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RESEARCH ARTICLE

VEGETABLE SEED PRODUCTION AND MARKETING IN KAVREPALACHOWK DISTRICT, NEPAL: AN ECONOMIC ANALYSIS

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ABSTRACT

Vegetable seeds, in Nepal's context, are regarded as a high-value and low-volume commodity that, despite having a great scope for lucrative production, still proves to be elusive for farmers. In this regard, a study was carried out in Kavrepalanchowk district of Nepal to assess the economics of vegetable seed production and determine the economic viability of seed production enterprises in increasing farm income and improving socio-economic status. Face-to-face interviews using a semi-structured survey questionnaire were used to collect the primary data. For the interview, a sampling frame of all seed producers in the district was prepared, out of which sixty seed producers were selected using a simple random sampling technique. Further, ten traders were also surveyed with a semi-structured questionnaire. The highest benefit-cost ratio was recorded in tomato (3.36), followed by kidney bean (1.55) and cress (1.34). Only one marketing channel was reported at the study site, with farmers selling their produce to a cooperative, which eventually sells the seeds to a seed company. According to the study, kidney bean seed producers had the highest share of consumer rupees (72%), followed by tomato seed producers (50%) and cress seed producers (16.67%). Limited irrigation facilities, the incidence of disease and pests, and limited market information have been reported as the major hindrances in the study area. Thus, the findings show the potential of vegetable seed production to be a financially lucrative enterprise. The enhancement of market linkage and better collaboration between various value chain actors and concerned stakeholders can help overcome existing problems and create a better foundation to improve the seed production enterprise.

KEYWORDS

Seed, Benefit-Cost, Irrigation, Market Access, Co-operative, Collaboration

1. INTRODUCTION

Vegetable production in Nepal is one of the most important farming practices, as it contributes around 16.36% to the Agricultural Gross Domestic Product (AGDP) (MOALD, 2022). As a significant part of the economy, vegetable production is efficient in generating cash from a small plot of land in a relatively short period of time, ultimately improving the livelihood of the farmers (Pandey and Gautam, 2021). In Nepal, a total of 3,091,000 ha of land is under agriculture, out of which vegetables are cultivated on 284,121 ha with 3,993,167 Metric ton (Mt) of production per year (MOALD, 2022).

Vegetable seed production is recognized as a profitable enterprise for improving the livelihood of farmers and addressing issues of self-sufficiency, food security, and economic development in remote areas (Timsina and Shivakoti, 2018). This makes it one of the most promising sub-sectors to enhance the rural economy. The increase in area and demand for fresh vegetables during the main season as well as the off-season has resulted in an increasing demand for improved vegetable seeds (Shrestha et al., 2019). Agro-climatic diversity in Nepal has great potential for growing different kinds of vegetable seeds, which can be used both for domestic consumption and export (MOAC, 2011).

More than 80% of the total seed demand in Nepal is met by the informal sector, where farmers produce and preserve their seeds and also take part in farmer-to-farmer exchange for their utilization in next season's planting. Only 16–17% of the total seed demand is met by the formal sector (Devkota and Shrestha, 2020). The value of exports of seeds, fruits, and spores used for sowing was about $100,000 in 2021, which is hugely overshadowed by the value of imports of the same commodity ($7.9 million) in the same year, which was a 26% increase as compared to the imports in 2020. These commodities accounted for 0.05% of the total import flow in 2021, in stark contrast to the mere 0.006% of total exports from Nepal (Trendeconomy.com, 2023).

Vegetable seed demand for 2016 was 2269 Mt, while the total vegetable seed production in the country in the same year was only 1050 Mt (KUBK, 2016). Whereas, the demand for vegetable seeds in the fiscal year 2019 was 1800 Mt, which is a 3.15% increase in demand as compared to the previous fiscal year but the domestic production of vegetable seed saw a decrease of 11.68% in 2019 with only 428 Mt of vegetable seed production in the country. The total available formal source of vegetable seed was 642 tons in fiscal year 2019/20, whereas the informal sector constituted 64% of the seed demand through farmer managed seed system in the same fiscal year (Karki et al., 2021).

One of the main sources of quality seed in Nepal is farmer-based seed multiplication, but farmers cultivate it haphazardly without understanding its costs, benefits, and results. The introduction of hybrid seeds, alternative employment opportunities, and weak research and extension support, among other problems, have resulted in diminishing

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seed production in the country in spite of increasing seed demands (Kaini, 2021).

Despite Kavrepalanchowk being one of the pocket areas for vegetable seed production with suitable climatic conditions and an appropriate topographical location, the paucity of proper research on the economic aspect of vegetable seed production resulted in the conception of this study. Thus, this research aims to delineate the economics of vegetable seed production in Kavrepalanchowk district by assessing the profitability and economic viability of different vegetable seed production enterprises, which can help in increasing farm income and elevating the socio-economic status of the farmers. In addition to that, the research also aims to shed light on the prevailing problems incurred in seed production in the study area and propose suitable solutions that can ultimately aid in enhancing the production of vegetable seeds.

2. Materials and Methods

2.1 Description of Study Area

The study was conducted in Kavrepalanchowk district, which is considered one of the remote districts in the central region of Bagmati Province in Nepal. The district was purposefully selected based on its climatic suitability and high seed production potential. Kavrepalanchowk district is also considered a pocket area for seed production after Rukum district (Timsina and Shivakoti 2018). Seeds of tomato, cress, chili, spinach, cucumber, okra, onion, kidney bean, and four-season bean, among others, can be grown in the area. The district lies at a latitude of 27^0 36' 59.99" North and a longitude of 85^0 32' 59.99" East. In 2022, the average annual maximum temperature was 22.16°C and the average annual minimum temperature was 13.83°C in 2022. The wettest month was July with 194.35 mm of rainfall, whereas December recorded only 0.1mm of rainfall, making it the driest month of 2022 (World Weather Online, 2022). It covers an area of 1,396 square kilometers, encompassing Namobuddha Municipality and Temal Rural Municipality, the study areas selected for this research.

2.2 Selection of Sample

From the 484 tomato, cress, and kidney bean seed producing farmers in the survey, 60 seed producers were chosen at a 90% Confidence Level and a 10% Margin of Error using simple random sampling. For tomato seed production, tomatoes of 'Srijana' variety were used, while for cress and kidney bean seed production, local varieties of each were used. The 10 traders, purposively selected for market information based on a key informant interview, included two cooperatives, seven agro-vets, and a seed company.

2.3 Data Collection

A household survey was conducted with a set of semi-structured questionnaires in order to get primary information. Secondary data were collected from different secondary sources, including journal articles, reports, books, websites, and organizational publications.

The socio-demographic parameters used for the survey included gender, education, age, ethnicity, occupation, and land holding. These parameters give a picture of how various social factors impact farm activities, the accessibility of services and benefits, and market information, which ultimately has an impact on seed production. Further, policymakers can avail themselves of essential information on such socio-economic parameters to formulate better plans and policies, making the incorporation of these parameters an inextricable part of the study (Pal et al., 2016).

2.4 Methods and Techniques of Data Analysis

Raw data collected in the field was entered, tabulated, and analyzed using Microsoft Excel. Descriptive statistics like frequency, percentage, and mean were used for analyzing socio-economic factors. The economic analysis included the following variables:

2.4.1 Cost of production

It is the total cost involved in the production of a certain output or product (Paudel et al., 2021**)** and is calculated by using the following formula:

$$TC = TFC + TVC$$

Where, TC = Total Cost of production

TFC = Total Fixed Cost, which included land tax and depreciation on plastic tunnels, machinery, tools, and equipment.

TVC = Total Variable Cost, which included seeds, manures, fertilizers, micronutrients, pesticides, irrigation, land preparation, planting, intercultural operations, crossing activities, harvesting, extraction/threshing, drying, and grading.

2.4.2 Gross Profit

Gross profit is the value of output by the producer, which is computed at the farm gate price minus the total variable cost (Shrestha and Dhakal, 2020).

$$Gross\ profit = Gross\ return - Total\ variable\ cost$$

Where,

$$Gross\ return = Price\ per\ unit \times Total\ quantity\ produced$$

2.4.3 Net Profit

Net profit is the profit obtained by the producers, i.e., the difference between gross return and cost of production (Pandey et al., 2021).

$$Net\ profit = Gross\ Return - Total\ cost$$

2.4.4 Benefit-Cost (B:C) ratio

The benefit-cost ratio was calculated using the gross return and total cost of production (Gayak et al., 2020).

$$B{:}C\ Ratio = Gross\ return\ /\ Total\ cost$$

2.4.5 Marketing margin

Market margin is the difference between the sale price and the cost incurred by value chain actors in each stage of the marketing chain.

Marketing Margin or Profit Margin=Sale price-Cost incurred by value chain actor

It can also be expressed as the percentage of the final weighted average selling price taken by each stage of the marketing channel.

$$Marketing\ Margin\ Percentage = Profit\ Margin\ /\ Sale\ price \times 100$$

A similar technique was also used for the calculation of profit margin of value chain actors by the tomato production system by (Paudel and Adhikari, 2018).

2.4.6 Producer's share and Price Spread

It refers to the share of producers in consumers' rupee. It can be calculated by using the same formula used by (Paudel et al., 2021).

$$Producer's\ share = Farm\ gate\ price\ /\ Retailer\ Price \times 100$$

The price spread is defined as the difference between the price paid by consumers and the net price received by the producer for an equivalent quantity of farm produce.

Price spread = Price paid by consumer - Price received by producer

A similar formula was used for assessing price spread by Paudel and Adhikari (2018).

2.4.7 Indexing

Scaling technique was used for production, post-harvest handling, and marketing problem ranking. The problems faced by seed producers were identified through key informant interviews, and then they were ranked by applying the scaling technique comparing, the intensity of severity using scale values 1, $(1-1/n)$, $(1-2/n)$, $(1-3/n)$ and so on.

Where; n = Number of categories in ranking.

Index of severity was calculated by using the following formula.

$$Is = \sum SiFi\ /\ N$$

Where; Is = index $0 < I < 1$

Si = scale value of i^{th} severity

Fi = frequency of i^{th} severity

N = total no. of respondents = $\sum f$

$\sum$ = Summation

Similar technique for problem ranking was used by Shrestha et al. (2019) for ranking problems in vegetable seeds.

3. RESULTS

3.1 Socio-Demographic Characteristics of Respondents

Among the 60 respondents in the study area, 53% were male and 47% were female (Figure 1a). This study illustrated that 23.3% of respondents were illiterate, and 35% had a primary level of education. Similarly, 35% had a secondary level, and only 6.7% had a higher secondary level of education (Figure 1b). Agriculture was found to be the main occupation in the study area, with 71.7% of respondents involved in it (Figure 1c). The average family size was 5.43 (Table 1), with an almost equal proportion of the study area covered by Brahmins (46.7%) and Janajatis (48.3%), as only 5% of the respondents belonged to the Dalit community (Figure 1d). In the study, 38.33% of respondents were between the ages of 20-40, 53.33% from 41-60, and 8.33% from 61-80 (Figure 1e). The average cultivated area of the respondents was 9.67 *ropani*, as tomato, cress, and kidney bean seed production covered 0.14, 3.70, and 1.95 *ropani*, respectively.

Note: One *ropani* = 0.0508905852 hectare

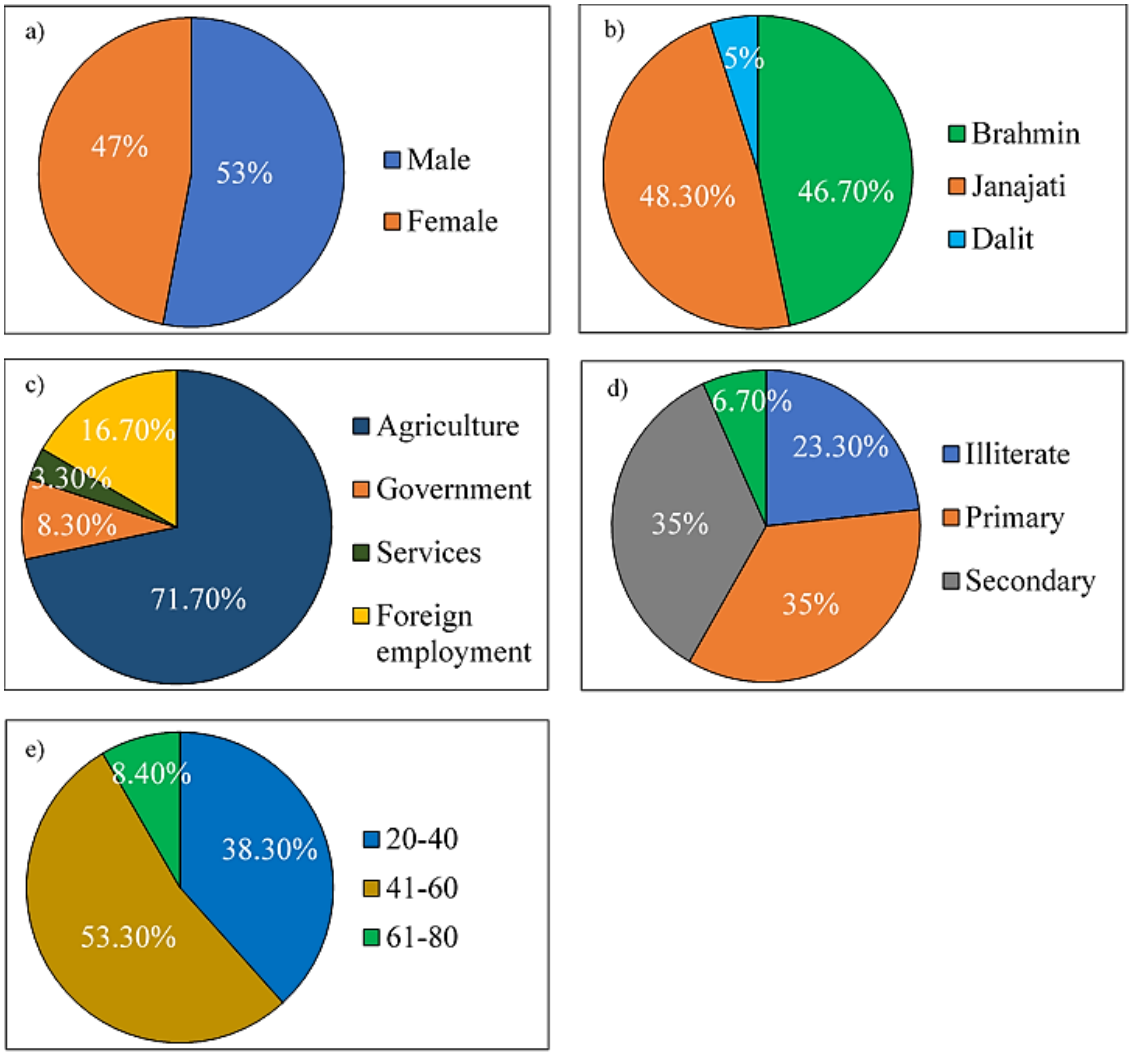

Figure 1: Socio-demographic characteristics

in pie-charts a) Gender of the respondents, b) Ethnicity of the respondents, c) Occupation of the respondents, d) Education of the respondents, e) Age group of the respondents

Table 1: Average family size and land under seed production	
Average family size	5.43
Average total cultivated land (*ropani*)	9.67
Average land under tomato seed production (*ropani*)	0.14
Average land under cress seed production (*ropani*)	3.70
Average land under kidney bean seed production (*ropani*)	1.95

Source: Field survey 2022

3.2 Cost of Production of Vegetable Seeds

While producing hybrid tomato seed (Srijana variety) on one *ropani* of land, NRs. 164,168.09 of the total cost was incurred in labor, NRs. 65,365.48 in inputs, and NRs. 29,291.19 in fixed costs (Table 2). Labor costs were the highest in hybrid tomato seed production, accounting for 63.42% of the total cost. In cress seed production, fixed and variable costs accounted for NRs. 3989.05 and NRs. 6277.42 per *ropani*, respectively (Table 2). Similarly, the fixed cost incurred in kidney bean seed production was NRs. 4273.55 and the variable cost was NRs. 4663.40. So, the total cost of producing tomato, cress, and kidney bean seeds per *ropani* was NRs. 258,824.76, NRs. 10,266.47, and NRs. 8,936.95, respectively (Table 2).

Depreciation has been estimated using the straight-line method in this study. In tomato seed production, depreciation on plastic tunnels, machinery, watering cans, sprayers, forceps, scissors, pipes and green nets was calculated. However, depreciation on machinery and sprayers were the only variables calculated in cress and kidney bean seed production. Further, irrigation water or water cost for cress and kidney bean production was not included in their cost of production as their seed production was rainfed and also utilized canal irrigation, which accrued near to no cost for the farmers. On the other hand, farmers drew water from the well, for which they had to pay per cubic meter of water consumed, accounting for its cost in tomato seed production.

Since the seed producers were using the hybrid variety of tomato 'Srijana', it required the crossing of HRD-1 (female line) and HRD-17 (male line), which required labor and was time consuming, adding to the cost of tomato seed production. However, the labor costs for crossing were not incurred in cress and kidney bean production as 'local' varieties of these vegetables were used and were open pollinated, which required no specific crossing activities (Thapa Magar and Gauchan, 2016).

Table 2: Cost of production of Vegetable seeds per *ropani*				
SN	**Cost description**	**Tomato (NRs.)**	**Cress (NRs.)**	**Kidney bean (NRs.)**
A. Fixed Cost				
1	Land tax	15	10	10
2	Depreciation	29,276.19	3979.05	4263.55
	Total Fixed Cost	29,291.19	3989.05	4273.55
B. Variable Cost				
Input Cost				
1	Seed	1590.75	750	895.90
2	Fertilizer	3715.28	340	248.125
3	Plant protection	35,880.25	423.81	447.75
4	Irrigation water	24,179.20	-	-
	Total Input Cost	65,365.48	1513.81	1591.77
Labor Cost				
1	Land preparation	1979.60	369.45	408.41
2	Sowing	1765	296.95	353.35
3	Manure and fertilizer application	5284.82	954.95	408.12
4	Intercultural operation	11,933.12	1056.41	624.86
5	Irrigation	3992.80	278.05	263.42
6	Crossing activities	117,401.80	-	-
7	Pesticide application	6186.25	115.85	103.68
8	Harvesting	3782.45	1058.75	342.29
9	Threshing/ Extraction	10,428.25	216.85	328.75
10	Drying and grading	1414	416.35	238.75
	Total Labor Cost	164,168.09	4763.61	3071.63
	Total Variable Cost	229,533.57	6277.42	4663.40
	Total Cost	258,824.76	10266.47	8936.95

Source: Field Survey 2022

3.3 Economic Analysis of Vegetable Seed Production

As presented in Table 3, the average production of tomato, cress, and kidney bean per *ropani* was 11.60 kg, 68.90 kg, and 76.70 kg, respectively. Further, the average price received by farmers per kg of tomato, cress, and kidney bean seed was NRs. 75,000, NRs. 200, and NRs. 180, respectively. So, the gross return from tomato, cress, and kidney bean seed production per *ropani* was found to be NRs. 870,000, NRs. 13,780, and NRs. 13,806, respectively (Table 3).

The gross margin and net profit of tomato seed per *ropani* were NRs. 640,466.43 and NRs. 611,175.24, respectively. Likewise, there was a gross margin of NRs. 7,502.58 and a net profit of NRs. 3,513.53 for cress seed per *ropani* (Table 3). Furthermore, kidney beans per *ropani* had a gross margin and a net profit of NRs. 9,142.60 and NRs. 4,869.05, respectively. Hence, in terms of the benefit-cost ratio, tomato seed production (3.36) was found to be the most feasible, followed by kidney bean (1.55) and cress (1.34), respectively (Table 3).

Table 3: Return, Profit, and Benefit-Cost analysis of vegetable seed production			
Measuring Criteria	**Average value per *Ropani***		
	Tomato	**Cress**	**Kidney bean**
Total Cost (NRs.)	258,824.76	10266.47	8,936.95
Average Production of Seed (Kg)	11.60	68.90	76.70
Average farmgate Price (NRs/Kg)	75,000	200	180
Gross Return (NRs.)	870,000	13,780	13,806
Gross Margin (NRs.)	640,466.43	7,502.58	9,142.60
Net Profit (NRs.)	611,175.24	3513.53	4,869.05
Benefit Cost Ratio (B:C)	3.36	1.34	1.55

Source: Field Survey 2022

3.4 Marketing

3.4.1 Marketing Channel

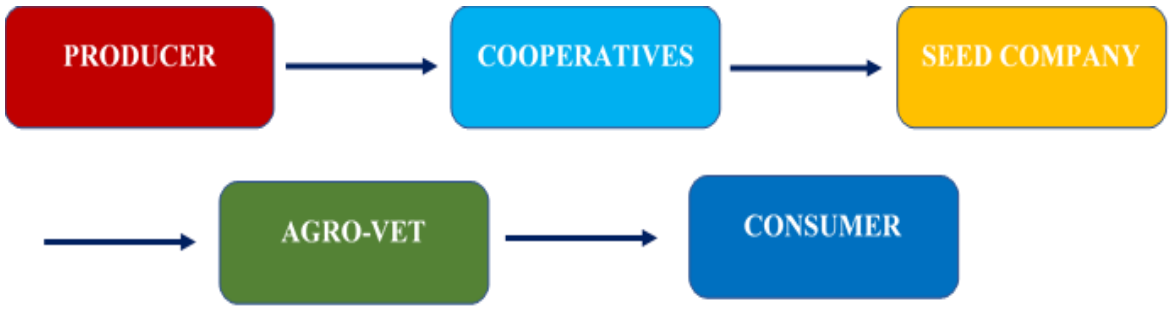

Figure 2: Marketing channel and flow of vegetable seeds

Producer → Cooperatives → Seed Company → Agro-vet → Consumer was identified as the only marketing channel in the study area (Figure 2). The surveyed respondents were the seed producers who sold their produce to the two cooperatives (Shree Jorsalla Vegetable Seeds Production Cooperative Society Ltd. and Fulbari Seed Production Cooperative) that provided inputs (seed, fertilizer, pesticides and agricultural finance) and marketed their farm produce. These cooperatives, under an informal contract with the seed company 'Life Seed Udhyog', marketed the seeds produced in the study area. Similar to the findings of Timsina and Shivakoti (2018) in Kavrepalanchowk district, this study also showed that 100% of seed production was based on the informal contract between the cooperative and the seed company. Along with the marketing of seeds, the seed company also provided regular technical guidance and field visits to assist the farmers in their enterprises. The seed company also processed the seeds obtained from the farmers to be sold to almost 40 agro-vets in Kathmandu Valley and Kavrepalanchowk district.

3.4.2 Market Margin

From production to final consumption, vegetable seeds undergo numerous value addition activities, which include cleaning, drying, grading, testing, treatment, and packaging. In the study, cleaning, drying, and grading were done by producers, while seed testing, treatment, and packaging were carried out by the seed company, i.e., processor. The total marketing and processing costs incurred by all the marketing intermediaries (farmers, cooperatives, processor, and agro-vet) were NRs. 2,526, NRs. 357, and NRs. 9 for tomato, cress, and kidney bean respectively (Table 4). Since the processor used 50 kg sacks for packaging, kidney beans incurred the lowest processing cost. In contrast, tomato and cress seeds were packaged in 2 gram and 20 gram plastic seed packets, increasing their processing cost.

In tomato seed marketing, the highest marketing margin was achieved by the producer (70.25%), followed by the processor (30.85%), retailer (23.33%), and cooperatives (2.59%) (Figure 3). Likewise, the producer (35.50%) shared the highest marketing margin in the marketing of kidney bean, followed by the retailer (15.20%), collector (9%), and processor (2.38%) (Figure 3). As for cress seed marketing, the retailer had the highest market margin (33.16%), while the processor held the second highest (28.37%), followed by the producer (25.50%), and then the collector (8.18%) (Figure 3).

Table 4: Market margin of value chain actors

Particular	Vegetable Seed	Producer	Cooperative (Collector)	Seed Company (Processor)	Agro-vet (Retailer)
Cost Price (NRs/ kg)	Tomato	22,312.47	75,000	77,000	1,15,000
	Cress	149	200	220	800
	Kidney bean	116	180	200	210
Processing/ Marketing Cost (NRs/kg)	Tomato	-	2	2,522	2
	Cress	-	2	353	2
	Kidney bean	-	2	5	2
Sale Price (NRs/kg)	Tomato	75,000	77,000	1,15,000	1,50,000
	Cress	200	220	800	1200
	Kidney bean	180	200	210	250
Marketing margin (NRs/kg)	Tomato	52,687.53	1998	35,478	34,998
	Cress	51	18	227	398
	Kidney bean	64	18	5	38

Source: Field Survey 2022

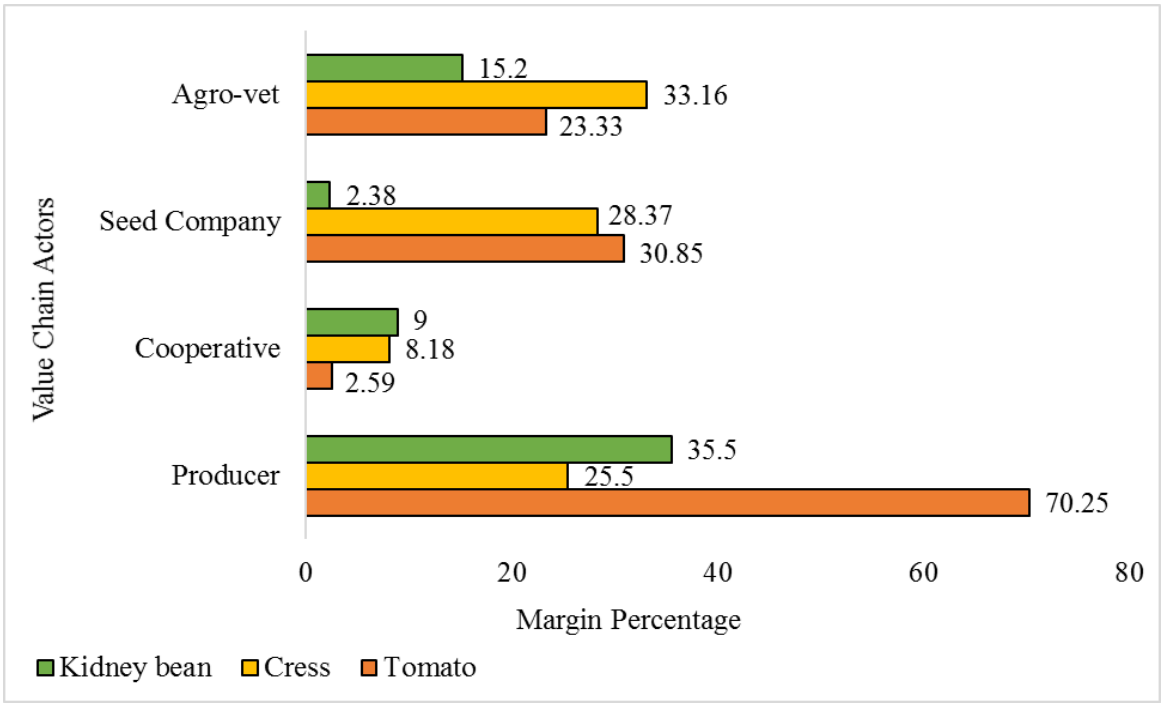

Figure 3: Market Margin of Value Chain actors

3.4.3 Producer's share and price spread

In the study, the producer's share was found to be the highest in kidney beans (72%), followed by tomato seed (50%), and cress seed (16.67%). On the other hand, it was tomato seeds that had the highest price spread per kilogram of seed (NRs. 75,000), followed by cress seeds (NRs. 1,000) and kidney beans (NRs. 70) (Table 5). The presence of many intermediaries typically increases the price spread which can explain the wide price spread, observed in tomato and cress in this study (Gosavi et al., 2021).

Table 5: Price spread and Producer's Share		
Vegetable Seeds	**Producers share (%)**	**Price spread (NRs/kg)**
Tomato	50	75,000
Cress	16.67	1,000
Kidney bean	72	70

Source: Field survey 2022

3.5 Problems in Production, Post-Harvest Handling and Marketing

Several problems related to the production, post-harvest handling, and marketing of vegetable seeds were identified in the study area. The study clearly indicated that among the various problems identified, limited access to irrigation facilities came out to be the most serious problem, followed by the incidence of diseases and pests, unavailability of inputs, lack of technical knowledge, demand-based production, labor scarcity, and less area under seed production (Table 6).

In the study area, since sun drying was the only method available to dry seeds to achieve the required moisture content, drying the same quantity of seeds multiple times resulted in a major post-harvest problem. A similar problem was also reported as a major problem in the study conducted on vegetable seeds in the Arghakhanchi district of Nepal (Shrestha et al., 2019). Other problems incurred after harvesting included manual threshing for extraction of seeds and a low level of post-harvest knowledge among the respondents in the study area (Table 7).

Inadequate market information was the major problem faced by farmers during the marketing of seeds. This was followed by the limited choice of trading partners or market inaccessibility, price fluctuation, and high marketing margins (Table 8). Demand-based vegetable seed production and the low involvement of farmers in vegetable seed production can be attributed to poor market access in the study area.

Table 6: Problem in production of vegetable seeds		
Production Problem	**Index Value**	**Rank**
Limited availability of irrigation	0.87	I
Diseases/Insects and Pests	0.82	II
Unavailability of input	0.70	III
Lack of technical knowledge	0.67	IV
Demand based production	0.54	V
Scarcity of labor	0.51	VI
Less area under seed production	0.43	VII

Source: Field Survey 2022

Table 7: Problems after harvesting of vegetable seeds		
Post-harvest problem	**Index value**	**Rank**
Need to dry several times	0.61	I
Manual threshing/ extraction	0.58	II
Low level of post-harvest knowledge	0.44	III

Source: Field survey 2022

Table 8: Problem in marketing of vegetable seeds		
Marketing Problem	**Index Value**	**Rank**
Inadequate market information	0.84	I
Limited choice of trading partner	0.70	II
Price fluctuation	0.62	III
High market margin	0.55	IV

Source: Field Survey 2022

4. Discussion

4.1 Economic Analysis of Vegetable Seed Production

The total cost of producing tomato seed of 'Srijana' variety was NRs. 344,466.37 per *ropani* (NRs. 40,645 in a plastic tunnel of dimension 12m × 5m) as per the findings of Thapa Magar and Gauchan (2016), which was higher than our result (NRs. 258,824.76 per *ropani*). Further, our findings showed a better average production of tomato seed per *ropani* of land (11.60 kg) compared to the study of which was 8.475 kg per *ropani.* The technical support provided by NGOs and seed companies can be attributed to the increased tomato seed production in our study (Thapa et al., 2016).

Thapa Magar and Gauchan (2016) outlined the benefit-cost ratio of tomato seed in their study to be 1.96, which was lower than our findings (3.36), which may be due to the lower cost of production and higher average production of tomato seed in the study year. The high benefit cost ratio makes tomato seed production a profitable enterprise for the farmers to attain a good income and improve their livelihood. Since tomato seed production also requires labor and time intensive crossing activities, it helps in generating employment in the study area, which can be corroborated by the study done in hybrid tomato in Karnataka that generated 104 man-days and 417 woman-days of employment (Sudha et al., 2006).

Despite having a higher benefit-cost ratio, the area under tomato seed production is smaller than other crops in the study area, as farmers are burdened by the problems of limited access to parental lines, the unavailability of skilled human resources for the crossing of parental lines, and limited access to the market (Thapa Magar et al., 2016).

The total cost of production of cress seed per *ropani* in the study conducted in Rukum (West) district was NRs. 11,047.81, which corroborates our findings. However, the benefit-cost ratio of cress was lower than in the study conducted in Rukum (West) district (2.5), which could be due to the lower production and lower selling price of cress (Gautam et al., 2021). Furthermore, the total cost incurred in kidney bean seed production was a bit higher (NRs. 8936.95 per *ropani*) than four season bean seeds (NRs. 6,390.94 per *ropani*) which may be one of the reasons for the low benefit-cost ratio of kidney bean (1.55) in our study, compared to four season beans (2.04) in the study undertaken in Arghakhanchi district (Shrestha et al., 2019).

Overall, the benefit cost ratio of all the vegetable seeds (tomato, cress, and kidney beans) was greater than 1, indicating the financial viability of these enterprises. Vegetable seed production can be a financially sustainable enterprise for the farmers if the major problems are addressed, as vegetable seeds have given 3-5 times higher income than alternative cereal crops, enabling farmers to buy at least three times more food than growing cereals on the same unit of land (Aryal et al., 2022).

4.2 Problems in Production, Post-harvest operation, and Marketing of Vegetable seeds

Inadequate irrigation facility was recognized as the major problem in vegetable seed production in the study area. Kattel and Nepal (2021) reported that rainwater harvesting is a feasible solution for irrigation problems in mountain agriculture, which allows for a diversity of cropping systems from subsistence cereal crops to high-value commercial crops. Therefore, the provision of rainwater harvesting would counteract the problem of insufficient irrigation in Kavrepalanchowk district.

Thapa et al. (2015) reported a high frequency of pesticide use in vegetables in Kavrepalanchowk district. Overuse of pesticides can have a serious impact on health and soil and can result in pest resistance to pesticides, a resurgence of pests, elimination of natural enemies, and disruption of ecosystems. As a solution to the problem of diseases and pest infestation, the Integrated Pest Management (IPM) technique could be adopted, which can help to increase productivity by reducing the incidence of diseases and pests in a sustainable and eco-friendly way (Bhandari et al., 2021).

As mentioned in the Agriculture Development Strategy, there is a need to formulate a policy for agriculture input supply and distribution. This will ensure timely access to inputs at affordable prices. Also, the establishment of an Input Voucher System (IVS) would be a solution to increase the purchasing power of smallholder farmers to buy inputs for production (ADS, 2015).

The government should emphasize on providing training related to seed production, disease pest management, and post-harvest technology at the local level to improve farmers' knowledge and skills. By enriching the marketing information network, strengthening market intelligence delivery under public-private partnerships, and activating Common Service Centers (CSCs) in villages, the requirements for market information can be fulfilled (Sarap and Nemade, 2021).

5. Conclusion

Vegetable seed production is a farm enterprise with high potential for income and employment generation in Nepal. The climatic and geographical location of Kavrepalanchowk makes it one of the most suitable pocket areas for vegetable seed production in the country. The benefit cost ratio obtained in all three vegetable seed production enterprises highlighted the financial viability of seed production at the study site. Further, the highest benefit cost ratio obtained in hybrid tomato seed production as compared to cress and kidney bean seed production shows the potential of tomato seed production to generate employment opportunities, increase farm income, and help alleviate poverty and improve the living standard of farmers.

However, limited irrigation facilities and insufficient market information were the major problems hindering the seed production enterprise in the study area. On top of that, insufficient market access, and demand for only specific vegetable seeds by the seed companies have compelled the farmers to produce vegetable seeds on demand, throwing a wrench in the prospect of a better and bigger seed production. With market expansion and increased market information and access, farmers can reduce their dependency on the seed companies and allow themselves to be on the fore front to sell their produce and attain a better income. By enhancing marketing linkages and increasing collaboration and cooperation with other value chain actors, the findings highlight further potential for scaling-up vegetable seed production in terms of production, area coverage, productivity, and profitability. Thus, further studies like this in similar areas can help in elucidating the economics of vegetable seed production and provide a better understanding of the existing problems that require attention from the concerned stakeholders.

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