Economics of Organic Finger Millet Farming and Its Contribution to Rural Livelihood: A Case of Dolakha District, Nepal

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Abstract

Purpose: Finger millet is important food crop for ensuring food and nutrition security of smallholder farmers in the hilly area of Nepal. It is widely grown in the eastern hills and mid-western region. This research was conducted to assess the economic viability of organic finger millet farming and its contribution to livelihood of farmers at Dolakha district of Nepal.
Methods: Simple random sampling was done to select 60 finger millet growers from the list of millet growers at Baiteshwor Rural Municipality, Dolakha, Nepal. The field survey was done using set of structured questionnaires as well as check-list to perform semi-structured interview to collect primary information whereas secondary information was collected from relevant publications.
Results: Result showed the benefit-cost (BC) ratio of greater than one (1.26) and positive gross margin of NRs. 13676 per hectare indicating the financial viability of organic finger millet production. Moreover, it is revealed that the average net income from the sale of processed value-added alcoholic beverages made from one-kilogram grain was NRs.102; the average price of one-kilogram grain was calculated NRs. 54. In addition, the average partial food availability from finger millet was calculated 2010 kilocalories per hectare per person per day which showed its contribution to household food security. Lack of technical knowledge (I=0.83) was, however, identified as the first major problem associated with finger millet farming.
Conclusion: Organic finger millet cultivation could support the livelihood and food security of rural farm households, especially the marginal farmers of hilly regions of Nepal, provided, technical support is available from the government in production, value addition, and marketing by integrating into the mainstream of agricultural development.

Keywords: Benefit-cost ratio, Livelihood, Organic finger millet, Partial food availability

1 Introduction

Millet is a collective term encompassing various small-seeded cereals which includes finger millet, proso millet, foxtail millet, barnyard millet, little millet, sorghum, pearl millet, etc. (MoALD, 2023). In Nepal, finger millet [*Eleusine coracana* (L.) Gaertn] ranks fourth place in terms of cultivated area, and production after rice, maize, and wheat (Ibid, 2023). In spite of its widespread cultivation from the mountains to the Terai region in Nepal, finger millet remains categorized as a neglected and underutilized crop (Bhandari *et al.*, 2010; Prasad *et al.*, 2010). Finger millet is frequently disregarded due to its perceived low value, especially among marginal farmers. Although it has been cultivated in Nepal since time immemorial, it is believed to have originated in Africa (Gari, 2002). Globally, millets encompassed a cultivated area of 30,934,728/ha, with a production of 30,089,625/t, and a productivity of 0.97 t/ha in 2021 (FAO, 2023). Nepal recorded a total area of 267,071/ha dedicated to finger millet cultivation, yielding 339,462/t, with a productivity of 1.27 t/ha in 2021/22 (MoALD, 2023). Furthermore, finger millet covers 7.66 percent of the country's total food crop area (Ibid, 2023) with 95 percent of its cultivation concentrated in the hill areas (Ghimire, 2019).
Finger millet is generally cultivated predominantly in marginal lands with minimal agricultural inputs. In terms of bioengineering point of view, the cultivation of finger millet has also contributed to the conservation of the slopy lands. Since finger millet cultivation in Nepal is mainly done in rural areas, farmers have invested direct labor from households without using farm machinery (Koirala & Subedi, 2011). Despite its low perceived value, finger millet remains a cost-effective and widely accessible food source for poor farmers, playing a crucial role in ensuring food and nutrition security across Nepal. It has also contributed to the well-being of the most vulnerable farmers in the remote hilly areas of the country (Prasad, *et al.*, 2010). In many hilly areas of Nepal, where road access is limited, locally produced finger millet plays a crucial role in rural food security. However, it remains one

of the under-utilized, devaluated, and low graded crops, often regarded as a food for marginalized communities (Adhikari, 2012; LI-BIRD, 2016). This perception stems from a lack of understanding of its importance and social prejudices. Despite its numerous benefits, finger millet faces cultural stigma associated with consuming it, causing families to claim they eat rice instead of finger millet at home to uphold social prestige. There was even a custom of not marrying a daughter into a household where finger millet was a staple food.
Although the perception of finger millet is regarded as poor person's food, the value of nutrition is superior to rice, wheat, and maize (MoAD, 2012). Finger millet is recognized for its numerous health benefits, including anti-diabetic, anti-tumorigenic, and antioxidant effects (Devi *et al.*, 2014). Studies have shown its efficacy in increasing milk production among pregnant women, and addressing hemoglobin deficiency (Kharde, *et al.*, 2010). With its high calcium, iron, fiber, and riboflavin content, finger millet serves as a valuable source to combat deficiencies in the essential nutrients, as outlined in the Table (1). Consequently, there is a growing demand for organic foods, particularly in developed countries.

Table 1: The nutritious value obtained from finger millet compared to other major crops

S.N.	Nutrition	Quantity per 100 grams			
		Finger Millet	Rice	Maize	Wheat
1.	Calcium (mg)	344	10	20	48
2.	Fiber (g)	3.6	0.2	1.6	1.9
3.	Riboflavin (mg)	0.19	0.06	0.11	0.17
4.	Minerals (g)	2.7	0.6	1.2	2.7
5.	Iron (mg)	3.9	0.7	2.4	4.9
6.	Carbohydrate (g)	72	78.2	72.1	69.4
7.	Portion (g)	7.3	6.8	9.2	12.1
8.	Fat (g)	1.3	0.5	3.9	1.7
9.	Calories (KCal)	328	345	360	341
10.	Phosphorous (mg)	283	160	256	355
11.	Carotene (mg)	42	0	305	29

Source: MoAD, 2012

Increasing organic finger millet production holds significant potential in elevating the living standard of the Nepalese poor farmers. Numerous studies conducted on finger millet in Nepal underscore the primary challenge facing this sub-sector; establishing its value, and developing national and international marketing networks (Gautam, 2008; Adhikari, 2012; Khanal *et al.*, 2014; ANSAB, 2015; LI-BIRD, 2016; Adhikari *et al.*, 2017; Gauchan *et al.*, 2020). The global integration of underutilized organic crops into international market has emerged as a pivotal concern for many nations (Mayes, *et al.*, 2012; Khanal, *et al.*, 2014). In line with these considerations, the following research questions were formulated:

1. Is organic finger millet farming financially viable?
2. What is the contribution of finger millet to livelihood, and food security at the household level in Dolakha?
3. Are existing public policies conducive to promoting organic finger millet production?
4. What are the major problems faced by the farmers in organic finger millet farming?

Thus, the main objective of this research was to assess the economic viability of organic finger millet farming and its contribution to livelihood of farmers at Dolakha district of Nepal.

2 Materials and methods

Dolakha district was purposively selected for this research. Baiteshwor Rural Municipality, with 5079 households (CBS, 2017), was chosen for this research in consultation with the Hill Crops Research Program (HCRP), Nepal Agricultural Research Council (NARC), and agricultural officials of the province and local government. A sampling framework of finger millet farmers in the study area was prepared, and a simple random sampling method was used to select a total of 60 sample households.
Out of the 60 respondents, 63.33 percent were male farmers, and 36.67 percent were female farmers. The total family size among respondents was 319 individuals, with 60 individuals under 15 years of age; 249 individuals aged 15-59 years, and 19 individuals above 60 years of age. The average age of the respondents was 46.76 years. Likewise, 38.33 percent respondents were Brahmins, 21.67 percent Janajati, 20 percent Dalit, and 20 percent Chhetri. Agriculture was the primary occupation for 96.80 percent of the respondents, while 1.6 percent were involved in service, and business activities.

All the data collected were entered in the Statistical Package for Social Science (SPSS) version 25, and MS-Excel for statistical analysis. Descriptive statistics were used to analyze the data. Compound Annual Growth Rate (CAGR) was applied to determine the growth rate of the area, production, and productivity of finger millet. To estimate the gross margin, and benefit-cost ratio, various variable costs such as those related to cultivation, seed, other inputs and post-harvest activities related costs. When calculating the total income from finger millet production, the quantity of household consumption was converted into income, along with lump sum income from the sale of alcoholic beverages, and the income from the sale of finger millet grains. Net income was calculated by subtracting total variable costs from the gross income. Similarly, the benefit-cost (B/C) ratio was calculated by dividing the gross income from the total variable costs.
Additionally, a scaling technique was used to identify the farming problems of finger millet based on priority points; 5 for the most serious, 4 for serious, 3 for moderate, 2 for little slightly serious, and 1 for least serious. The problems were scaled using the following formula (Miah, 1993);

$$I_{\text{prob}} = \sum_{i=1}^{N} S_i \cdot f_i$$

Where:

- I_{prob} = index value for the severity of the problem
- $\sum$ = summation
- S_i = scale value at the i-$^{\text{th}}$ severity
- f_i = frequency of the i-$^{\text{th}}$ severity
- N = total number of respondents = $\sum f_i$

Partial Food Availability (PFA) from organic finger millet production is defined as the food supply in Kilocalories (KCal) per hectare per person per day (KCal/ha/p/d). To assess the food availability condition of farmers from organic finger millet production, the study computed the PFA in KCal/ha/p/d using the formula indicated in Equations 1 and 2.

$$C_i^* = C_i - \beta_i \tag{1}$$

Where C_i is the total calorie availability and β_i is the consumption needs of the farm household. $C_i^* \geq 0$ indicates that the farm household has adequate PFA, while $C_i^* \leq 0$ indicates that the farm household has inadequate PFA from finger millet. Therefore, the total household PFA model of farming household expressed as PFA (KCal/ha/p/d) is as shown in Equation (2).

$$PFA_{T_i} = \frac{\sum_o^i \left[\frac{(TFMO_i - TFMOS_i)\cdot C}{365}\right]_{ha_i}}{H_i} \tag{2}$$

Where:

- PFA_{T_i} = Total Partial Food Availability of the farmer
- $TFMO_i$ = Total Finger Millet Output of the farmer
- $TFMOS_i$ = Total Finger Millet Output Sold by the farmer
- C = Calorie content for finger millet
- ha_i = Farm size of the farmer
- H_i = Family size of the household

Equation (2) elucidates the process of calculating the total quantity output of farmers for personal consumption, converted into calories, divided by the number of days in the year (365), and divided by total farm size. This gives PFA per day/hectare calorie. Consequently, each household's food availability is determined by dividing their PFA per day/hectare calorie by their household size, which varies depending on the number of adult male/females and children. Various key variables were employed to assess PFA, including total finger millet production, and sales by farmers in kilograms over one farming year. Subsequently, the remaining finger millet after deducting total sales from total production was converted into edible finger millet, and transformed into calories. Additionally, the area utilized for finger millet production as taken in hectares, and number of households living in the same household with the head of the household were taken (Chima, 2015). The calorie intake per kg of finger millet was computed based on standard value of 100 grams finger millet equating to 328 Calories (KCal) (MoAD, 2012). Upon calculating the calories per kg of finger millet, the formula referenced in Equation (2) was applied in the MS-Excel format to determine PFA from finger millet per person, per ha, per day in Kcal. Apart from primary data, various secondary sources such as different books, journals, online documents, and related policy documents on organic farming were reviewed, contextualized, and transcribed and presented in the both textual as well as graphical formats.

3 Results

3.1 Policy issues of organic finger millet farming in Nepal

Organic farming was considered for the first time in the Seventh Plan (1985-1990) (NPC, 1985). Objective of this plan was to reduce the import quantity of chemical fertilizers by using the local organic fertilizers. Similarly, target of this plan was to produce 2800 t of organic fertilizers from biogas plants. The Eighth Plan (1992-1997) (NPC, 1992) had set a target to use organic fertilizers in promoting crop farming based on natural and organic fertilizers. The major aim was to train the farmers in preparing organic manure. The Ninth Plan (1997-2002) came up with objective of emphasizing a balanced use of chemical fertilizer, and organic fertilizer for maintaining soil fertility. However, this plan was focused on neither organic nor inorganic farming. But this plan somehow realized the negative effects of pesticides (NPC, 1997). The Tenth Plan (2002-2007) was launched using the terms of "organic agriculture" for the first time with setting the goal of promoting Integrated Pest Management (IPM) along with the minimum use of pesticides, and production under organic farming. The aim of this plan was to encourage cooperatives, and the private sector in the organic farming system (NPC, 2002). Likewise, the Eleventh Plan (2008-2010) gave special importance to organic farming by maintaining the credibility of Nepalese organic products in the national as well as international markets (NPC, 2007). The Twelfth Plan (2010-2013) aimed to promote high-value organic crops for international markets, development of organic fertilizer factories, and certification of organic products (NPC, 2011). The Thirteenth Plan (2014-2016) was also committed to promote organic products through brand certification and provide subsidies for organic fertilizers and pesticides, counting the targets set in the Twelfth Plan (NPC, 2014). The Fourteenth Plan (2017-2019) was implemented with the aim of identifying potential organic products and areas of organic farming, and promoting organic products in national and international markets. The additional commitment was made to provide insurance, and subsidies for organic manure factories. The policy document also committed that the capital grants would be provided for the establishment of an organic manure factory. The goal of this plan was to promote organic agriculture by increasing storage facilities, developing farming technologies, and improving infrastructure facilities (NPC, 2017). The Fifteenth Plan (2020-2024) could be considered as one of the most detailed documents on organic farming system in Nepal so far. For the first time, the government has written in the policy document considering the uncontrolled and unsafe use of pesticides and chemicals in the commercial sector which had affected human life, and environmental health. The plan aims to develop and expand agricultural technologies, including climate adaptation and uplifting organic farming by minimizing the negative effects of climate change and disaster. The plan highlights the potential of organic farming due to returning young farmers, expanding markets, and increased trade access. It also emphasizes certifying and branding organic products, and aims to promote indigenous crops like finger millet to improve food and nutritional security. It has also been mentioned that the production and consumption of finger millet have decreased in Nepal. In order to promote this type of indigenous crops and improve the food and nutritional security of the people, a program to improve the eating habits of the people shall be launched. (NPC, 2020). Likewise, Agricultural Biodiversity Policy, 2006 was another policy document, which enhanced the organic agriculture system (MoAC, 2006). The Agriculture Development Strategy (ADS), which is being implemented as a recent agricultural strategy, has discussed the relation between human health and agriculture production which indicated the strategy indirectly favored organic agriculture but the strategy has not explicitly favored organic agriculture (MoAD, 2015).

3.2 The trend of area, production, and productivity of finger millet in Nepal

Figure 1 shows the area, production, and productivity of finger millet from 1961 to 2022 in Nepal. Analyzing the data, it is observed that there has been a significant increase in the cultivated area of finger millet, which was expended from 0.068 million/ha in 1961 to 0.267 million/ha in 2022. This upward trend indicates a growing interest and investment in finger millet cultivation over the decades. In terms of production, there has been a substantial rise from 0.063 million/t in 1961 to 0.339 million/t in 2022. This increase in production reflects not only the expanded cultivation area but also improvements in agricultural practices over time. Productivity, measured in tons per hectare has also shown the modest yet positive growth. From relatively low productivity of 0.93 t/ha in 1961, it has increased to 1.27 t/ha by 2022. This improvement suggests advancements in crop management, the development of better seed varieties, and more effective use of fertilizers and pest control methods (Figure 1).

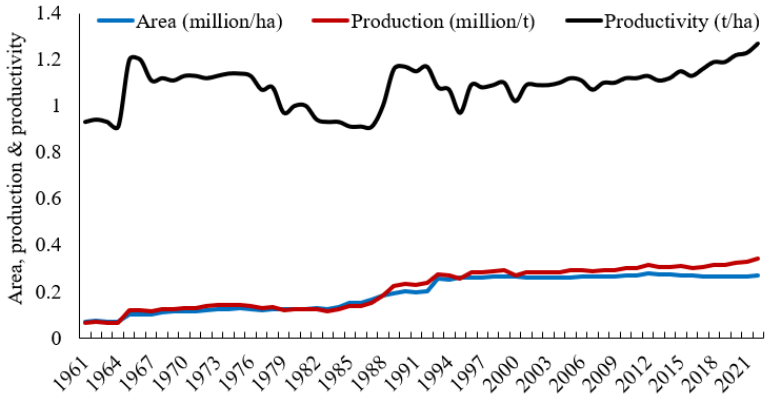

Figure 1: The trend of area, production, and productivity of finger millet in Nepal from 1961 to 2022
Source: FAO, 2023

Table (2) presents the CAGR of area, production, and productivity of finger millet in Nepal from 1961 to 2022. The findings revealed notable increase of CAGR of area, production, and productivity growing at rates of 2.29, 2.51, and 0.20 percent per annum, respectively. These growth rates are statistically significant at 1 percent level of significance.

Table 2: CAGR of area, production, and productivity of finger millet in Nepal from 1961 to 2022

Parameters	Intercept	CAGR	R^2	P-value
Area	-2.44	2.29*	0.87	0.00
Production	-2.43	2.51*	0.85	0.00
Yield	0.01	0.20*	0.18	0.00

*Note: * Significant at 1 percent level*

3.3 Financial analysis of finger millet production

Findings revealed that the average cost of production of finger millet per hectare was NRs. 54,384 whereas the total income was NRs. 68060/ha. After deducting variable costs, the gross margin was estimated NRs. 13676/ha. The benefit-cost ratio was 1.26, indicating the economic viability of organic finger millet farming. Previous studies (Adhikari, 2012) reported lower gross margin in Bagnas and Kalabang Kaski, Nepal NRs. 790.58/ha (B/C ratio 1.04) and 602.45/ha (B/C ratio 1.05), respectively. Similarly, Upreti *et al.*, (1991) reported varied gross margins across different regions, with NRs. 641 (B/C ratio 1.07) in the Eastern Mid Hills, NRs. 951/ha (B/C ratio 1.13) in the Western Hills, and negative gross margin of NRs. 3101/ha (B/C ratio 0.61) in the Far Western Mid Hills. In contrast, Bhandari *et al.*, (2010) reported negative gross margin of NRs. 1785/ha in Kaski district in Nepal. Our research findings also revealed that approximately one-third (32%) of the total income was derived from the direct sale of alcoholic beverages. Additionally, 60% of the total volume of produced finger millet grain is utilized to make alcoholic beverages. The average net income from the sale of processed value-added alcoholic beverages made from 1 kg of grain was NRs. 102, whereas the average price of grain was NRs. 54.

3.4 Exploring marketing channels of finger millet business

In order to identify the marketing channel of the organic finger millet business, farmers were asked several related questions. The findings revealed three primary distribution channels. The first, direct from producers to consumers, was the most comfortable and direct channel of distribution. Findings also showed that this network accounted for more than three fourths (79%) of the total turnover of finger millet trading. The transactions on this channel were mainly for the purpose of making alcoholic beverages. The second, from producers to Hat bazar to consumers, comprised 12.82% of business volume. Lastly, the producer to local collector to retailor to consumer channel constituted 8.18% of total business in the study area (Figure 2).

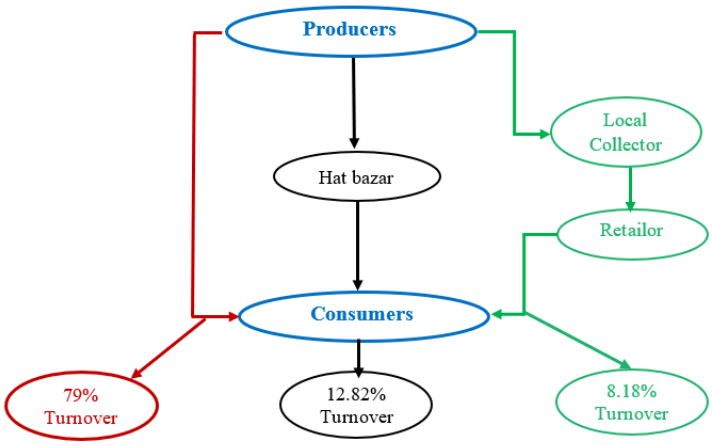

Figure 2: Key stakeholders in the finger millet market in Dolakha district
Source: Field survey,2020

3.5 Evaluating partial food availability from finger millet

We also analyzed the PFA from the organic finger millet by each household, considering factors such as farm size, quantity of production, family size, and sales volume. On an average, respondents reported a PFA 2010.45 KCal/ha/p/d from their farm production. Comparing this to PFA findings from rice, yam and cassava in Nigeria, which were 4693.34 and 4492.78 KCal/ha/p/d, respectively (Chima, 2015; Rahman & Chima, 2018), the results of PFA from finger millet of Nepal indicted that the production of Nepalese finger millet was found to be a greater contribution to food security than in Nigeria. Additionally, a comparison with PFA data for rice in Nepal, reported by Pandit (2021), revealed that the PFA from rice in Nepal was 6961.36 KCal/ha/h/d, 28.8% higher than that of finger millet. The FAO (2002) recommended that an average adult calorie requirement range for an active to a normal person is from 2000 to 2800 calories per day. The calorie availability of this study seems to be balanced when calculated on average. However, the calorie availability of individual farmers ranged from the lowest of 294.47 to highest of 8834.35 KCal/ha/p/d. The findings further indicated that about 57 percent of the farmers had less than 2,000 KCal/ha/p/d available while the rest of the farmers had more than that. Surprisingly, in the study area, out of the total farm size, only one farmer cultivated finger millet in more than one hectare of land, while the rest of the farmers cultivated in less than one hectare. Furthermore, the findings also revealed that 90 percent of the farmers had adopted improved varieties of finger millet, including Kabre Kodo-1 (30.35%), Sailung Kodo-1 (22.82%), Okhle-1 (33.82%), Dalle-1 (0.58%), and local landraces (12.43%). Additionally, 90 percent of the farmers used farmyard manure, while the remaining 10 percent did not use any fertilizer. None of the farmers used organic or chemical pesticides, preserving the organic value of the crop. According to Pool (2014), small-scale farmers are crucial to the local food production system. It is important to note that organic finger millet production in Nepal is dominated by small-scale subsistence farming, which plays a vital role in local food security.

3.6 Major problems in finger millet production

Farmers were asked to rank the problems they faced in organic finger millet farming. The results indicated that the lack of technical knowledge was the most significant issue ($I = 0.83$). The lack of subsidies ranked second ($I = 0.74$), followed by disease and pest infestation ($I = 0.54$). The lack of marketing facilities, and lack of quality seeds ranked fourth, and fifth with scaling values of I = 0.53, and $I = 0.35$ (Table 3).

Table 3: Identification of the major problems associated with the finger millet production in the study area.

Problems	Most serious	Serious	Moderate	A little bit	Least	Index value	Rank
Lack of technical knowledge	35	12	5	4	4	0.83	I
Lack of subsidy	16	26	8	3	7	0.74	II
Disease/pest infestation in the field	7	5	23	13	12	0.54	III
Lack of marketing facilities	2	12	16	25	5	0.53	IV
Lack of quality seeds	0	5	8	15	32	0.35	V

Source: Field survey, 2020

Apart from this, the average harvesting costs accounted for 30 percent of the total cost. Farmers also reported that harvesting of finger millet was challenging, and time-consuming due to the use of traditional methods. LI-BIRD (2016) identified similar issues when analyzing constraints and opportunities for the promoting of finger millet in Nepal. Chandra, *et al.*, (2018) also emphasized the need for modern harvesting technologies to benefit rural communities. Adhikari (2012) highlighted additional issues such as rat infestations during the standing crop phase, and the lack of quality seeds. The lack of promotion, research, and publicity from the government has led to finger millet being considered a neglected crop in the society, resulting in farmers sticking to traditional cultivation methods. By improving farming practices, and providing subsides, the government could significantly increase farmers' interest, attraction and income through enhanced production, and productivity.

4 Discussion

4.1 Policies promoting organic finger millet in Nepal

The movement of organic agriculture farming could have been considered a long time but it was officially re-energized in the Tenth Plan. In general, Tenth Plan mentioned promoted organic agriculture farming, especially for indigenous species including finger millet, with its visible impact on international market as well (NPC, 2002). Considering the problems faced by the farmers regarding the reliability of organic products, the government has adopted a policy of easy branding and certification of organic products. If the policies implement successfully, the problems of the farmers could be resolved to some extent by expending finger millet market and improving its business.

However, in the absence of clear policy, there is no large machinery and industries to process finger millet products. Our finding revealed that, due to lack of proper market arrangements, most of the farmers use a large proportion of their products in home consumption as well as for making alcoholic beverages.

Despite its critical role in food and nutrition security, the lack of proper attention from policymakers had drowned a large portion of the government's potential revenue from this sub-sector. However, small businesses have been replaced by large enterprises, and major crops have given higher priority by the government. As a result, the local food system is deteriorating (Adhikari, *et al.*, 2017), which limits the cultivation and consumption of finger millet. One of the reasons for the lack of development in this sub-sector is the inability to formulate investment policies in marketing and value addition activities.

Despite its numerous advantages, it has failed significantly to boost the production and consumption of finger millet as expected, because of giving the preference to rice in the diets of typical Nepalese households, and the overarching influence of government agricultural policies favoring rice cultivation (Shrestha, 2023).

However, Fifteenth Plan mentioned increasing the marketing activities of finger millet through the national and international marketing network. The term "finger millet" appears only in the Tenth and Fifteenth Plans, whereas "organic agriculture" is mentioned in all period plan documents from Seventh to Fifteenth Plan (NPC, 2020). Besides this, the Seed Act, 1988, includes provisions granting ownership rights to local varieties, which is applicable to finger millet too (GoN, 1988). Likewise, National Seed Policy, 1999 includes provisions for conserving local crop varieties, such as finger millet, and safeguarding the right of local communities over them (MoAD, 1999).

At the same time, the government has been investing public funds for developing finger millet technologies through the Hill Crops Research Program (HCRP) on an annual basis (NARC, 2020), As a result, 6 improved varieties (five released and one registered) of finger millet have been notified in Nepal so far (SQCC, 2023). As a result, farmers are gradually adopting new improved varieties, which is expected to enhanced yields and increased income of farmers.

Consistent increase in cultivated area and production (Figure 1) indicates a growing recognition of finger millet's value among farmers, and policymakers. However, despite these positive trends, the productivity growth remains modest, highlighting the need for further improvements in crop management techniques, seed quality, and the effective use of agricultural inputs. Despite the increased cultivation and productivity, finger millet lacks comprehensive policy support (Sapkota & Joshi, 2023). On the other hand, the International Year of Millet (IYM), 2023 was celebrated with great enthusiasm to promote finger millet cultivation in Nepal, with the aim to ensure that finger millet production significantly contributes to food and nutrition security in Nepal.

Given its crucial role in food security, especially in the Mountainous and Himalayan region of Nepal (Gairhe, *et al.*, 2021), there is a need for more robust frameworks, and targeted investments to enhance the development and market integration of finger millet production.

4.2 Economic viability and marketing networks: Enhancing finger millet farming in Nepal

Findings of our research showed an improvement in gross margin and benefit-cost ratio, mainly due to the increased productivity from adopting improved seed varieties and the higher price of finger millet grains. For example, 90% of farmers in Baiteshwor, Dolakha, adopted improved seed varieties, resulting in an average productivity of 1.27 t/ha, higher than the national average productivity of 1.19 t/ha in 2019 (MoALD, 2020). Therefore, the gross income and benefit-cost ratio are higher in the study site. A comprehensive analysis could be conducted to know the variation in gross income, cost of production, and benefit-cost ratio of Kalikot and Dolakha districts in distinct scenarios. Jha, *et al.*, (2023) in his study in Kalikot district revealed a high gross volume of NRs. 70859.68/ha, accompanied by a total cost of production NRs. 58314/ha with BC ratio 1.24 and net income NRs. 12544.93. Conversely, in this study, calculated gross volume was less than the Kalikot district which was NRs. 68060/ha. However, the cost of production corresponded NRs. 54384/ha, resulting in a slightly higher BC ratio 1.26. Consequently, the net income was estimated to be NRs. 13676/ha.
The BC ratio measures the profitability on the investment. In Dolakha, BC ratio of 1.26 indicates that every unit of cost invested generates 1.26 units of benefit, suggesting a relatively favorable return on investment. Likewise, in Kalikot, the BC ratio of 1.24 signifies a positive return on investment slightly lower compared to Dolakha. Comparing both ratios, it is observed that both demonstrated positive returns but Dolakha may be slightly more efficient. So, it could be stated that organic finger millet farming is financially viable and profitable.
The significant portion of income derived from the sale of alcoholic beverages underscores the importance of value addition in improving livelihood security and generating social benefit through employment generation in the society. Bhandari *et al.*, (2010) indicated a significant net profit, up to 49.09 percent, from finger millet alcoholic beverages of the total investment. This highlights the potential of value addition in stimulating local economies and providing employment opportunities.

4.3 Finger millet: Vital for food security amidst farming problems

Findings of our research revealed that finger millet alone provides 2010.45 $KCal/ha/p/d$, fulfilling a significant portion of the 2000 to 2800 calories per day (FAO, 2002). This emphasizes the critical role of finger millet farming in ensuring food security in Nepal. Which emphasize the importance of finger millet production in Nepal for food security, with organic farming practices preserving its nutritional value. However, disparities in PFA between finger millet and other staple crops like rice (Pandit, 2021), highlights the need for further research and development to enhance finger millet's contribution to food security. Additionally, the variation in individual farmer calorie availability suggests the need for targeted interventions to ensure adequate nutrition among farming communities.
In summary, when considering the availability of calories as a key metric for assessing food security, it is evident that the adoption of improved rice, yam and cassava varieties has led to increased productivity, thereby contributing significantly to food security (Chima, 2015; Rahman & Chima, 2018; Pandit, 2021). Similarly, promoting the adoption of improved finger millet varieties enhance better food availability among rural farmers. Despite its significance for food security, a challenge persists in utilizing millet dishes effectively within the food system in the society (Dhital, 2023). Consequently, there is a compelling need to formulate policies to encourage the adoption of improved finger millet varieties to further enhance food security.

5 Conclusion

The prevailing public policies in Nepal show a progressive but inconsistencies to promote finger millet production. Policies have evolved to broadly address organic farming, but support for finger millet remains limited. The higher gross income and benefit-cost ratio demonstrates the favorable return on investment associated with finger millet production, emphasizing the necessity of adopting improved seed varieties, and value-added processing techniques. Furthermore, the income generated from value-added products emphasizes the importance of legal production and market integration, particularly for the production of finger millet alcoholic beverages. Thus, the government should implement organic farming policies by supporting branding, certification, market arrangements, and training in value addition. Investment in finger millet technology, and linking farmers to international value chain networks can boost income, and health benefits. Comprehensive policies supporting cultivation, including subsidies and infrastructure development are essential. Legal production of finger millet alcoholic beverages could stimulate import substitution and contribute to national wealth by reducing foreign liquor imports.

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Authors' contribution

This research concept was formulated by the RP, NRD was involved in preparation of questionnaire and data collection process. The DD played a key role in data analysis, while TP contributed to the manuscript's design and preparation. Ultimately, all authors collaborated in reviewing the results and manuscript, and collectively approved the final version of publication.

Conflict of interest

The authors declare that there are no conflicts of interest regarding this research article. All authors have seen and agreed with the contents of manuscript, and there is no financial and other interest.

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