International Journal of Innovation Scientific Research and Review
Vol. 06, Issue, 11, pp.7311-7315, November 2024
Available online at http://www.journalijisr.com
SJIF Impact Factor 2023: 6.599

Research Article

ISSN: 2582-6131

AN ECONOMIC ANALYSIS OF TUNNEL TOMATO FARMING IN RUPAKOT MAJHUWAGADHI MUNICIPALITY, KHOTANG, NEPAL

[1,] *Dhurba Banjade, [1]Aman Shrestha, [2]Savyata Acharya, [3]Dipak Khanal, [4]Narayan Prasad Belbase, [5]Nirajan Banjade, [1]Pratima Regmi

[1]Department of Agriculture,Institute of Agriculture and Animal Science, Gauradaha Campus, Nepal.
[2]G.P. Koirala College of Agriculture and Research Centre, Gothgaun, Morang, Nepal.
[3]Department of Soil and Crop Sciences, Texas A & M University, College Station, USA.
[4]Department of Agronomy, Institute of Agriculture and Animal Science, Nepal.
[5]Department of Agriculture, Institute of Agriculture and Animal Science, Lamjung Campus, Nepal.

Received 08th September 2024; Accepted 09th October 2024; Published online 26th November 2024

ABSTRACT

In Nepal, most of the rural population depends on agriculture for employment, income, and food, making it an essential sector of the country's economy. This study aimed to examine the marketing and economics of tunnel farming for tomato production in the RupakotMajhuwagadhi municipality of the Khotang district of Nepal. Data was collected from 60 farmers across seven wards within the municipality through structured interviews. The findings revealed tunnel tomato farming is profitable in the study area, with an average Benefit-Cost Ratio (BCR) of 1.23. The average productivity was 5133.17 kg/ropani, with an average price of NRs. 61/kg. The total revenue generated from tomato sales was NRs. 313121.38/ropani per season, while the production cost was NRs. 254578.14/ropani per season. The most significant costs were associated with tunnel construction and labor, accounting for 46.54% and 34.37% of the total expenses, respectively. The minimum support price (MSP) was NRs. 62/kg at the farmer's level. Regression analysis shows that the cost of tunnel construction and farmer age explains 25.6% of revenue variation. Specifically, higher tunnel construction costs significantly increase revenue, while older age slightly decreases it. The study also identified three primary marketing channels, with direct sales to consumers, particularly restaurant and hotel owners, being the most common. Despite its profitability, farmers face several challenges, including pest and disease infestations, high initial investment costs, significant market price fluctuations, and a lack of motorable roads, which limits the potential for expansion and increased profitability. Thus, the result signifies tunnel tomato farming is profitable, although the initial investment is higher.

Keywords: Agricultural marketing, Cost-benefit analysis, Tomato production, Tunnel farming.

INTRODUCTION

In Nepal, for most people living in rural areas, agriculture is their primary source of food, income, and work, making it the backbone of the country's economy (Gautam *et al*., 2024). Approximately 65.6% of Nepalese people depend on agriculture for their livelihood (Basyal *et al*., 2019). With an annual growth rate of 5.05%, agriculture and forestry contribute up to 1/4 (25.8%) of the GDP (MOF, 2020/21). In the fiscal year 2019/20, the agriculture industry alone contributed 22.96% of the total GDP (K.C & Poudel, 2023).

The vegetable sector is growing as an essential sub-sector and making a substantial contribution to the overall horticultural GDP of Nepal (Basyal*et al*., 2019). Because vegetables yield larger returns than other crops, particularly cereals, the area under cultivation in Nepal grows fast each year (Kunwar & Maharjan, 2019). The cost-benefit ratio of vegetable crops, which is 1:3, is greater than that of cereals, which is 1:1.5 (Kunwar & Maharjan, 2019; Banjade & Shrestha, 2023). A total of 289,839 hectares are used for vegetable cultivation, yielding 4,153,157 metric tons of produce (MoALD, 2023; Ghimire *et al*., 2023; Acharaya, 2020). Household consumption accounts for 39% of these total productions; the remaining 61% was for total sales (Neupane *et al*., 2018). The vegetable industry has grown to significantly contribute to Nepal's AGDP, making about 13.4361% of the total in 2022–2023 (Ghimire *et al*., 2023).

***Corresponding Author: Dhurba Banjade,**
1Department of Agriculture,Institute of Agriculture and Animal Science, Gauradaha Campus, Nepal.

Because Nepal offers a diverse range of agro climatic and topographical conditions, including subtropical, temperate, and cold climates, there is tremendous potential for growing many vegetable crops (Bhandari *et al*., 2016, Banjade *et al*., 2023). In emerging nations, agricultural practices are inefficient, and it is tough to meet the rising demand for food when such inefficient farming methods are used (Joshi, 2019; Ahikari ,2021). Agricultural interventions such as plastic tunnel farming is crucial to meet the growing need for food (Ali *et al*., 2017). However, it is crucial to ask yourself, "Are new farming techniques better than the old ones?" before implementing any new technology (Joshi, 2019). This study uses economic analysis of tunnel tomato production to try and answer this question. Most people in the Khotang district work primarily as tunnel vegetable farmers (Joshi, 2019). Much research has yet to be done in Khotang on how well tunnel technology works for growing vegetables. Finding the chances and limitations in tunnel tomato farming is essential to expanding and advancing vegetable farming. The primary goals of this study are to explore the cost-benefit analysis of tunnel tomato farming, identify the factors influencing resource usage efficiency in tunnel tomato farming, and assess the economics and marketing of tunnel tomato production in the Rupakot municipality of Khotang district.

MATERIALS AND METHOD

StudyArea

One of the possible districts for tunnel tomato growing in terms of area and productivity is RupakotMajhuwagadhi Municipality of Khotang district of Koshi Province, Nepal, where the study was

carried out. There were 175,298 people living in the 1,591 square kilometer Khotang district, with a population density of 110.2/square kilometer (CBS, 2021). The RupakotMajhuwagadhi Municipality was chosen for the study because, in addition to maize and goat, it has been designated as a vegetable zone by PMAMP, and many farmers there employ tunnel tomato cultivation to sustain their families. Seven major tomato-producing wards of RupakotMajhuwagadhi Municipality were targeted for the study. These wards are part of the Prime Minister Modernization Project (PMAMP) and are designated as the Khotang district's vegetable zone. RupakotMajhuwagadhi Municipality was purposively selected based on farmers involved in tomato production potentiality, so the site chosen represents the district in large tomato farming and production and gives some basis for comparison based on location. The study area, RupakotMajhuwagadhi Municipality, is 246.5 square kilometers, with a total population of 43,008 and 15 wards.

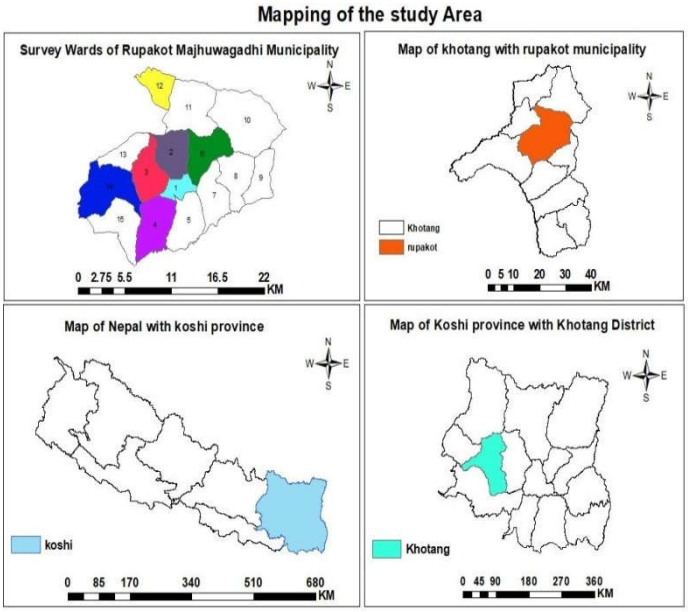

Figure1: Mapping of the study area (ArcGIS, Esri, 2024)

Selection of respondents

A total of 60 farmers were selected by purposive sampling method from 7 different wards of RupakotMajhuwagadhi Municipality. A well-structured questionnaire was used to interview all farmers at their homes and farms.Farmers cultivating tomatoes were appropriate for the study so that we could get useful information regarding the economics of tunnel tomato production.Focus group discussions (FGD) and participant observation were used to obtain qualitative data, while household surveys and other measuring tools were used to gather quantitative data.Tunnel tomato farmers were chosen for the questionnaire survey using a purposive sample technique.FGD was conducted to generate the preliminary status of the farmers and the situation of tomato production at the survey site.Crosscheck interviews were conducted with the agriculture officer of PMAMP and Agriculture Knowledge Centre (AKC) to learn in-depth about tunnel tomato production and with the farmer's Group Leader of each Municipality to know the agriculture extension and facilities provided by the agriculture office in RupakotMajhuwagadhi Municipality.

Data Analysis

Qualitative and quantitative data analysis techniques were used to code, tabulate, and examine the primary and secondary data gathered from field surveys and other sources. Micro-Soft Excel (2010) and the statistical package of social sciences (SPSS Version 27) were utilized to compute yield, cost of production, B:C ratio, resource use efficiency, and other factors. Descriptive statistics like frequency, percentage, mean, standard deviation, and so forth were used to describe the socio-demographic features, including age, gender, ethnicity, occupation, schooling, family size, education status, and land holding. Many rating methods were applied to determine the severity of the issues. As a result, tables, bar graphs, and pie charts were used to display the data and findings. Among other things, the benefit-cost ratio, minimum support price, and problem ranking were carried out.

RESULTS

Socio-demographic characteristics of respondents of the study area

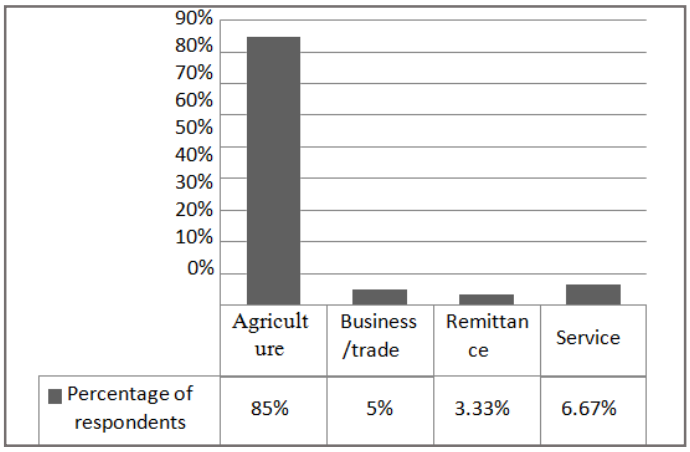

Figure 2: Primary income sources of the respondents in the study area

The survey study found that 60% of the respondents needed an alternative source of income. Other respondents" alternative sources of income were agriculture 15%, services 10%, business/trade 8.33%, remittance 5% andwage/labor 1.67%.The total land holding of the sampled household was 1679.56 ropani in the survey area. Out of 1679.56 ropani land, the total land used for agricultural purposes was 1114.38 ropani. The average cultivated land in the study area was 18.57 ropani.

Similarly,27.18 ropani lands were used for tunnel tomato farming; out of this, tunnel coverage of individual tunnel tomato farmers ranged from a minimum of 0.12 ropani to a maximum of 2.18 ropani with an average of 0.45 ropani. The table above contains further details about the land holdings of the sampled area.Tunnels are the most important assets for tunnel tomato farming. Plastic tunnel was the most common type of tunnel used in sampled regions. From the survey study, the total number of tunnels in the sample household was 184, where the number of tunnels for the individual tomato farmers ranged from a minimum of 1 tunnel to a maximum of 11 tunnels. The average number of tunnels was found to be 3.07.The two major varieties of tomatoes cultivated by respondents of the study area were Srijana and Win sari (F1 Hybrid tomato). Out of 60 respondents, 80% used the seed Srijana variety, and the remaining 20% used an F1 Hybrid tomato seed known as Win sari for tunnel tomato production. Win sari was comparatively more expensive than Srijana and had higher germination and productivity.

Table 1: Family Size of the respondents in the study area

Family Description	No of respondents
Nuclear family	31(51.7%)
Joint family	29(48.3%)
Family size	

Up to 5 members	34(56.7%)
Above 5 members	26(43.3%)
Average house hold members Involved in agriculture	3

Source: Fieldsurvey 2024

Table 2: Reason for choosing tunnel tomato farming

Reason for choosing tunnel farming	Index	Rank
Escape adverse climatic conditions	0.871	I
Escape adverse climatic conditions	0.822	II
Credit availability for tunnel construction	0.555	III
Offseason production	0.413	IV
Easy marketing	0.306	V

Source: Fieldsurvey 2024

Many organizations provided the respondents with different types of technical and financial support, such as subsidies for tunnel constructions, tunnel covers, seeds and saplings of tomatoes, etc. The study indicated that most (46.70%) of tunnel tomato farmers practiced tunnel farming without any subsidy. Itwas found that 15% of the respondents got a subsidy from the Agriculture Knowledge Center, 8.30% of the respondents got subsidy support from both the municipality and the Agriculture Knowledge Center, and 18.30% and 11.70% of the respondents got subsidy support from the municipality and PMAMP respectively. Out of the 60 sampled households, 56.7% had access to the internet, while the remaining 43.3% did not have access to the internet in their household. About half of the respondents need internet access, making it harder for the information to flow throughout the districts. As most of the notices were posted on the internet online, the household without internet needs to get proper information.

Table 3: Training on vegetable farming

Status	Frequency	Percentage
Not received	15	25.2 %
Received	45	74.8 %

Source: Fieldsurvey 2024

Economic analysis of tomato production under plastic tunnel

The simple approach was used to compute the land, production, cost of production, return on product, and benefit-cost ratio for the economic study of tomato production. Production cost data from the field survey and secondary data from the municipality, Agriculture Knowledge Center, and Prime Minister Agriculture Modernization (PMAMP) were used to determine the cost of producing tomatoes. The consistency of the data has been analyzed on a per-season basis for each ropani. The analysis of production costs was divided into two categories: variable costs and fixed costs. Every fixed cost for growing tomatoes in a plastic tunnel per ropani per season was determined. The research area's fixed cost analysis included all expenses related to fixed inputs utilized in tomato production using plastic tunnel technology.The two main ones are land rent and fixed asset depreciation. Land rent, tunnel construction expenses (depreciated amount), and equipment and machinery costs (depreciated amount) are the only three costs that make up the fixed cost.The average cost of tunnel construction, equipment and machinery, and land rent was obtained NRs. 130985.27/ropani/season. The tunnel construction cost includes the cost of plastic covers, bamboo, nails, and binding wires, transportation costs for bamboo, and labor costs for tunnel construction. Likewise, equipment costs include the cost of irrigation pipes, tanks, and sprayer equipment.

All expenses related to variable inputs, including fuel, staking, irrigation, seeds, fertilizers, manures, pesticides, labor for transplanting and land preparation, and so on, were considered variable costs. The monetary worth of each variable input was added to determine the total variable cost of tomato production per ropani every season. The variable and constant costs of all inputs used in tomato production under a plastic tunnel are included in the total cost of production per ropani tomato. According to the study, the total cost of producing one tomato ropani each season was NRs. 254578.14.

Table 4: Total cost of production per ropani of tomato under plastic tunnel (Per season per ropani)

Costs	Amount(NRs)
Total variable cost	123592.87
Total fixed cost	130985.27
Total cost	254578.14

Source: Fieldsurvey,2024

The benefit-cost ratio merely shows how production costs are recovered through product returns. Finding the ratio at which return was achieved in relation to investment cost is an easy process. It gauges the project's or company's value. Using the gross return from one ropani of land and the overall cost of production, the benefit-cost ratio of tomato production was determined.

Table 5: Benefit-cost ratio, profit, and productivity of tunnel tomato farmers of RupakotMajhuwagadhi Municipality of Khotang district.

Indicators	Unit	Value
Productivity	Kg/ropani	5133.17
Averagepriceoftomato	NRs./kg	61
Totalrevenue	NRs./ropani	313121.38
Profit	NRs./ropani	58543.24
Benefit-costratio		1.23

Source: Fieldsurvey, 2024

The minimum price set (MPS) is the minimum price fixed by the government for certain agricultural products. It is calculated by using the formula:

$$\text{MPSperkg} = \frac{Cost\ of\ production + 25\%\ cost\ of\ production}{Total\ yield}$$

$$= \frac{254578.14 + 25\%\ of\ 254578.14}{5133.17}$$

$$= 62.00$$

The MSP for tunnel tomato is indicated in this context by the value of NRs.62.00.The MPS plays a crucial role in supporting farmers 'income and promoting agricultural production by providing a price floor to protect them from price volatilityandmarket uncertainties.The ANOVA table above indicates that the overall regression model is statistically significant (**F** = 4.741, **p** = 0.002). This implies that the independent variables (age of respondents, total cost of tunnel construction, training received, and subsidy received) significantly predict total revenue, making the model a good fit for explaining revenue variation among farmers.

Table 6: ANOVA table of Regression Analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.932E+11	4	1.483E+11	4.741	.002[b]
Residual		1.721E+12	55	3.129E+10		
Total		2.314E+12	59			

Source: Fieldsurvey, 2024

Marketing channel of tomato

The marketing channels of Khotang district are different. The survey results revealed that there were three marketing channels. The resultsshowed that most tomato farmers, i.e., 54%, directly sold their produce to theconsumers. Most of them are restaurant and hotel owners. 48% of Farmers sold their produce through channel 2 (Farmers – retailers- consumers), and only 2% of tomato farmers used channel 3-(Farmers- wholesalers, Retailers- Consumers) for marketing. This shows that there is little or no intervention of intermediaries like mediators while marketing tunnel tomato.

Table7: Responseofrespondents withthe production oftomatoes under plastic tunnel

Satisfaction with tunnel tomato production	Frequency Of respondents	% of respondents
Highly satisfied	16	26.67
Moderately satisfied	6	9.99
Satisfied	34	56.67
Moderately unsatisfied	4	6.67
Total	60	100

Source: Fieldsurvey, 2024

Tunnel tomato farmers have been facing different production problems; their nature and degree of seriousness were identified, and ranking was done. The major problem identified in the study site was disease and pest infestation, with an index valueof 0.96 (I), followed by a higher initial cost for tunnel construction with a 0.72 (II) index value. Likewise, the lack of credit facilities for tunnel construction and repair was evaluated as the third most serious issue with a 0.6 (III) index value. Both lack of goodcultivation training and problems in irrigation were ranked as little serious issues at 0.52(II) and 0.2 (I), respectively.

Table8: Ranking of problems during the marketing of the tomatoes

Marketing constraints	Index	Rank
Pricefluctuation	0.99	I
Lackofmotorableroads	0.78	II
Unorganizedmarket	0.52	III
Lackofprocessingknowledge	0.44	IV
Lackofstorage	0.26	V

Source: FieldSurvey, 2024

SWOT Analysis

The SWOT analysis of farmers using plastic tunnels highlights several vital aspects. Strengths include protection from harsh weather, efficient water use, and the ability to produce higher-quality tomatoes, especially during the offseason when prices are higher. However, weaknesses like high initial costs, plastic sensitivity to natural forces, and difficulty managing humidity present challenges. Opportunities arise from government subsidies, off-season farming, and premium markets like hotels and supermarkets. Threats include damage from climatic hazards, a shortage of skilled labor, and potential pest adaptation to the controlled environment.

DISCUSSION

The results of this study show that tunnel farming for tomato production in RupakotMajhuwagadhi Municipality is a beneficial agricultural innovation. The average Benefit-Cost Ratio (BCR) of 1.23 is consistent with the findings of Kunwar & Maharjan (2019), who observed similar economic feasibility of off-season tomato production under controlled conditions in Nepal, with BCRs ranging from 1.2 to 1.5. The high yield (5133.17 kg/ropani) recorded in this study is consistent with the productivity levels reported in Pokhara Metropolitan City by Gautam *et al*., (2024). This consistency suggests that tunnel farming offers equivalent benefits in regions with varying agro-climatic variables.

Furthermore, the obstacles reported, such as insect infestations and high initial investment expenditures, are consistent with the findings of Joshi (2019), who performed a study in Kirtipur Municipality and identified similar barriers to tunnel farming adoption. Addressing these challenges, such as through subsidies and training programs, has been suggested to increase the adoption of this technology. The study also supports the efficacy of direct marketing channels, with 54% of farmers in the study area selling their produce directly to consumers, minimizing reliance on middlemen. Similar findings were reported in the Lalitpur district, where Ghimire *et al*., (2023) emphasized the benefits of direct sales in reducing market swings and increasing profitability.To build on these findings, future research into value-added solutions such as processing and packaging could help to overcome market constraints such as price volatility and a shortage of storage facilities. Basyal *et al*., (2019) made similar recommendations in their economic analysis of vegetable production systems in Nepal.

CONCLUSION

Tunnel tomato farming in RupakotMajhuwagadhi municipality has become a key contributor to employment and household income, offering year-round production with higher profits, especially during off-seasons. Adopting plastic tunnel technology has significantly improved farmers' yields, weed management, and financial returns. However, challenges such as pest infestations, unstable pricing, and inadequate infrastructure persist. Addressing these requires targeted training, better market systems, and infrastructure improvements like roads and storage facilities.For future success, providing financial support, improving marketing systems, and conducting research on production efficiency and value addition are essential to further enhance the productivity and profitability of tunnel tomato farming.

ACKNOWLEDGEMENTS

We would like to express our sincere gratitude to the colleagues and experts whose insights and feedback significantly enhanced this research. Additionally, we appreciate the support and encouragement from our friends and family throughout the research process.

REFERENCES

Acharya B., 2020. Opportunities and Challenges in Studies of Host-PathogenInteractions and Management of Verticillium dahliae in Tomatoes. Researchgate.

Adhikari B., 2021. Post-harvest practices of horticultural crops in Nepal: Issues and management. Research gate.

Ali Q., Ashfaq M. and Khan M., 2017. An economic analysis of offseason tomato production in Punjab. The Journal of Animal & Plant Sciences, 27(1), 294-301.

BasyalK., KhanalK. and Dhakal S., 2019. Socio-Economic Study of Tomato Producing Farmers in Lamahi, Dang. Biomedical Journal of Scientific and Technological Research, 20(5).

Banjade D. and Shrestha A., 2023. Analysis of the Economic of Rice (*Oryza Sativa* L.) Farming in Nepal's Kapilvastu district. Food and Agribusiness Management, 4(1), 01–03. https://doi.org/10.26480/fabm.01.2023.01.03

Banjade D., Khanal D. and Shrestha A., 2023. Effect of zinc and boron foliar application on tomato growth and yield under protected structure. International Journal of Agricultural and Applied Sciences, 4(2), 39–45. https://doi.org/10.52804/ijaas2023.425

Bhandari N. B., Bhattarai D. and AryalM., 2016. Demand and Supply situation of tomato in Nepal. Ministry of Agriculture Development, Department of Agriculture. Agribusiness Promotion and Marketing Development Directorate.

CBS. 2021. census. Central Bureau of Statistics.

Gautam A., Lamichhane S. and Chapagain B., 2024. An economic study on the production and marketing of tomato (*Solanum lycopersicum*) in Pokhara Meteropolitan city, kaski district of Nepal. Food and Agri Economics Review (FAER).

Ghimire A., Aryal M., Karki R., DhitalD., Dahal M. and Poudel A., 2023. Navigating the Economics of Production and Marketing of Tomatoes in Lalitpur, Nepal. Global scientific Journals, 11(9).

Joshi D., 2019. Micro-economic analysis of tunnel vegetable farming in kirtipur municipality, Kathmandu. Faculty of Humanities and Social Science, Tribhuvan University Campus, Kirtipur Kathmandu, Nepal.

KC N. and Poudel S., 2023. Value chain analysis of tomato sub-sector in Bhaktapur district, Nepal. Food & Agribusiness Management (FABM),4(2), 117-126.

Kunwar B. and Maharjan B., 2019. Economic Analysis of Off-Season Tomato Production under Poly-house in Okhaldhunga, Nepal. The Journal of Agriculture and Environment,20.

MoALD., 2023. STATISTICAL INFORMATION ON NEPALESE AGRICULTURE.Statistics and Analysis section.

Neupane H., Poudel P. and Parajuli S., 2018. Value Chain Analysis of Tomato in Chitwan District of Nepal. Acta Scientific Agriculture, 2(7).

****