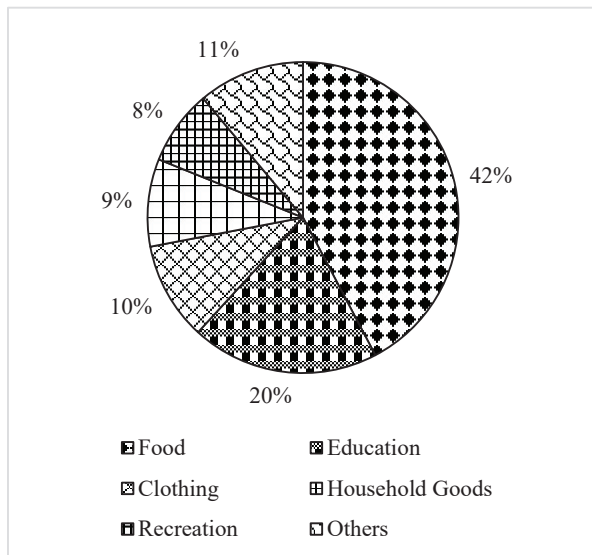**Expenditure pattern of the households**

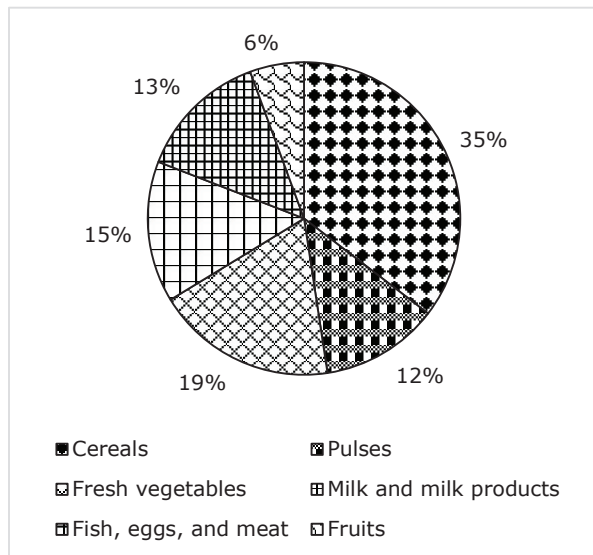**Fig. 6. Household expenditure distribution**

Fig. 7. Household food expenditure breakdown

Households allocate the largest portion of their budget to food (42%), with cereals making up the highest share (35%) of food expenses (Fig. 6 & Fig. 7). Discretionary spending on recreation (8%) and fruits (6%) remains relatively low, indicating a priority on basic needs over luxuries. Expenditure was poorly allocated for protein and fresh produce indicating limited nutritional diversity. The detailed monthly expenditure in overall and in food breakdown is presented in Table 7 and Table 8 respectively. Monthly food consumption is dominated by rice (40.80 kg), vegetables, and meat, reflecting a dietary focus on staple grains and protein (Table 9).

Table 7. Breakdown of monthly expenditure (NRs.)

Monthly Expenditure	Mean	Maximum
Food	13161.15 (3549.02)	25000
Education	2238.09 (1885.55)	6000
Clothing	1410.63 (1166.23)	5000
Household Goods	1753.62 (1079.70)	5000
Recreation	806.45 (904.72)	10000
Others	1740.38 (1098.54)	7000

Note: Figures in the parentheses indicate the standard deviation

Table 8. Breakdown of household's monthly expenditure (NRs.) on food

Monthly Food Expenditure Breakdown	Mean	Maximum
Cereals (Rice, Maize, Wheat)	7650.57 (3391.29)	18000
Pulses	631.25 (539.94)	2000
Fresh vegetables	677.27 (785.01)	3000
Milk and milk products	262.16 (419.06)	1800
Fish, eggs, and meat	3343.67 (1600.63)	7500
Fruits	334 (516.11)	2500

Note: Figures in the parentheses indicate the standard deviation

Table 9. Breakdown of household's monthly food consumption

Monthly Food Consumption	Mean	Maximum
Rice (kg)	40.80 (18.86)	125
Maize (kg)	3.77 (3.78)	30
Wheat (kg)	1.16 (1.56)	10
Pulses (kg)	1.94 (1.11)	5
Milk (liter)	3.09 (3.88)	15
Egg (pcs.)	25.08 (15.53)	60
Meat (kg)	5.89 (3.06)	15
Vegetables (kg)	7.87 (4.52)	21
Fruits (kg)	1 (1.17)	5

Note: Figures in the parentheses indicate the standard deviation

Access to drinking water and nearby market

51 % of the responding households use tap water while 49 % use stream water as a source of their drinking water. The majority of the households (92%) reported that they had a source of water on their premise whereas the rest (8 %) didn't. The most common range is 1-5 km with 45.98% of households, followed by 28.74% who travel 5-10 km to reach their nearby markets traveling moderate distances (Fig. 8). The most common mode of transportation to the ration shop is walking (63.22%), followed by walking plus bus/jeep (14.94%) and exclusive use of jeeps (12.64%) as shown in Fig. 9. About 75% of respondents reported the presence of NGO/INGOs addressing food-related issues, while 25% reported no such organizations in their area.
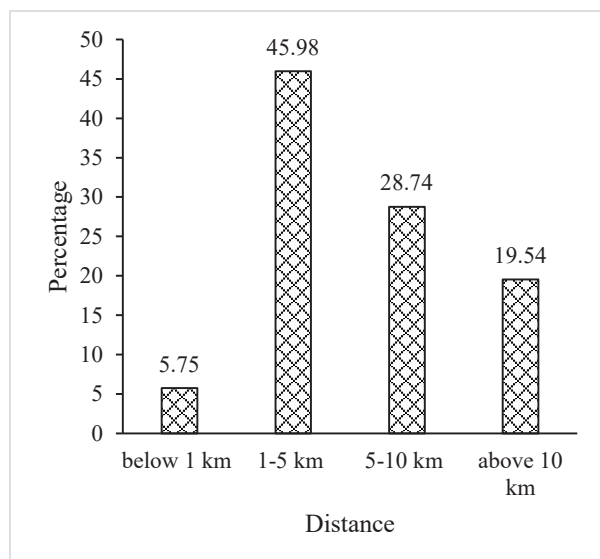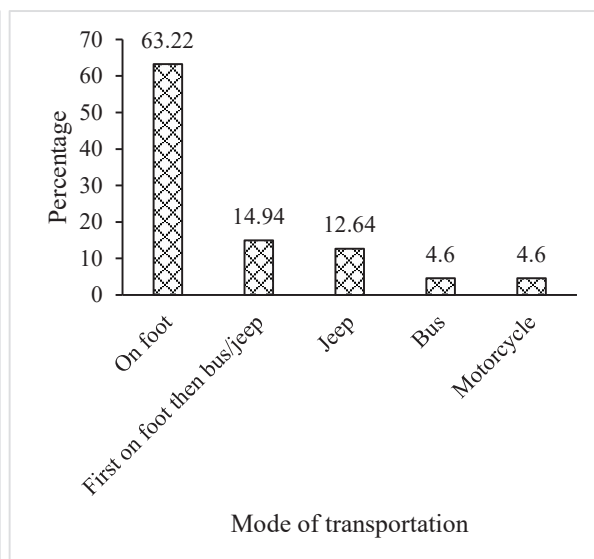
Fig. 8. Distance to the nearby market

Fig. 9. Transportation modes to reach the market

Socio-economic determinants of food security: estimates from logit model

The coefficient, odds ratio and marginal effects from the ordered logit model reveal key socio-economic determinants influencing the likelihood of the dependent variable (Table 10). Household head age, household head gender, land size and savings have no significant effect on food security status of Chepangs. Many studies report that household head gender is a significant contributor to household food insecurity, which contrasts with this finding (Kassie et al., 2014; Mustapha et al., 2018; Zhou et al., 2019). Female headed households were more food insecure than male headed households (Agidew & Singh, 2018). This is usually attributed to factors such as lower access to resources, income-generating opportunities, land ownership, and social support for women. Adeniyi and Ojo (2013) reported that household head age had a significant but negative effect on food security status, meaning that each unit increase in age reduced food security. Household head education level, family size and annual household income have statistically significant effect on Chepang household food security status.

Education and food security

The strong positive effect of higher education level (primary and secondary compared to illiterate) aligns with the consensus that education improves food security. Household with literate heads are more likely to be secure (Yovo & Gnedeka, 2023). The marginal effects suggest that household head having primary or secondary level of education reduces the probability of household being food insecure by about 15 % (dy/dx= -0.156) keeping other factors constant. Households with educated household heads are less likely to fall into the most insecure category. Households with higher-educated heads were more food secure, as each additional year of schooling had a direct positive impact on food security (Jabo et al., 2017). Agidew and Singh (2018) studied that educated households are more likely to engage in generating non-farm, enhancing farm efficiency, increasing yields, and improving food security. Female education is crucial as women are primarily responsible for food preparation and serving (Mango et al., 2014). Chepangs are mostly engagaed in unskilled labor work due to their low educational profile securing uncertain and lower source of income (Gurung, 2022).

Family size and food security

The positive and significant (at 1 %) coefficient for family size suggests that the larger households are associated with higher food security categories. Larger households tend to have more working members who can contribute labor and income, they are more likely to achieve better food security. The marginal effects suggest that unit increase in the household size of the family reduces the probability of household being food insecure by 4 % on average (dy/dx = -0.042), other factors remaining constant. Aryal et al. (2021) also reported that family size positively and significantly contribute to food security but more children having households are less secure. This outcome is contradictory to the study conducted by Jabo et al. (2017) and Mustapha et al. (2018) where unit increase in family size leads to reduction in food security status.

Annual household income and food security

The significant coefficient for annual household income underscores income's critical role in food security. The marginal effects (dy/dx = - 0.365) indicate that a unit percentage increase in household income causes the probability of household being food insecure to be reduced by around 35 % on average, keeping other variables constant. This outcome is in line with the study of Akbar et al. (2023) reporting food insecurity is more prevalent for the respondent with lower annual income. Higher annual income having households were more likely to be food secure (Mazenda et al., 2022). Awoke et al. (2022) reported that off farm activity participation enhances the food security status. Income diversification must be encouraged in order to face severe food insecurity (Danso-Abbeam et al., 2023).

The log likelihood of -63.3399 and Wald chi^2 (8) value of 35.18 with a p-value of 0.000 indicate that the model is statistically significant, with the independent variables collectively influencing the dependent variable. The Pseudo R^2 of 0.2516 suggests a moderate level of explanatory power typical for ordinal regression models. A mean VIF of 1.27 suggests that the model is free from significant multicollinearity.

Table 10. Determinants of household food security: estimates from ordered logit model

Variables	Coefficient	Odds ratio	Marginal effects
HHAge	-0.270 (0.020)	0.973 (0.022)	0.003 (0.002)
HHGender (Female=1, Male=0)	0.0004(0.476)	1.000 (0.517)	-0.000 (0.064)
HHEducation (Illiterate (0) as base)			
Primary Education (1)	1.699*(0.753)	5.472*(3.984)	- 0.156*(0 .055)
Secondary Education (2)	2.569*(1.108)	13.058*(13.893)	- 0.156*(0.045)
lnIncome (annual)	2.949**(1.012)	19.094**(17.968)	- 0.365**(0.123)
Family size	0.342**(0.106)	1.408**(0.197)	- 0.042**(0 .0179)
Land size (kattha)	0.040 (0.082)	1.040 (0.079)	- 0.004 (0.009)
Monthly savings (Yes=1, No=0)	-0.634 (0.578)	0.530 (0.325)	0.087 (0.094)
/cut 1 value	37.04		
/cut 2 value	41.041		
log likelihood	- 63.3399		
Wald chi^2(8)	35.18		
Prob>chi^2	0.000		
Pseudo R^2	0.2516		

Note: Figures in the parentheses indicate the robust standard errors, * & ** denotes the level of significance at 5% and 1%

Brant test
Table 11. Brant test of parallel regression assumptions

Variables	chi^2	p>chi^2
HHAge	0.01	0.922
HHGender	0.03	0.866
Education (dummy1)	0.00	0.994
Education (dummy2)	0.00	0.993
Annual Income (ln)	0.02	0.884
Family size	0.80	0.371
Land size (kattha)	0.50	0.481
Monthly savings	0.01	0.909
All	3.05	0.931

The Brant test results show that all individual variables and the overall model have p-values greater than 0.05, indicating no violation of the parallel regression assumption. Therefore, the assumption holds for the model.

Coping strategies
The most common coping strategy among Chepang households is consuming wild edibles (41.37%), followed by wage labor earnings (26.43%) and livestock sales (19.54%). Aryal (2013) reported that wage labor earnings and wild edibles together was the most common food management strategies of Chepang community.

Table 12. Key coping strategies adopted by Chepang households

Coping Strategies	Frequency	Percent
Wage labor earnings	23	26.43
Consumption of wild edibles	36	41.37
Borrowings from neighbors/relatives/friends	8	9.19
Cutting off number of meals/days	3	3.44
Livestock sale	17	19.54
Total	87	100

CONCLUSION

This study reveals that Chepang community faces chronic food insecurity with 82% categorized as insecure or vulnerable based on food consumption score. Socio-economic disparities, particularly low education levels, limited income, and dependency on subsistence strategies, uphold this crisis. Higher education and income emerged as critical drivers of food security, enabling access to diverse diets and stable livelihoods. Poor dietary diversity, low monthly savings, and the high prevalence of ailaani landholding (no legal ownership) reflect systemic challenges affecting food security and overall welfare which further escalate these vulnerabilities. Despite coping mechanisms like foraging and wage labor, these measures remain inadequate for long-term resilience. Addressing these issues requires holistic strategies that integrate education, economic empowerment, and equitable resource access to break the cycle of poverty and food insecurity.

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AUTHOR CONTRIBUTIONS

Author A: Conceptualization, Methodology, Writing, Funding Acquisition, Data Curation, Analysis, Visualization Original Draft Preparation

Author B: Visualization, Supervision, Review & Editing

CONFLICT OF INTEREST

The authors declare that they have no competing financial or non-financial interests.

ETHICS APPROVAL

Since this study was based on voluntary participation of respondents through semi-structured interviews, and did not involve any experimental intervention, no formal ethical approval or permits were required. However, informed consent was obtained from all participants, and confidentiality of their responses was maintained.

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