ECONOMIC ANALYSIS OF OFF-SEASON TOMATO PRODUCTION UNDER POLY-HOUSE IN OKHALDHUNGA, NEPAL

B. Kunwar[1] and B. Maharjan[2]

ABSTRACT

Nepal has diverse agro-climatic zones which provide an opportunity for off-season vegetable cultivation. Growing tomato in hilly areas during summer season under poly house is considered off-season and farmers are found attracted towards this business. This study analyzes the different economic aspects of tomato production under poly-house. Cobb-Douglas production function was used to analyze thecost of production. Results showed seed, manure, plant protection and human labor significantly determine gross return of tomato production. Similarly decreasing return to scale was observed. Analysis of total variable cost, gross margin and B/C ratio revealed tomato production is aprofitable business. Problem of disease was major production problem and lack of transportation facility was major marketing problem.

Keywords: gross return, off-season, poly-house, profitable, tomato

INTRODUCTION

The area under vegetable cultivation in Nepal is increasing rapidly every year because of higher return compared to other crops especially much higher than cereals. The increase in area under vegetable cultivation is increased by about forty percent between 2005 and 2015 (MoAD, 2015). Vegetable production have higher cost benefit ratio of 1:3 compared to 1:1.5 for cereals (Bhandari *et al.,* 2015). Off-season vegetable is being recognized as a major agriculture commodity that has the comparative advantage for export to India (HVAP, 2011). Vegetables especially off-season are considered as a means of reducing poverty because of higher demand and higher prices. In commercializing the agriculture sector, offseason vegetable farming has played a vital role contributing to enhancement of economic status of the farmers of the hills of Nepal. It has been providing regular employment and income to the marginal farmers and their family members throughout the year by bringing economic gains (Panta, 2001). Although the terai region produces and sells more vegetables, vegetables grown in hilly region have better value because they

1 Plant Protection Officer, Ministry of Agriculture and Livestock Development, Kathmandu, Nepal. Corresponding Author: Email: redcrag.bk@gmail.com

2 Technical Officer, Nepal Agriculture Research Council (NARC), Agri-botany Division Khumaltar, Nepal.

Produces and sell more vegetables, vegetables grown in hilly region have better value because they are produced during rainy reason when prices are relatively higher (Prasain, 2011).

Tomato production in poly-house during summer in hilly areas of Nepal is considered off-season and fetch good price. Off-season tomato which is produced in the hills (400-1800 masl) from Ashad to Mid Mangsir is one of the important cash generating commodities suitable for small and poor farmers of hills (Budathoki *et al.,* 2000). The area of tomato is recorded 19,805 hectare with total production of 333,510 metric ton and productivity of 16.84mt/ha in Nepal in year 2015. Okhaldhunga district is one of the good producers of off season tomato. In Okhaldhunga there are 700 poly-houses in year that covered about 6 hectares. Total production of tomato was recorded 120 metric ton in this district (VDD, 2015). Tomato cultivation in open field during winter season is common in terai and inner terai while in hills it is rare. In hilly region of Nepal, in the past only local tomatoes were grown at subsistence level at rainy season but in recent years hybrid tomato cultivation under poly-house is popular and increasing. It is considered off-season production and has potential market all over the country.

There lacks research and analysis on efficacy of production of off-season tomato production. It is also necessary to know whether the farms are they operating rationally, is the farmers deriving benefits, is the number of offseason tomato growers increasing yearly. Similarly it is important to know what are the factors affecting gross return of offseason tomato cultivation. This research aimed to find the answer of the above stated problems.

The main objectives are:

- To analyze the factors affecting gross return of tomato production.
- To analyze profitability of tomato under poly- house condition
- To study the market, marketing system and marketing channel
- To study Production and marketing problem

METHODOLOGY

THE SURVEY

Altogether 100 samples were selected from different four VDCs namely Bigutar, kuntadevi, Barnalu and Saleri of Okhaldhunga district. Samples were selected randomly. A household survey was carried out with the help of semi-structured interview schedule to collect information. In addition, key informant interview was done to validate collected information.

PRODUCTION FUNCTION ANALYSIS

Cobb-Douglas production function

The Cobb Douglas production function is one of the most widely used function in the economic analysis of the problems relating to empirical estimation in agriculture and industry. Considering wider application, the Cobb Douglas production function was applied. The algebraic forms of this function with one, two and more input variables are presented below in equation (1), (2) and (3), respectively.

$Y = a^o x^{a1}{}_1$.....(1)

$Y = ao\ x^{a1}\ x^{a2}{}_2$.....$x^{an}n$.....(2)

$Y= a^o\ II\ x^{ai}{}_i,\ \ i = 1,2, ...,n$.....(3)

Here, Y and xi (i =1, 2 … n) are the levels of output and inputs. The constant a_o and a_i (i = 1, 2, 3…n) represent the efficiency parameter and the production elasticities of the respective input variables. This exponential form can be changed into log-linear form to estimate the parameter. The estimating forms of the equations corresponding to the above are:

$lnY= lna^o + a^1ln\ x\ ^1$.....(4)

$lnY= lna^o+ a^1ln\ x1+ a^2lnx^2$.....(5)

$lnY = lna^o + a^ilnx^i$ where, i= 1, 2,....,n.....(6)

Return to scale

Return to scale describes response of an output towards its proportional change from input in overall. Return to scale was calculated as the sum of individual production input elasticities.

Gross margin analysis

A gross margin is calculated for individual enterprise by subtracting variable costs from financial output (Firth *et al.*, 2005).

Gross margin = Gross return – Total variable cost

Where, Gross return = Price of the per unit produce (selling price) x Total quantity marketed

Total variable cost = summation of all cost of variable items

Cost-Benefit analysis

Benefit/Cost ratio = gross return/variable cost.

Indexing

Farmers perception on the importance given to the different production and marketing constraints were analyzed by using 3 point scale of constraint comprising very high importance, medium, and the least importance by using 3, 2, and 1, respectively.

The index of importance was computed by using the following formula:

$I_{imp} = \sum (Si\ F_i\ /N)$

Where,

I_{imp}= Index of importance

$\sum$ = Summation

Si = Scale value

F_i = Frequency of importance given by the respondents

N = Total numbers of respondents

RESULTS AND DISCUSSION

PRODUCTION FUNCTION ANALYSIS

Cobb-Douglas production function model was applied on the basis of the best – fit and significant effects of resources on gross returns. For all enterprises four explanatory variables were taken into account to explain variations in production.

Factors Affecting Gross Return Of Off- Season Tomato Production

The coefficient of multiple determinations (R^2) was 0.688 which indicates that 68.8 % of the variations were explained by the explanatory variable included in the model. The F- value was 10.459 of the equation were significant at 1 % probability level, which indicates good fit of the model.

Cost of seed (X_1): It was observed from Cobb-Douglas production function that the production co-efficient of Cost of seed of tomato production was significant at one percent level of significance. The magnitude of the regression coefficient is 1.638 (Table 1) with negative sign. It implies that with one percent increase in cost of seed of tomato production, keeping others factors constant, would lead to a decrease in the gross return by 1.638%. It is consistent with the result of Akter *et al.,* (2011).

Cost of manure (X_2): The regression coefficient of manure cost of tomato production was 3.057 (Table 1). This coefficient was significant at one percent level of significance. It implies that one percent increase of manure cost, keeping other factors constant, would lead to an increase in the gross return by 3.057%.

Cost of plant protection(X_3): The regression coefficient of cost of plant protection of tomato production was positive and non significant.

Human labour cost (X4): It is observed from the Cobb-Douglas production function that the production coefficient of human labour cost of tomato production was significant at five percent level of significance. It implies that one percent increase of human labor, keeping other factors constant, would decrease the gross return by 1.500 % (Table 1). This result is in consistent with Amhed et al., (2012) and Akter *et al.,* (2011).

Table 1: Estimated values of coefficient and their related statistics of production function for tomato in study area (2015)

Explanatory variable	Estimated coefficient	Standard error	t-value
Constant	6.230	2.274	2.739
Cost of seed	-1.638***	0.413	-3.962
Cost of Manure	3.057***	0.630	4.587
Cost of plant protection	0.496	0.370	1.341
Cost of Human labour	-1.500**	0.587	-2.554
R^2	0.688		
F-value	10.459	Prob>F(0.0001)	
Return to scale(∑bi)	0.415		

Source : field survey (2015)

Note : ****significant at 1 % level*

** *Significant at 5 % level*

RETURN TO SCALE

Return to scale describes response of an output towards its proportional change from input in overall. Return to scale was calculated as the sum of individual production input elasticities.

Table 2: Return to scale of tomato under poly-house

Vegetables	Return to scale
Tomato	0.415 (Decreasing return to scale)

Decreasing return to scale was observed in tomato production. The return to scale of analysis of tomato showed that with one percent increase in all inputs, the output would increase by 0.415.

PROFITABILITY ANALYSIS OF TOMATO UNDER POLY- HOUSE CONDITION

In order to determine the cost of purchased inputs, prevailing market price was used but for of the case of home supplied inputs, the opportunity cost was considered.

Cost of seed is one of the important costs involved in the tomato production. Most of the farmers establish their own nursery for raising seedling but few farmers purchase the seedling of tomato. On an average per Ropani cost of seed required for tomato production was NRs. 4622.26.

Manure was the major input for the production of different crops. Most of the farmers use animal manure for the production of tomato. Animal urine was also used by the majority of farmers at later stages of tomato. The use of chemical fertilizers like DAP, Urea was nominal. Very few say one or two farmers in the study area use bio-fertilizers at nominal doses. So, major input used for the production of tomato was animal manure. On an average, the cost of manure per Ropani was found NRs.30779.51.

Tomato crop suffer frequently from diseases and pest, therefore, cost for plant protection is found important. Per Ropani cost on plant protection was observed NRs.9234.36.

The value of human labour was the most important for tomato production. Both hired and home laborsar were taken into account. On an average per Ropani human labor required was NRs.32915.21.

Table 3: Table showing total variable cost, gross return, gross margin and B:C Ratio in production of Tomato under poly house condition

Items		Tomato
A.	**Gross return**	
	Main product(NRs/Ropani)	280727.6
B.	**Variable cost**	
	Cost of seed(NRs/Ropani)	4622.265
	Cost of manure(NRs/Ropani)	30779.51
	Cost of plant protection(NRs/Ropani)	9234.36
	Cost of human labour(NRs/Ropani)	32915.21
	Total Variable cost	77556.42
C.	**Gross margin(NRs/Ropani)**	**203171.1**
D.	**B:C Ratio**	**4.11**

Source: Field survey, 2015

The gross margin per Ropani was NRs. 2,03,171.1. Here the fixed cost was not taken into account. When variable cost was determining the profitability of any business at that scenario production tomato under poly-house condition was found luxurious business for earnings.

The benefit cost ratio was 4.11 which means benefit was 4.11 times more than cost involved in production of tomato. It signifies tomato under poly-house condition to be a profitable business.

MARKET, MARKETING SYSTEM AND MARKETING CHANNEL

Major markets of the tomato producers of the study area are the Hat bazaars of the district. Okhaldhunga bazar consumes more than 60 % of total produce of the farmers while Rumjhatar and Rampur bazar consume rest of the production of the study area.

Marketing of off-season tomato encompasses all the activities being performed in moving vegetables from producers to the hands of ultimate consumers. Marketing system creates time, space and form utilities of the farm produce for the consumers. The producers, traders, transporters, wholesalers, retailers were the main actors of off-season marketing in Nepal.

MARKETING SYSTEM IN THE STUDY AREA

Mainly the tomato producers and the local traders were the main actors involved in the marketing. Generally the producers found large in numbers whereas traders were few number. Most of the portion of produce was sold by the producers themselves in local hat bazars while some portion was marketed by the local traders. Buying, assembling, transportation, financing and selling activities were done by the traders and producers. The marketing system of the study sites was very simple type. Most of the production was marketed by the producers themselves. Producers carry on their back and some use vehicles for transport and sell them in the local market. Most of their produce was sold on the day of hat bazaar. Hat bazaar is organized twice a week namely on Wednesday and Saturday in Okhaldhunga hat bazaar. Likewise, on Thursday on Rampur hat bazaar and on Friday on Rumjhatar hat bazaar are run. Producers sell some of their produce to the local traders who further sell to the retailer and consumer. Producers also sell their product to the retailer directly who sell to the consumer. The common marketing channel of the study area that is observed is presented in Figure 1.

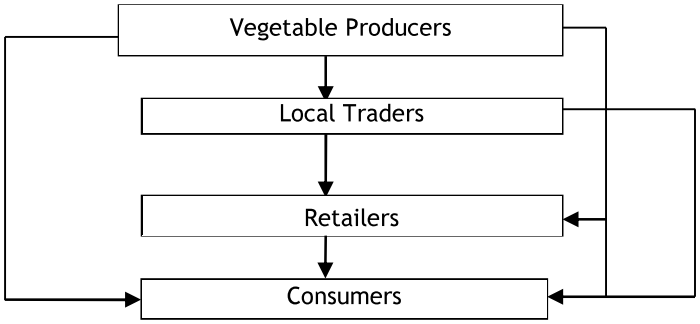

Figure 1. Marketing channels and functionaries in the marketing of tomato in the study area.

Source: Author's estimation

PRODUCTION AND MARKETING PROBLEM ANALYSIS

In the study areafarmers has been facing production and marketing related problems. Some problems were found entirely related to producers, some to traders. To identify the problems in the production and marketing of off-season tomato in the study sites, the respondents were confronted with some open ended questions, asked to mention and rank all the problems.

Production Problems

Great deals of problems being faced by the tomato producers were explored. The nature and degree of seriousness of the problems depended upon the educational status of the respondents, years of tomato cultivation and other working experiences. Altogether, 6 production problems were identified by the tomato producers. The most important problem of tomato producers in the study area was the problem of diseases (Table 4).

Table 4: Intensity of production problems faced by tomato producers (2015)

Problems	Index	Rank
Diseases	0.72	I
Insects and pests	0.69	II
Lack of technical knowledge	0.68	VI
Lack of quality seed and planting materials	0.54	V
Loan facility	0.26	IV
Insurance facility	0.24	III

Note: Respondents were asked to tell problems in scales ranging from high to low by assigning three level scales. The scale values considered were 3 for high, 2 for medium and 1 for low level problem

Marketing problems

Marketing plays important role for the easy disposal of the product from producer ultimately to the consumer. Due to low storage life in ordinary condition, easy and safe disposal of the commodity after harvesting is most important.

Various problems were mentioned and assigned scores by the tomato producers. Study showed that the major marketing problems as perceived by farmers were the problem of lack of transportation facility from the zone of production to zone of consumption followed by lack of market information. The third rated problem was perishability of product followed by lack of packaging materials and lack of processing facility. Similarly, price instability, lack of

storage facility and finance/credit availability were other serious problems being faced by tomato producer for marketing.

Table 5: Intensity of marketing problems faced by tomato producer during marketing (2015)

Problems	Index	Rank
Lack of transportation facility	0.81	I
Lack of market information	0.78	II
Perisibility of product	0.76	III
Lack of packaging materials	0.68	IV
Lack of processing facility	0.46	V
Price instability	0.42	VI
Lack of storage facility	0.36	VII
Finance/credit availability	0.34	VIII

Note: Respondents were asked to tell problems in scales ranging from high to low by assigning three level scales. The scale values considered were 3 for high, 2 for medium and 1 for low level problem.

CONCLUSION

Vegetable cultivation during off-season is raising and have been considered a profitable business in mid- hills of Nepal. Tomato production in poly-house during summer is considered off-season production and fetch good price. The research was carried out in Okhaldhunga district in Eastern mid-hills of Nepal to assess the factors affecting gross return of tomato production and to analyze the economics of tomato production. Descriptive statistics and analytical tools like t-test, gross margin, and cost-benefit analysis, Cobb-Douglas production function, return to scale, indexing were used to analysis the data. Cobb-Douglas production function was used to determine the nature of input-output relationship in tomato production.

For tomato production, cost of seed and cost of human labor was found negative relationship that implies 1% increase would decrease gross return by 1.638% and 1.50%, respectively. On the other hand, cost of human labor was positively significant and with 1% increase would increase gross return by 3.057%. In return to scale analysis, decreasing return to scale was observed in tomato production.

The total variable cost was found highest for off-season tomato production. The gross margin per Ropani for tomato production NRs. 2,03,171. B:C ratio was for off-season tomato was 4.11. Thus, tomato production was found most promising business. The producer, local traders, retailer, and consumer were main actor of marketing channel in the study area. Problem of disease was ranked as the most severe problem followed by insect pest, lack of technical knowledge etc. The major marketing problems as perceived by farmers were the problem of lack of transportation facility from sites to markets.

It is recommended to the concerned stake holder to invest in off-season tomato production as it is found to be a profitable business. Similarly government should make policy to facilitate farmers involved in off-season tomato production by formulating programme to support farmers for fixed cost and variable inputs. It is also recommended to the government sector to support farmers by providing extension services to address disease, insect -pest problems, provide technical knowledge and provide transportation facility.

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