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Economic Analysis of Potato Production under Bung Practice in Solukhumbu District, Nepal

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ABSTRACT

In 2023, an economic evaluation of potato cultivation within the bung system was carried out in Nepal's Solukhumbu district. A purposive sampling was performed to choose sixty potato-farming households from the Solududhkunda, Thulung Dudhkosi, and Sotang rural municipalities. A pre-tested semi-structured interview schedule, direct observation, focus group discussions, and key informant interviews were used as primary data collection. Whereas, secondary data were obtained from journals, research papers, bulletins, and reports published by diverse organizations. Data were evaluated via descriptive statistics. The data showed that the majority of bung potato farmers were women. "Producers-Collector-Wholesalers-Consumer" was the primary marketing channel for bung potato in the study area. The average cost of potato production was NRs. 89,269.57 per hectare, with land preparation and plantation accounting for the largest share. The gross income and net return were NRs. 216,181.40 and NRs. 126,911.80 per hectare, respectively, yielding a benefit-cost ratio of 2.4, which confirms the high profitability of bung potato cultivation. Around 80% of the producer's share in the consumer price was estimated with a price spread of 20%. The major issues in bung potato farming were identified as lack of technical expertise, lack of improved variety, shortage of labor, weather uncertainty, and disease and insect pests.

Keywords: Bung, Economic, Marketing, Potato, Production

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INTRODUCTION

Potato (*Solanum tuberosum*) is a prominent crop in Nepal. It is more popular among Nepal's rural, resource, and small-landholding farmers (Sapkota and Bajracharya 2018). It is primarily grown and used as a vegetable in plains and mid-hills (Kafle and Shah 2012). It is Nepal's fifth most significant crop in terms of acreage after rice, wheat, maize, and millet, and second in terms of productivity (Gautam et al 2024). Potato supports national food security by complementing grain-based diets, and it has a higher production potential and productivity than other cereal crops (Baral et al 2021). Furthermore, potato is regarded as a key food crop, behind maize, rice, and wheat. (Khalid et al 2020). Potatoes are grown on 211,505 hectares, producing 3,521,794 mt/ha. The national average potato yield is 16.65 mt/ha (MOALD 2025). According to national statistics, the area, production, and yield of Solukhumbu district are 5,695 ha, 92,600 mt, and 16.26 mt/ha, respectively (MOALD 2025). For the fiscal year 2023/24 (2080/81), potatoes contributed 6.5566% to Nepal's Agricultural Gross Domestic Product (AGDP). Based on the broader economic data, this represents approximately 1.58% of Nepal's total national GDP (MOALD 2025). Sloppy fields and rocky terraces are the most distinctive features of the high hills and mountains. Crop cultivation on Nepal's sloping slopes requires labour-intensive and extensive land management (Bajracharya 2001). The country's climatic diversity allows for year-round potato production from the plains (70 m a.s.l.) to the highlands (4400 m a.s.l.). According to the agroecological region, approximately 15.97% of the entire area under potato cultivation is in high hills/mountains, 42.39% in mid-hills, and the remaining 41.64% in Terai and Bhabar (MOALD 2025). Potato (*Solanum tuberosum* L.) evolved in the Andes of South America,

primarily in cool climates. People who live above 2000 m a.s.l. eat potatoes as their only staple meal because the environmental conditions do not encourage the growing of other crops, such as cereals and legumes (Sapkota et al 2019).

Nepal has several indigenous methods for cultivating potatoes, including the bung and lhose systems, which are employed in the country's highlands under certain agro-ecological conditions. The bung system is more prevalent in eastern high-hill districts like Solukhumbu and is characterized by pit-based farming augmented with organic matter, despite the fact that both systems are historic (Upadhyay and Timilsina 2020). Potatoes are grown in deep, organic-matter-rich holes using a traditional pit-based method called "bung" in the high highlands of eastern Nepal. The local Sherpa/Tibetan dialect is said to be the source of the word "bung," which describes a pit or hollow dug for crop production and represents both the physical structure and traditional ecological knowledge instilled in the technique (Upadhyay and Timilsina 2020). The bung method is popular in the highland areas of the Solukhumbu, Ramechhap, Dolakha, and Okhaldhunga districts. The annual potato production under the bung system accounts for approximately 40% of total production (Upadhyay and Timilsina 2020). The bung approach is predominantly practiced at elevations above 2500 m a.s.l., however, reports indicate that cultivation may also occur from around 1800 m a.s.l. This farming practice is well known throughout Okhaldhunga, including Thade and Patale, as well as in the bung areas of Solukhumbu. The bung practice holds significant importance for high-altitude communities, enabling potato production on marginal sloping lands where conventional farming is challenging, thereby supporting food security and livelihoods in remote mountainous areas. Its merits include enhanced soil fertility from organic enrichment, improved water retention and reduced erosion through pit structures on steep slopes, higher tuber quality often fetching premium prices due to organic-like attributes, resilience in cool climates, and low dependence on external chemical inputs or mechanization (Upadhyay and Timilsina 2020). However, demerits include high labor intensity for pit digging and maintenance, vulnerability to soil erosion on muddy or post-harvest grounds, sensitivity to weather uncertainties like erratic rainfall or frost, increased risk of disease and pest buildup in organic-rich pits, limited scalability due to manual processes, and difficulties in adopting improved varieties or modern techniques (Bajracharya, 2001, Phulara et al 2021).

Economics, marketing, and restrictions in different contexts have all been covered in earlier studies on potato cultivation in Nepal. Studies such as (Chauhan et al 2022) analyzed economics in Darchula district, while more recent works include (Kandel et al 2024) on comprehensive evaluation in Baglung, Gautam et al. (2024) on profitability and resource efficiency in Doti, and (Dhakal et al 2024) reviewing indigenous high-altitude practices. (Upadhyay and Timilsina 2020) specifically documented the bung system's traditional aspects in the eastern hills, highlighting its advantages, though limited recent economic analyses focus on Solukhumbu. This study examines production obstacles and the potential for agricultural practices and marketing of bung potato in Solukhumbu district. Inadequate research exists on the economic impact of bung potato practice in this specific district, representing a notable gap given its prevalence and contribution to local economies. This research enhances comprehension of the financial aspects inherent in bung potato cultivation, offering perspectives that are valuable to farmers, extension services, and policymakers alike. However, the study is subject to certain constraints. These include its dependence on a purposive sample of 60 households drawn from specific municipalities, the potential for recall bias stemming from self-reported data from 2023, a focus limited to a single growing season, and the omission of long-term environmental or multi-year variability considerations. The primary objectives of this investigation are to evaluate the costs, returns, and profitability, encompassing the benefit-cost ratio, associated with bung potato production in the Solukhumbu district, to identify and prioritize the principal production and marketing challenges encountered by farmers, and to propose recommendations aimed at improving the economic viability and sustainability of the bung practice.

MATERIALS AND METHODS

The study was conducted in Solukhumbu district, which lies in the eastern upper hills of Nepal, geographically situated between latitudes 27°20’39” N and 28°6’24” N, and longitudes 86°0’21” E and 87°0’1” E, with an elevation range from approximately 600 m a.s.l. in the lower valleys to 8,848 m a.s.l. at Mount Everest (Wikipedia, 2025). The study was carried out from March to June 2023. The study was carried out in three local levels within Solukhumbu district: Solududhkunda municipality (centered around Salleri, approximate coordinates 27°30’16” N, 86°35’11” E, with key elevations around 2,661 m a.s.l., (Wikipedia 2025), Thulung Dudhkoshi rural municipality (centered around Mukli, approximate coordinates 27°26’ N, 86°41’ E, with varied elevations from river valleys ~1,000-1,500 m a.s.l. to higher ridges >3,000 m a.s.l., (Wikipedia 2025), and Sotang rural municipality (approximate coordinates 27°28’10” N, 86°47’25” E, with representative elevations around 2,426 m a.s.l., (Wikipedia 2025). The map of Nepal showing Solukhumbu district with the study area is presented in Figure 1.

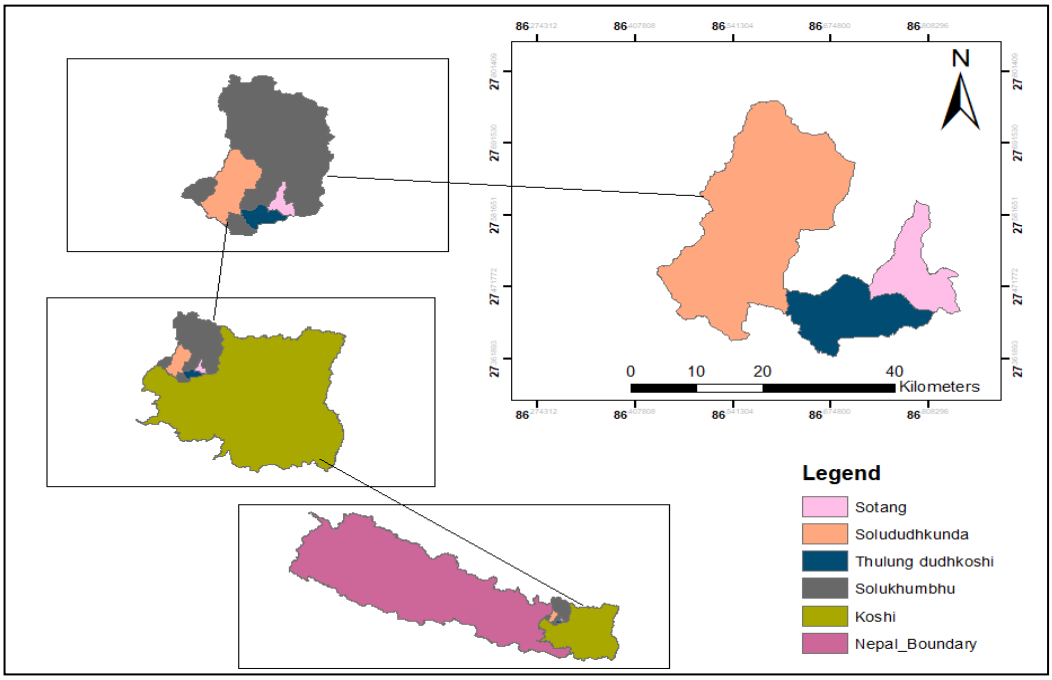

Figure 1. Study Area Mapping of Solukhumbhu District showing Sotang, Solududhkunda, and Thulung Dudhkoshi Municipality

Sample and Sampling Technique

The total number of respondents from Solududhkunda municipality, Thulung Dudhkoshi rural municipality and Sotang rural municipality was 60. Purposive sampling (non-probability sampling) techniques were used in the selection of samples from the respective areas that were involved in potato production under bung practice. The survey was done by interviewing the selected farmers with the help of semi-structured questionnaires. Group Discussions and Key Informant Interview was carried out, which represented the small farmers, leading farmers, subject matter specialists, and other related stakeholders.

Sources of Data

The study was based on primary and secondary data. The primary data was collected from the farmers by conducting household surveys (face-to-face interviews), Focus Group discussions (FGD), Key Informant Interviews (KII), phone calls and recording socio-demographic and farm characteristics with the use of questionnaires. The secondary data and information were obtained from various sources such as published and unpublished literature, the Department of Agriculture (DOA), Central Bureau of Statistics (CBS), Ministry of Agriculture and Livestock Development (MOALD), government and non-government project reports, articles, internet materials, NARC publishing materials, textbooks, libraries, study reports, government's planning and policy documents, Agriculture Knowledge Center (AKC), publications of Bagbani Kendra Solukhumbu, Krisi Diary etc.

Data Analysis Techniques

The back-to-home data analysis and interpretation exercise was followed immediately after the completion of the field survey. The collected data were analyzed systematically to meet the objective of the study. Economic analysis was performed on potatoes under bung practice in three local levels of the Solukhumbu district. The qualitative data of the study are summarized and presented in a descriptive form in the report. Tables, figures and graphs are used for the presentation of data. Data sets obtained through the household survey were analyzed by using MS EXCEL.

The analyzed data were carried out by using the following analytical tools.

Benefit-cost ratio

It is the quickest, easiest, and most effective method of determining a farm business's economic performance. The benefit-cost ratio (BCR) identifies the relationship between the benefit and cost of a proposed activity (Kandel et al 2024).

$$\text{Benefit Cost Ratio (BCR)} = \text{Total benefit} / \text{Total cost} \quad \text{.....(Eq. 1)}$$

Gross margin
Gross margin is calculated for individual enterprises by subtracting total costs from financial output. It is the difference between gross income or gross return and total cost incurred in the production process. It is calculated as.
Mathematically,
Gross margin = Total Revenue - Total Costs…….. (Eq.2)
where,
Total Revenue = Total production × Price of product

Source: (Kandel et al 2024)

Gross return
Gross return = Price of Potato × Total Quantity Sold…… (Eq. 3)

Source: (Kandel et al 2024)

Indexing
To know the importance of different production and marketing problems five-point scale was used based on farmers' perceptions of them. It includes very high importance, high importance, normal importance, less importance, and the least importance to the different problems using numeric values 1, 2, 3, 4, and 5, respectively. The index of importance was calculated using the following formula:

$$I_{imp} = \sum (S_i F_i / N) \ldots\ldots\ldots\ldots \text{(Eq. 4)}$$

where,
I_{imp} = Index of importance
$\sum$ = Summation
S_i = ith Scale value (1, 2, 3, 4, and 5)
F_i = Frequency of ith importance given by the respondents
N = Total number of respondents

Source: (Kandel et al 2024)

RESULTS AND DISCUSSION

Adoption and prevalence of bung potato cultivation
According to all respondents, potato is grown by almost 90% of households in the highlands of the study area. This high adoption rate is further supported by the conclusions of the Solukhumbu Detailed Need Assessment (ACTED 2015).

Demographic and social factors
The study showed that more than half of the respondents were female (51.67%), and the remaining were male (Figure 2). The study conducted by (Sapkota et al 2019) in Achham district revealed that out of a total of 90 respondents sampled, 71.11% were male and 28.89% were female. The district profile of Solukhumbu shows Janajati as a major ethnic population. The study also revealed Janajati as the major ethnic group, followed by Chhetri 23.33%, Brahmin 6.67% and Dalit 5%.

The study found the average age of the respondents to be 41.2 years, within the range between 22 and 72 years. In the study conducted in Darchula District, (Chauhan et al 2022) revealed that 56% were found to be an economically active population of the age group 15-59 years. The average family size of the respondents in the study area was found to be 6.07, which was higher than the national average. (Chauhan et al 2022) also revealed that the average family size was 6.54.

Out of 60 respondents, 50% were illiterate, 21.67% studied primary school level, 25% had secondary school level education, and 3.33% had graduation and above level of education (Figure 2). In the study conducted in Achham District, (Sapkota et al 2019) revealed that 88.9% were literate and the remaining 11.1 % were illiterate.

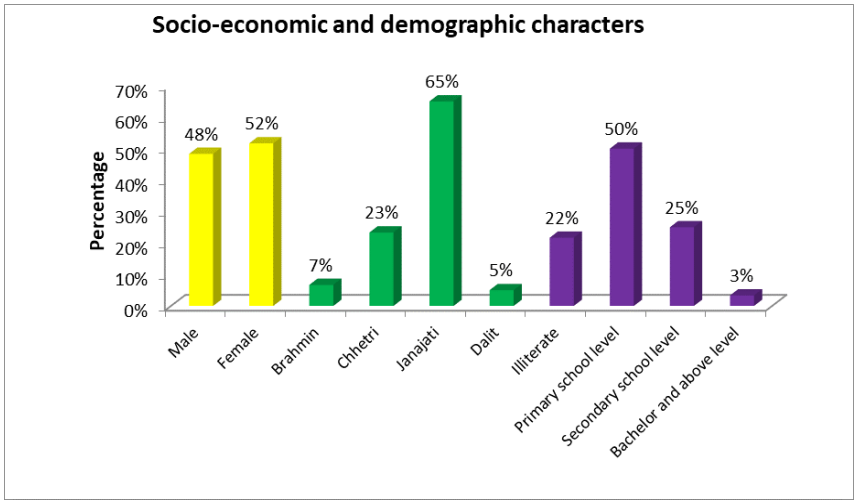

Figure 2. Graph showing Gender, Ethnicity, and Education Status of respondents in the study area

Economics of bung potato production

Cost of cultivation

The total cost of production associated with bung potato farming was NRs 89,269.57 per hectare. Out of the total cost, the cost of Land preparation and plantation constituted the majority, slightly more than 50%. Similarly, the cost of raw materials and input accounted for about 20 %, less than that of harvesting cost (24.68%). About 5% was spent on different miscellaneous production activities (Table 1). Although the bung system is not practiced in districts such as Darchula, studies from these areas provide an indicative comparison of cost components under conventional potato production systems. For instance, (Chauhan et al 2022) reported that tuber costs constituted the highest share (25.74%), followed by weeding (22.66%), FYM (18.74%), land preparation (14.66%), harvesting (9.46%), and planting (8.84%) costs in Darchula district. Similarly, the average variable cost of potato production per hectare under conventional systems was reported as NRs. 2,13,777.47 in Baglung, NRs. 2,56,285.29 in Achham, and NRs. 2,67,219 in Darchula (Chauhan et al 2022, Kandel et al 2024, Sapkota et al 2019).

Table 1. Cost of production of bung potato (per hectare)

Activity	Production cost/hectare (NRs)	Contribution of total cost (%)
Land preparation and plantation	45181.04	50.61
Raw materials and input	17614.18	19.73
Harvesting cost	22029.03	24.68
Other costs	4445.323	4.98
Total	89269.57	**100**

Source: Field survey 2023

Return of bung potato farming

The benefit-cost ratio of bung potato cultivation was 2.4, indicating that farmers obtained a profitable return and that the bung system represents a viable enterprise in the study area (Table 2). This value is notably higher than the benefit-cost ratio of 1.27 reported for conventional potato cultivation in Baglung District (Kandel et al 2024). Although published information on the cost of production and returns of traditional bung and lhose systems remains limited, available studies suggest that the bung system produces higher yields and often receives a premium market price compared to lhose, contributing to relatively higher economic returns per unit area (Upadhyay and Timilsina 2020). In contrast, conventional potato production systems in Nepal show well-documented gross and net returns, with reported gross incomes of NRs. 373,384.45 ha^{-1} in Achham, NRs. 432,804 ha^{-1} in Darchula, and NRs. 268,047 ha^{-1} in Baglung (Chauhan et al 2022, Kandel et al 2024, Sapkota et al 2019), which provides useful benchmarks for economic comparison.

Potatoes are a useful alternative for improving the health and nutrition of rural populations, as they are more productive than other grains and have higher economic value (Sapkota and Bajracharya 2018). To improve the economic status of smallholder farmers, the demand for potato chips, fries, and mashed potatoes has increased (Subedi et al 2019). It is an essential crop for food security in Nepal's high hills, providing a significant source of income for resource-poor mountain farmers (Shrestha and Yadav 2018). Despite constraints, potatoes continue to be an economically viable option because of their higher production compared to other vegetables (Dahal et al 2023).

Table 2. Profitability of bung potato farming in the study site.

S. N	Indicator	NRs/hectare
1	Cost of the production	89,269.57
2	Gross income	2,16,181.4
3	Net income	1,26,911.8
4	Benefit Cost Ratio	2.4

Source: Field survey 2023

Marketing channel of potatoes in the study site

In the study area, potato marketing involved two main channels. Producers sold their potatoes either directly to consumers or through intermediaries, including collectors and wholesalers. The majority of farmers relied on collectors and wholesalers to reach the market, while a smaller proportion sold directly to local consumers. This indicates that intermediaries play a significant role in the potato marketing system of the region.

Table 3: Marketing Channel of bung potato in the study area

Channel	Actor involved	Frequency	Percentage
Channel-I	Farmer » Village level collector » Wholesaler » Consumer	45	75
Channel-II	Farmer » Consumer	15	25
Total		60	100

Source: Field survey 2023

From the survey, only two marketing channels were observed. Among them "Producer-Collector-Wholesaler-Consumer" marketing channel was more highly applied than another marketing channel "Producer-Consumer" (Table 3). The study conducted by (Dahal et al 2023) revealed that out of four distinct marketing channels identified, the longest channel involves intermediaries like collectors, wholesalers, retailers, and finally consumers, which was the most prevalent, with 46% of individuals choosing this route.

Production constraints

The study revealed that lack of technical knowledge was the most severe problem faced by bung potato growers, with a problem severity index of 0.84 (mean score = 4.04 on a 5-point scale). Lack of improved varieties was ranked second, and labor scarcity was the third most important constraint. Weather uncertainty was ranked fourth, with a mean score of 3.6. Disease and pest infection were considered a less significant problem (Table 4). Other major production constraints reported in previous studies included the unavailability of improved seed, insufficient seed quantity, untimely seed supply, high seed cost, shortage of irrigation infrastructure, costly manure, lack of labor, expensive and untimely chemical fertilizers, and unfavorable climate during harvest (Phulara et al 2021).

Table 4: Ranking of production problems in the study area

Problem	Index value	Ranking
Lack of technical knowledge	0.84	I
Lack of improved variety	0.76	II
Lack of labor	0.74	III
Weather uncertainty	0.6	IV
Disease and pest infection	0.32	V

Source: Field survey 2023

Respondents' perceptions of other constraints varied: while most agreed on the marginality of land, they were largely unsure about seed availability and germination issues. Many respondents strongly disagreed about the adequacy of irrigation facilities and were uncertain about labor availability (Chauhan et al 2022). Similarly, a study in the Bajura district identified infrastructure limitations as the most critical problem, followed by insect pests, unavailability of inputs, and postharvest losses (Anish and Bhat 2020).

According to farmers in Solukhumbu, storage and technical expertise are the most pressing issues in potato production under current practice, followed by bad handling, transportation, diseases, and pests. The muddy grounds provide a great risk of soil erosion. Potato growing sustainability remains a difficulty that must be overcome.

Marketing constraints

Lack of market information was ranked as the most important problem with an index value of 0.76. Unorganized markets and low prices were ranked second and third most important problems by respondents.

The absence of a good road facility was ranked last with an index value of 0.42 (Table 5). The major marketing problems were transportation and a lack of support from the local government (Chauhan et al 2022). The major problems in the market were more middlemen, followed by inadequate information about market price, fluctuation in price, malpractice in weighing, malpractices in trade, and delay in payment, respectively. (Phulara et al 2021).

Table 5. Ranking of marketing problems in the study area

Problem	Index value	Ranking
Lack of marketing information	0.76	I
Un-organized market	0.62	II
Low price offered by the trader	0.57	III
Lack of a good road	0.42	IV

Source: Field survey 2023

CONCLUSION

There is an increase in the production of bung potatoes, but the problems related to this sub-sector are unsolved. From this study, the benefit-cost ratio was found to be 2.4, which means that potato production in the Solukhumbu district is a very profitable business. The study revealed that the lack of technical knowledge was the most serious problem (0.84), followed by the lack of improved variety (0.76), labor scarcity (0.74), weather uncertainty (0.6), and disease and pest infection (0.32). Similarly, lack of market information, unorganized markets, low prices, and absence of a good quality road were marketing constraints.

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AUTHORS' CONTRIBUTION

S. K conceptualization, methodology, investigation, and data collection, S. G data curation, formal analysis, writing (original, review and editing), preparation of final manuscript, S. B methodology, investigation, literature review, writing (review and editing), S. K. C formal analysis, validation of economic results, writing (original and review), P. P writing (review and editing). All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST

The authors declare that they have no competing financial interests or personal relationships that could influence the work reported in this study.

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