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RESEARCH

# Assessment on Impact of Agricultural Subsidies on Potato Production: Evidence from Syangja, Nepal

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## Abstract

This study examines the impact of agricultural subsidies on potato production in the Syangja District of Nepal, where the current productivity is not sufficient to meet the increasing demand despite favorable policies by the government. The study analyses data from 103 potato farmers across four municipalities of Syangja, using a mixed-methods approach to assess the changes in yield, profitability, and farming practices- after the implementation of agricultural subsidies. Major findings of this study reveal substantial improvements: yield increased by 37%, gross margin increased by 85%, and the benefit-cost ratio increased by 72%, following subsidy. Agricultural subsidies also promoted the rapid adoption of modern farming techniques like the use of quality seeds, fertilizers, modern machineries, and improved farming techniques. Regardless, the study unravels critical challenges of such support, including a 15% decline in potato market price, reflecting marketing saturation, and disproportionate benefits to large-scale farmers due to unbalanced subsidy allocation. Although the result demonstrates the efficacy of agricultural subsidies in enhancing short-term productivity and farm income, it also highlights structural challenges in program design regarding equitable access to such programs and market linkages of farm produce. These findings contribute to ongoing policy discussions by providing empirical evidence that while agricultural subsidies help to intensify agriculture, their long-term sustainability requires fair distribution, enhanced extension services, and improved market infrastructures. The study provides valuable policy recommendations for policymakers to improve subsidy schemes towards sustainable agriculture development in Nepal and similar contexts.

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**Statement of Sustainability:** This study on the impact of agricultural subsidies not only offers farm profitability but also on economic equity and farmers' perceptions of such policies, which is often unrepresented in agricultural economics research. This directly supports Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) by enhancing food security through increased yield, SDG 1 (No Poverty) via improved farm profitability, and SDG 10 (Reduced Inequalities) by highlighting access disparities.

## 1. Introduction

The agricultural sector plays a critical role in Nepal's national economy, contributing 24.1% of the country's GDP. However, the growth in agricultural GDP (AGDP) has shown notable volatility in recent years (MoF, 2022). Despite this importance, production levels and productivity across agricultural activities have not met expectations, resulting in the increased import of agricultural products (MoF, 2022). This lackluster growth has made Nepal's agriculture increasingly uncompetitive in both domestic and international markets (World Bank Group, 2016). Among Nepal's cash crops, potatoes play a vital role in addressing food insecurity and alleviating poverty among smallholder farmers (Lamichhane et al., 2019). Potatoes are rich in carbohydrates, proteins, and vitamin C, making them a valuable energy source for rural populations (Timsina et al., 2013). Global potato production in 2022 reached 3.7 billion tons, with an average yield of 21.06 metric tons per hectare. Nepal's productivity was 17.20 metric tons per hectare during the same period (FAOSTAT, 2022). Potatoes are the fifth-largest crop in Nepal in terms of area and the second-largest crop in production, with an

output of 198,253 tons in 2022. The crop contributes 6.35% to Nepal's AGDP, surpassing wheat but slightly trailing maize by 2022 (MoALD, 2022). Despite a 43% increase in potato productivity over the past 35 years, the country's yields remain among the lowest globally (Timsina et al., 2013). Syangja District is a significant potato-producing region, with productivity nearly matching the national average. Potato farming is becoming more popular among Syangjali farmers because of crop adaptability, high yields, and strong market demand. Compared with other staple crops, potatoes offer higher economic returns. The availability of quality seeds and guaranteed markets for tubers have further incentivized farmers to expand potato cultivation in the region.

Agricultural policies in Nepal emphasize the role of subsidies in enhancing production and improving small farmers' access to quality inputs (Panta et al., 2023). Throughout various planning periods, agriculture has remained a policy focus because of its critical role in the economy (Thapa et al., 2023). Globally, agricultural subsidies are often debated, with critics arguing that they disproportionately benefit affluent landowners and farm operators, at the expense of taxpayers. However, proponents believe that subsidies stabilize markets, support low-income farmers, and contribute to food security (Agricultural Subsidy Program, 2008). Subsidies can significantly influence farming decisions, encourage cultivation, reduce land abandonment, and increase both sown area and overall output. These programs are among the most effective tools available to governments for promoting agricultural development, raising farmer's incomes, and ensuring food security (Panta et al., 2023). Moreover, subsidies motivate farmers to invest in their farms, participate in agricultural activities, and attend training programs, all of which can lead to increased productivity and income. Research highlights a positive, statistically significant relationship between agricultural production and subsidies (Vozarova and Kotulic, 2016). Well-designed subsidies also serve social welfare objectives, addressing food insecurity and improving nutrition (World Bank Group, 2016). Agricultural subsidies come in various forms: area-based, quantity-based, or production-based, and their impacts differ. For example, although some subsidies promote food security, they may also have adverse environmental effects. In South Asia, water and energy subsidies intended to achieve food self-sufficiency have contributed to the depletion of natural resources (Zhang et al., 2021). Effective access to subsidized inputs remains crucial for strengthening the agricultural sector (Thapa et al., 2023).

In Fiscal Year 2022/23, Nepal allocated an NRs. 31.8 billion for agricultural subsidies, covering fertilizers, seeds, machinery, and insurance premiums (Economic Survey for FY 2022/23 presented in parliament, 2023). Since FY 2012/13, Nepal has offered a 75% subsidy for agricultural insurance premiums, increasing to 80% in FY 2022/23. These subsidies include technical support, agricultural credit, and machinery aids. However, agricultural productivity has not seen the expected increase, and food imports continue to rise. Despite substantial government subsidies aimed at increasing potato production, productivity in Nepal's Syangja District has not kept pace with rising demand due to various challenges like inequitable distribution and market saturation. This study seeks to address these challenges by evaluating the impact of subsidies on potato production, profitability, and equitable access while identifying systemic barriers that hinder their effectiveness. Existing literature underscores the potential of subsidies to enhance agricultural productivity and farmer incomes (Lamichhane et al., 2019; Vozarova and Kotulic, 2016). However, studies also highlight disparities in subsidy access, with larger farmers benefiting disproportionately due to better networks and resources (Thapa et al., 2023). This disparity leaves many of the most vulnerable farmers without sufficient support, highlighting the systemic issues in equitable subsidy distribution. Additionally, subsidies often lack complementary measures such as market linkages and training, limiting their long-term impact (World Bank Group, 2016). Environmental concerns, such as resource overuse linked to input subsidies, further complicate their sustainability (Zhang et al., 2021). This study fills a critical gap by examining subsidy impacts in Nepal's mid-hill farming systems, an underrepresented area in empirical research.

This study hypothesizes that agricultural subsidies significantly improve potato productivity and farm profitability in Syangja District but are undermined by inequitable distribution, market inefficiencies, and inadequate training. The thesis argues that while subsidies are effective in the short term, their long-term success depends on addressing these systemic issues. The primary objective of this study is to evaluate the impact of agricultural subsidies on potato production in Nepal's Syangja District, focusing on yield improvements, profitability, and technology adoption. Additionally, the research examines the equity of subsidy distribution to determine whether smallholder farmers benefit equally compared to larger landowners. Another key objective is to identify challenges such as market saturation and price declines resulting from increased production. Finally, the study aims to provide actionable policy recommendations to enhance the effectiveness, fairness, and long-term sustainability of subsidy programs in Nepal's agricultural sector.

## 2. Materials and Method

This study evaluated the effectiveness of agricultural subsidies on potato production in the Syangja district (latitude 28˚4′60N and longitude 83˚52′0E), which is located at an altitude ranging from 300 m asl at the base of the Kaligandaki River up to 2266 m asl, utilizing a mixed-methods approach. The research was conducted across four municipalities:- Galyang, Waling, Chapakot, and Bhirkot, selected for their notable potato production potential. A preliminary field visit facilitated rapport-building with local communities and allowed the identification of critical factors influencing potato cultivation. The field survey was conducted from March 15, 2024, to May 15, 2024. The target population comprised farmers who received subsidies for potato cultivation, totaling 334. Since the study mainly focused on subsidy-receiving potato producers, we employed a purposive sampling technique to ensure that the participants would be the major subsidy receiver, and the sample size was calculated using the following formula with a 10% error margin (Yemane, 1967):

$$\text{Sample size (n)} = \frac{N}{1 + N.e^2}$$

Data were systematically collected through a semi-structured questionnaire administered via face-to-face interviews, enabling farmers to articulate their perceptions of subsidies. The questionnaire was pretested with five households in each municipality to ensure the clarity, reliability, and validity of the data collection instrument. The primary data sources included farmers, cooperatives, and service providers, supplemented by secondary data from relevant institutional reports and publications. Statistical analyses were performed using SPSS and Microsoft Excel. Descriptive statistics, including means, percentages, and standard deviations (SD), were used to summarize the demographic characteristics of the sample population. To assess the economic impact of subsidies, paired sample t-tests were conducted to compare the cost factors, and economic determinants before and after the provision of subsidies. The formulas employed in the analysis are as follows:

$$\text{Revenue from potato sales (R)} = GR = P \times Q$$

$$\text{Total variable cost (TVC)} = \sum [\text{Cost of seeds} + \text{fertilizers} + \text{labor} + \text{machinery} + \text{others}]$$

$$\text{Benefit} - \text{cost ratio (BCR)} = \frac{GR}{TVC}$$

Also, the index of importance to rank the factors is calculated as (Khatri et al., 2023):

$$\text{Iimp} = \frac{\sum[Si \times Fi]}{N}$$

Where $S_i$ represents the scale value for each priority; $F_i$ represents the frequency of that priority; and N represents the total number of respondents. Additionally, the paired sample t-test evaluates the effectiveness of subsidies by comparing economic indicators, while the McNemar test assesses changes in technology adoption.

## 3. Results

### 3.1. Demographics and Socioeconomic Status of Respondents

Tables 1 and 2 demonstrate the socioeconomic status of the respondents in the study area. The average age of the surveyed farmers was 46.99 years highlighting that middle-aged farmers, particularly those between 40 and 55 years old, represent the largest demographic group engaged in potato production in the study area. The average family size of respondents was 5.64. Of these, 3.99 were economically active, falling within the working-age range of 15 to 60 years, while 1.66 members were economically inactive, being either under 16 or over 60 years old. The average dependency ratio for the surveyed households was 41.60%, indicating that for every 100 economically active individuals, there were approximately 42 dependents. Additionally, the mean number of employees per household was 0.83, indicating a relatively low level of formal employment within households. The average annual income of the surveyed farmers was NRs. 8,49,902.91, with significant earnings variability indicated by higher SD. The average landholding of the respondents was 0.7 hectares, of which 0.47 hectares were irrigated. Notably, potato cultivation occupies more than half of the irrigated land, reflecting a strong focus on potato production within the limited irrigated land resources of the farmers.

Table 1. Demographics and socioeconomic status (a) of the respondents.

| Variables | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Age(years) | 46.99 | 9.23 | 25 | 70 |
| Family size | 5.65 | 2.06 | 2 | 13 |
| Economic members | 3.99 | 1.49 | 1 | 10 |
| Non-economic members | 1.66 | 1.58 | 0 | 6 |
| Dependency ratio(%) | 41.60 | 60.13 | 0 | 200 |
| Formally employed members | 0.83 | 1.00 | 0 | 5 |
| Annual income (NRs./year) | 849902.91 | 1142165.56 | 50000 | 4500000 |
| Landholding(ha) | 0.70 | 0.67 | 0 | 4.58 |
| Irrigated land(ha) | 0.47 | 0.55 | 0 | 4.58 |
| Potato area(ha) | 0.28 | 0.33 | 0.05 | 0.33 |

Source: Field survey (2024).

Of the 103 respondents, 54% were male, and 46% were female. This near-equal gender distribution suggests a balanced participation of both men and women in potato farming within the surveyed group. Among the respondents, 79% were of Brahmin/Chhetri community, 9% were of Janajati community, and 12% were of Dalit community, reflecting the predominance of Brahmin/Chhetri participants in the survey, with smaller but significant representations from the Janajati and Dalit communities. In terms of education, the majority, nearly 35%, had completed the certificate level, while a smaller percentage, 7.7%, had attained university-level education, and an equal percentage of respondents were only illiterate. This distribution highlights a broad range of educational attainment among farmers, with a significant portion having completed formal education up to the certificate and secondary levels.

Table 2. Demographics and socioeconomic status (b) of the respondents.

| Variables | Categories | Frequency (N=103) | Percentage (%) |
|---|---|---|---|
| Gender | Male | 56 | 54.40 |
| | Female | 47 | 45.60 |
| Ethnicity | Brahmin/Chhetri | 82 | 79.60 |
| | Janajati | 9 | 8.70 |
| | Dalit | 12 | 11.70 |
| Education level | Illiterate | 8 | 7.80 |
| | Only literate | 17 | 16.50 |
| | Primary level | 10 | 9.70 |
| | Secondary level | 24 | 23.30 |
| | Certificate level | 36 | 35.00 |
| | University level | 8 | 7.80 |
| Major economic activity | Agriculture | 53 | 51.50 |
| | Foreign employment | 25 | 24.30 |
| | Service | 21 | 20.40 |
| | Business | 4 | 3.90 |
| Agriculture type | Subsistence | 25 | 24.27 |
| | Semi-commercial | 52 | 50.48 |
| | Commercial | 26 | 25.25 |
| Experience on potato cultivation | 0-5 years | 30 | 29.10 |
| | 6-10 years | 10 | 9.70 |
| | 11-15 years | 10 | 9.70 |
| | 16-20 years | 20 | 19.40 |
| | >20 years | 33 | 32.00 |
| Training access | Yes | 57 | 55.30 |
| | No | 46 | 44.70 |
| Loan Source | No loan | 21 | 20.38 |
| | Local moneylenders | 19 | 23.17 |
| | Cooperatives | 23 | 36.50 |
| | Microfinance | 6 | 9.52 |
| | Formal banking | 34 | 53.96 |

Source: Field survey (2024).

A significant proportion (51.5%) of respondents were practicing agriculture as their main source of income. This shows that, while agriculture remains the dominant livelihood for over half of the respondents, a considerable proportion also depends on non-agricultural sectors. Most of the respondents (5-.48%), were following semi-commercial agriculture, reflecting a blend of subsistence and market-oriented practices. This distribution underscores the prevalence of semi-commercial practices within the farming community and highlights the diverse agricultural strategies employed

by farmers in the region. In terms of experience, there was a diverse range of experience levels in potato farming: 30 farmers (29.12%) had less than five years of experience, while 10 farmers (9.7%) had 6 to 10 years. An additional 10 farmers (9.7%) had 11 - 15 years of experience, and 20 farmers (19.42%) had 16 - 20 years of experience. Notably, 33 farmers (32%) had more than 20 years of experience in potato farming. This distribution underscores the blend of novice and veteran farmers, indicating the potential for knowledge exchange and mentorship within the community. Forty-five percent of the surveyed farmers had received at least one training opportunity to enhance their skills, while a significant majority (55%), had not yet had the chance to participate in any training program related to potato farming. This disparity underscores a critical gap in access to educational resources, which may hinder the professional development of more than half of farming communities. Among the 103 respondents, a substantial majority of the 82 farmers took loans to support their agricultural and other household activities. Of these, 63 farmers (approximately 77%) secured loans from institutional sources, such as banks, cooperatives, or microfinance institutions, while 19 farmers (approximately 23%) obtained funding from local moneylenders, possibly including family, relatives, and neighbors. This indicates a strong reliance on external financial institutions for credit, which may reflect farmers' need for more capital to invest in their operations and enhance productivity.

### 3.2. Comparison of Production Cost and Economic Determinants Before and After Subsidy

The results of the paired t-test comparing various input costs and economic determinants of potato production before and after the provision of agricultural subsidies in the study area are presented in Table 3. Some input costs like labor cost, machinery cost, FYM cost, and transportation cost, that did not change after subsidy implementation are not included. The findings revealed a significant reduction in seed costs, with an average decrease in NRs.100,511.64/ha, supported by a t-value (31.20) and a highly significant p-value (0.000). Similarly, fungicide and packaging costs showed substantial declines by NRs.8,256.60/ha and NRs.4,975.78/ha, respectively, both of which were statistically significant. Interestingly, while most input costs decreased, the total chemical fertilizer cost increased by NRs.3,958.90/ha. This increase is due to the shift(increase) in fertilizer usage post-subsidy because of improved awareness of farmers regarding recommended fertilizers' dose, which is also supported by the negative t-value (-21.21).

Table 3. Comparison of production cost and economic determinants in the study area.

| Particulars | Mean Before Subsidy (SD) | Mean After Subsidy (SD) | Mean Difference (SD) | t-value | p-value |
|---|---|---|---|---|---|
| Seed cost (NRs./ha) | 137645.95 (35563) | 37134.31 (8409.35) | 100511.64 (32691) *** | 31.20 | 0.000 |
| Fungicide's cost (NRs./ha) | 8568.35 (4570.67) | 311.76 (1603.51) | 8256.60 (4658) *** | 17.10 | 0.000 |
| Post-harvest cost (NRs./ha) | 6657.12 (3191.26) | 1681.35 (814.33) | 4975.78 (2383) *** | 21.19 | 0.000 |
| Chemical fertilizers' cost (NRs./ha) | 17362.76 (8205) | 21321.66 (10095) | -3958.90 (1894) *** | -21.21 | 0.000 |
| Total variable cost (NRs./ha) | 356904.34 (61693) | 247959.00 (46534) | 108945.33 (32894) *** | 33.61 | 0.000 |
| Yield (Mt/ha) | 11.08 (6.52) | 15.26 (7.28) | -4.18 (8.23) *** | -5.16 | 0.000 |
| Selling price (NRs./kg) | 56.37 (7.78) | 47.82 (11.07) | 8.55 (9.08) *** | 9.56 | 0.000 |
| Gross return (NRs./ha) | 622478.15 (373660) | 738149.68 (419527) | -115671.5 (493435) ** | -2.38 | 0.019 |
| Gross margin (NRs./ha) | 265573.82 (359624) | 490190.67 (410424) | -224616.85 (488882) *** | -4.66 | 0.000 |
| B: C ratio | 1.73 (0.96) | 2.98 (1.60) | -1.25 (1.71) *** | -7.44 | 0.000 |
| Potato area(ha) | 0.16 (0.28) | 0.28 (0.33) | -0.12 (0.16) *** | -7.37 | 0.000 |
| Seed requirement(kg/ha) | 1720.36 (444.48) | 1856.48 (420.41) | -136.12 (455.68) *** | -3.03 | 0.003 |

Note: **& **** indicate significance at 5% and 1% levels. Source: Field survey (2024).

The total variable cost(sum of all input costs: seed, labor, machinery, fertilizers, FYM, transportation, and postharvest management costs), also experienced a significant reduction in NRs. 108,945.33 per hectare (p-value 0.000), demonstrating the effectiveness of the subsidy in easing the financial burden on farmers. These results underscore the program's role in improving profitability, with most input costs significantly reduced. Results also revealed a significant increase in potato yield, by 4.18 mt/ha following the subsidy, maybe due to the increased use of fertilizers and adoption of modern farming techniques. This boost in productivity is accompanied by a substantial increase in both gross returns and gross margins. The increase in gross margin (by NRs.224616.85/ha) can be attributed to the reduction in total variable costs. Additionally, the B: C ratio improved significantly, rising from 1.73 to 2.98 after the subsidy was implemented. Interestingly, the selling price per kilogram of potatoes decreased by NRs. 8.55/kg post-subsidy, suggesting market saturation. These findings underscore the positive impact of subsidies on potato production economics, thereby enhancing profitability and efficiency for farmers. The area allocated for potato farming also increased from 0.16 hectares before the provision of subsidies to 0.28 hectares afterward, a change that is statistically significant with a p-value of 0.000. This indicates the substantial impact of the subsidy on expanding the cultivation area. Additionally, the increase in seed requirement per hectare from 1,720 kg before the subsidy to 1,856 kg after the subsidy,

with a p-value of 0.003, suggests that the subsidy not only encouraged farmers to increase the planting area but also led to more intensive seed use per hectare, potentially reflecting investment in higher yields and improved farming practices.

### 3.3. Comparison of Technology Adoption Scenario Pre- and Post-Subsidy

Table 4 illustrates the technology adoption scenario in the study area. The introduction of subsidies significantly raised the use of modern farming techniques, increasing the use of quality seeds from 12 to 95, and modern machinery from 37 to 79. This sharp change suggests that the subsidy program successfully eliminated the financial constraints on access to important agricultural technologies. However, the slower pace of practice adoption, for example, that is related to plant geometry maintenance and improved methods of harvesting, brings into focus that behavioral and knowledge-based factors may still be a hindrance to full practice. Targeted training can help bridge these gaps, thereby further improving productivity. The Mc-Nemar test results confirm a highly significant shift in technology adoption before and after the subsidy, with a p-value of <0.001. The result illustrated that the subsidized provision of funds to farmers assists in overcoming their former economic and technical constraints, which always hindered farm efficiency, improved yields, and proper resource management. This eventually positions farmers in a more competitive and viable manner, in the future.

Table 4. Adoption of modern farming techniques pre- and post-subsidy.

| Modern Farming Techniques | Adoption Before Subsidy | | Adoption After Subsidy | | Mc Nemar Test Stat | P-value |
|---|---|---|---|---|---|---|
| | Yes | No | Yes | No | | |
| Quality seed use | 12 (11.7) | 91 (88.3) | 95 (92.2) | 8 (7.8) | 73.89*** | 0.001 |
| Micronutrients use | 11 (10.7) | 92 (89.3) | 76 (73.8) | 27 (26.2) | 59.36*** | 0.001 |
| Plant protection measures | 10 (9.7) | 93 (90.3) | 88 (85.4) | 15 (14.6) | 70.58*** | 0.001 |
| Modern technology use | 37 (35.9) | 66 (64.1) | 79 (76.7) | 24 (23.3) | 36.54*** | 0.001 |
| Crop geometry maintenance | 48 (46.6) | 55 (53.4) | 79 (76.7) | 24 (23.3) | 29.03*** | 0.001 |
| Good harvesting measures | 18 (17.5) | 85 (82.5) | 73 (70.9) | 30 (29.1) | 44.86*** | 0.001 |

Note: *** indicates significance at a 1% level. Source: Field survey (2024).

### 3.4. Farmer's Perception(a)

Farmers' perceptions on the following nine statements: Subsidies have changed the lifestyle of rural farmers (A), Use of modern agriculture techniques has been increased after provision of subsidies (B), There are significant differences between marketing techniques and channels pre-and post-subsidies (C), Subsidies has been provided to needy ones (D), Subsidy program is satisfiable (E), Attraction of youth towards farming has increased after provision of subsidies (F), Extension officers are visiting the field regularly (G), The subsidy amount and frequency are directly proportional to increased production and profit (H), and Subsidies program is demand based (I), were taken and coded respectively from A to I for convenient interpretation.

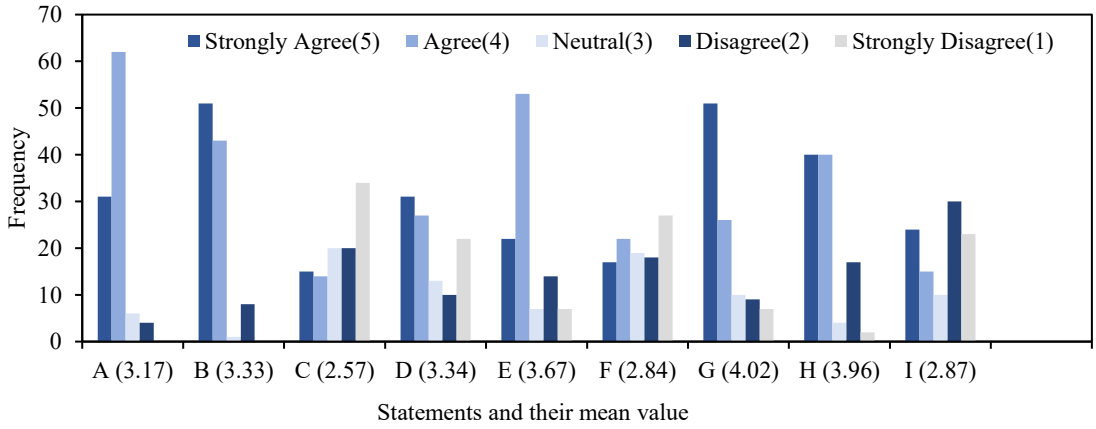


Figure 1. Farmer's perceptions (a) on the impact of agricultural subsidy *Note: The mean value is obtained by assigning a value of 1 to strongly disagree, 2 to disagree, 3 to neutral, 4 to agree, and 5 to strongly agree respondents' sentiments.

Figure 1 shows farmers' perceptions of agricultural subsidies in various dimensions: a strong majority (60.2%) believed that subsidies have improved their lifestyles;- and the mean score of 3.17 reflects the belief in general

agreement with their benefits. Modern farming techniques were generally adopted after receiving a subsidy, as revealed by the mean score of 3.33, suggesting that financial support encourages innovation. However, responses towards marketing techniques are less unanimous. With a mean of 2.57, some farmers felt that progress was being achieved, whereas others were unconvinced. The fact that subsidies are specifically targeted towards those in greatest need yields a positive response, as seen with a mean of ss3.34, indicating equity in the program's distribution. Whereas general satisfaction with the subsidy reaches a high mean score of 3.67, attractiveness to the youth towards agriculture was somewhat lower, with a mean score of 2.84, hence requiring specific strategies for engaging the younger generation. In fact, regular field visits by extension officers have been rated very highly with a mean of 4.02, underlining their primacy in maximizing the benefits from subsidies. The correlation of subsidy amounts and increased production had an average of 3.96, indicating perceived profitability, whereas mixed feedback regarding demand-based subsidies had an average of 2.87, indicating areas of improvement. In summary, while an appreciation of the idea that subsidies are indeed helpful is found, some key areas that need attention are the engagement of youth and the refinement of program design to ensure long-term success.

### 3.5 Farmer's Perceptions (b)

Perceptions of farmers on following six statements: Subsidies provided is timely (A), Provided subsidy is easily accessible (B), You are likely to continue potato farming if subsidies are removed (C), Availability of subsidy has positively impacted the potato farming operations (D), You are interested in increasing the potato area next year (E), and You face market problem often during selling of potatoes (F) were taken and coded respectively from A to F for convenient interpretation. Figure 2 shows farmers' perceptions of the implementation of subsidies in potato farming. Most farmers perceived the availability of subsidies to be timely. However, the variation in their responses showed that for some, these subsidies came a bit late. As far as accessibility is concerned, it can be perceived as rather easy, with an average of 3.85. Assumingly, a majority of the farmers (54.4%) were very confident of continuing potato farming without subsidies (mean 3.97), though variability in responses suggests not all would find it easy. Improvement in farming operations post-subsidy was reported by 66% of the farmers with a mean score of 3.22, with relative consistency of responses suggesting widespread agreement on benefits accrued. Moreover, 53.4% of the respondents wished to expand the potato farming area, which might be stimulated by subsidies, as expressed by the mean of 3.22. However, market-related problems are often mentioned, with a mean of 3.77, with 41.7% reporting these issues to happen often, showing that besides production support, market access remains a major issue. Overall, the data showed that subsidies are perceived as timely, approachable, and relevant; hence, many farmers are encouraged to increase the area under potato cultivation, although at less than full potential, due to various market-related problems.

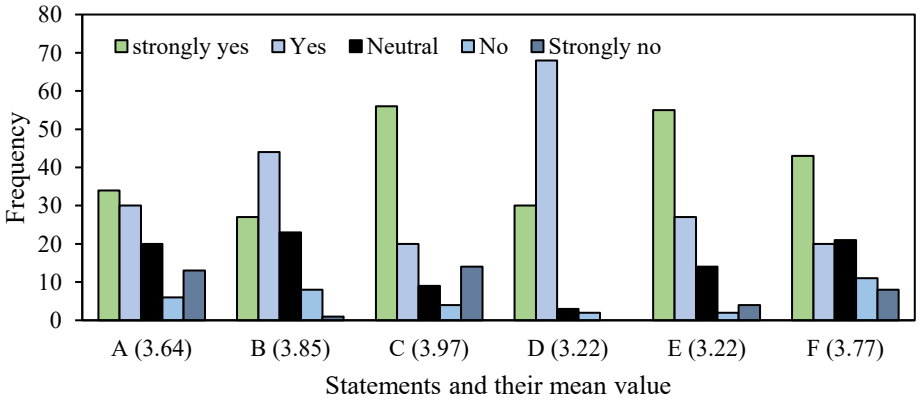


Figure 2. Farmer's perceptions (b) on the impact of agricultural subsidy *Note: The mean value is obtained by assigning a value of 1 to strongly disagree, 2 to disagree, 3 to neutral, 4 to agree, and 5 to strongly agree respondents' sentiments.

### 3.6. Results of Forced Ranking

Table 5 shows the results of the forced ranking of several factors including factors affecting farmers' access to subsidies, specific benefits of the subsidies perceived by the farmers, farmer's expectations regarding the type of subsidies, and weaknesses of such subsidy programs. Regarding factors affecting farmers' access to subsidies, membership to cooperatives, scoring 0.77, acted as the main barrier to accessing the subsidy, indicating that farmers who were not members of such networks were at a disadvantage. The unawareness of farmers and reliance on

subsistence farming equally act as major factors limiting access;- with a score difference of only 0.01. The fourth rank is occupied by the coordination gap between service providers and farmers, indicating, that communication needs to be improved. Surprisingly, perceived bias in authorities scored the lowest at 0.34, indicating that it is not a serious issue in the study area. These results underscore the importance of expanding membership, sensitization, and increasing farm size as the most promising strategies for enhancing access to subsidies. Additionally, coordination between farmers and service providers should be conducted to make the process easier, and access to subsidy distribution can result in greater equity and efficiency. Regarding its benefits, farmers perceived subsidies as, most effective in reducing production costs, with an index value of 0.75, indicating that financial relief is utmost. Increased productivity comes next, which shows that subsidies are strongly associated with improved yields and farming efficiency. Third, the adoption of new technologies, means that technology adoption is less attributed than cost-saving and productivity. Access to resources followed at 0.52, which indicates that although subsidies enhance the acquisition of inputs, they are less important than financial and technological benefits. Lastly, improved product quality is 0.42;- which means that subsidies were primarily focused on immediate reduction in costs and efficiency enhancement rather than the improvement in the quality of their products. Overall, farmers view subsidies largely as a tool/policy of financial benefits, followed by productivity and the adoption of technology.

Table 5. Result of forced ranking (factors affecting farmers' access to the subsidy program).

| **Factors affecting farmers access to subsidy program** | | |
|---|---|---|
| Factors | Index/Score value | Rank |
| Biasness of authority | 0.34 | V |
| Membership in cooperative | 0.77 | I |
| Farmer's awareness | 0.67 | II |
| Coordination gap between service providers and farmers | 0.55 | IV |
| Small landholding/ subsistence agriculture | 0.66 | III |
| **Specific benefits of subsidies perceived by farmers** | | |
| Specific benefits | Index/Score value | Rank |
| Increased productivity | 0.70 | II |
| Reduced cost of production | 0.75 | I |
| Adoption of new technologies | 0.62 | III |
| Access to resources | 0.52 | IV |
| Improved quality of products | 0.42 | V |
| **Subsidy type expected by farmers** | | |
| Expected subsidy type | Index/Score value | Rank |
| Input subsidy | 0.72 | II |
| Product subsidy | 0.73 | I |
| Machinery subsidy | 0.54 | IV |
| Marketing subsidy | 0.60 | III |
| Technical subsidy | 0.41 | V |
| **Weaknesses of present subsidy program** | | |
| Weaknesses | Index/Score value | Rank |
| Lengthy and difficult/papery process | 0.51 | III |
| Insufficient quantity | 0.72 | II |
| Communication gap between service providers and farmers | 0.49 | IV |
| Lack of demand-driven subsidy | 0.80 | I |
| Poor monitoring | 0.48 | V |

From the result, it is observable that production-linked support is highly emphasized by farmers, as represented by the highest score of 0.72. This shows that farmers believe the subsidies linked to output greatly increase yield and profitability. Of equal importance, input-linked subsidies also scored the same at 0.72, emphasizing access to such vital resources at lower costs. Marketing subsidies are third with a cumulative value of 0.60, reflecting that farmer expects government support in the sale of products and access to markets. It is also indicative of the presence of challenges related to market access and pricing in the study area. Machinery subsidies were expected relatively less with an index value of 0.54. This indicates that modernization in farming is important but is relatively less important than production and input assistance. Technical knowledge and training subsidies had the lowest value of 0.41, implying that farmers need urgent financial support instead of long-term skill development. In general, farmers focus on/expect subsidies that reduce production costs and increase yields. On the other hand, they highly valued marketing support and equipment. Regarding the weaknesses of the present subsidy program, the most critical issue is the non-demand-driven nature of

subsidies, as expressed by farmers. Farmers believed subsidies have not considered farm-level needs. This was closely followed by insufficient quantities of subsidy (0.72), indicating that even when available, subsidies are not enough to meet the demands of the farmers. The third most important challenge is the cumbersome and lengthy application procedure, scoring 0.51, while the communication gap between service providers and farmers takes fourth place, with a score of 0.49. This would explain the inadequate information flow that further complicates access. Finally, poor program monitoring at 0.48 signifies weak oversight as a complement to inefficiencies and probable mismanagement. These results point to a subsidy program that is poorly aligned with farmers' needs, poorly distributed, and afflicted with problems of procedure, communication, and oversight, thus requiring a system that is more responsive, and transparent.

## 4. Discussion

Socioeconomic characteristics like landholding, income, economic activity, credit sources, and training access of the respondents are almost like the previous studies conducted in Syangja like Pradhan et al. (2023). The findings of this study confirm that agricultural subsidies have contributed significantly to improving potato production in the Syangja District of Nepal. The results indicate that the yield of potatoes increased significantly from 11.08 mt/ha to 15.26 mt/ha ($p = 0.000$), which underpins the fact that the subsidy has facilitated farmers' access to improved inputs such as seeds and fertilizers. This agrees with Lamichhane et al. (2019), who, in their work, stated that "targeted subsidies can improve agricultural productivity and food security". Gross margin also increased from NRs.265,573.82 to NRS 490,190.67, reflecting that the financial benefits enjoyed by the subsidy were real. This increased profitability supports the argument of Panta et al. (2023) that well-structured subsidy programs can stabilize farmers' incomes, thereby enabling them to reinvest in agricultural activities. Furthermore, the benefit-cost ratio increased significantly from 1.73 to 2.98, an indication of the higher economic viability of potato farming and farmers reaping better returns for their investments. Although these results are promising, the challenge remains, particularly for the equity criteria on subsidies. Indeed, the study shows that larger farmers benefit more from subsidies owing to resource access and better networks, as portrayed by Thapa et al. (2023). Such disproportionate access raises important questions regarding the efficiency of subsidy programs for successful rural development. The relevant policies should therefore ensure that the sharing of subsidies is fair and that smallholder and marginalized farmers who, due to various resource constraints, are often excluded from such programs must be incorporated. Reduced selling prices of potatoes, from NRs. 56.37 per kg to NRs. 47.82 per kg ($p = 0.000$), suggesting market saturation. While this rise in production is good, the result of such a high level of production, without corresponding market demand, is often a drop in prices. This calls for a well-developed market infrastructure that would help farmers obtain decent prices for their produce. Zhang et al. (2021) underscore the dependency on effective ways in which market mechanisms absorb increased supply, thereby emphasizing that effective market access is crucial for price stability and income security for farmers. Training accompanied by financial support is intrinsic to the maximum effect of productivity subsidies. Although the subsidy has brought financial relief, many farmers are either unaware of or have not received any training in modern agricultural practices. Other studies, such as those by Timsina et al. (2013), have found that a lack of adequate knowledge and skills is one of the main deterrents to the effective utilization of given subsidies. Integrating training and extension into subsidy programs will enhance farmers' capabilities for the better adoption of modern technologies and sustainable practices.

The results also showed that concerns about sustainability in subsidy programs are critical. While subsidies have realized some short-term gains with respect to productivity, full reliance on input-based subsidies leads to environmental degradation and resource overutilization. Policymakers should incorporate aspects of sustainability into subsidy frameworks to foster responsible resource management and ensure that agriculture is viable in the long run, as noted in the existing literature, ensuring that natural resources are protected such that agricultural systems remain productive in the future. In addition, 79.62% of the farmers surveyed still depended on loans, which indicates that even valuable subsidies cannot eliminate the need for credit. According to the arguments of Vozarova and Kotulic (2016), dependence on credit may well act as a deterrent to fully implementing modern practices. Assuring access to subsidized credit would contribute much more to farmers' investment in resources and technologies, which could enhance their productivity and profitability. Farmers' perceptions of subsidies indicate optimism; many farmers appreciate the improvement in their livelihoods and productivity due to financial support. However, farmers mentioned certain concerns related to the accessibility and timeliness of subsidy provisions. Subsidy provision in regular installments,- with timely delivery,- is crucial for farmers to plan and execute their agricultural activities efficiently. After these issues have been addressed, farmers will be more confident in subsidy programs and increase participation accordingly.

This research also suggests that farmers outside organized groups face significant barriers, aligning with broader studies showing that collective action plays a crucial role in accessing resources aligning with the results of Zhang et al. (2021). Increasing awareness and targeting subsistence farmers could bridge this gap (Panta et al., 2023). Regarding the benefits of subsidies, the highest-ranking advantage perceived by farmers was cost reduction, followed by increased productivity, and technology adoption. These results reinforce the effectiveness of subsidies in improving farm efficiency, supporting the literature that links subsidies to increased agricultural productivity (Vozarova and Kotulic, 2016). However, less emphasis was placed on improved product quality (0.42), which suggests a need for future programs to focus not only on quantity but also on enhancing the quality of agricultural outputs. Similarly, regarding farmers' expectations of subsidies, production-based subsidies (0.73) were the most desired, closely followed by input subsidies (0.72), reflecting farmers' prioritization of direct financial support to enhance yields. Marketing subsidies (0.60) and machinery subsidies (0.54) are also significant, highlighting the need for comprehensive support beyond inputs alone (Thapa et al., 2023). The weaknesses of subsidy programs ranked the lack of demand-driven subsidies as the most critical issue (0.80), followed by insufficient subsidies (0.72), and lengthy application processes (0.51). These barriers point to the need for more tailored and timely support to meet farmers' specific needs and simplify the bureaucracy involved in accessing subsidies (World Bank Group, 2016). Agricultural subsidies have resulted in increased production of potatoes and, consequently, higher profitability in the Syangja District. However, equitable access, distribution, and market accessibility, together with sustainability issues remain important challenges to the full accomplishment of such programs. Policymakers can further make agricultural subsidies effective for rural development and food security in Nepal by targeting smallholder farmers with training and market linkages.

## 4. Conclusion and Recommendations

Agricultural subsidies are the critical determinants of enhancing potato production in Syangja, Nepal. Improvements in yield, farm profitability, and technology adoption are possible through subsidy programs. However, the full potential of such programs is limited by equitable distribution and market access. More resource-owned farmers with larger bureaucratic connections benefitted more compared to small-scale farmers. Policymakers should focus on allocating such support in an equitable manner, which can be ensured through better transparency in the allocation process and targeted intervention. Training programs should also be combined with financial support so that layman farmers can properly use advanced technologies and sustainable practices. More inclusive and sustainable subsidy programs will improve its efficiency towards rural development, and poverty alleviation along with agricultural sustainability over long-run.

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**Data Availability/Sharing:** The datasets used and analyzed during the current study will be made available from the corresponding author upon a reasonable request.

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