PROFITABILITY AND PERCEPTION OF NEPALESE FARMERS IN PROTECTED VEGETABLE FARMING IN NEPAL

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ABSTRACT

The study was conducted 7 districts of Nepal by selecting 90 respondents to understand profitability of vegetable farming under different type of protected structures namely temporary, semi-permanent and permanent. Descriptive statistics and scaling techniques were used to analyze data. The financial analysis showed significantly higher benefit cost ratio and payback period in temporary structures than that of semi-permanent and permanent structures. The net present value was found statistically similar in all types of protected structures. The age of household head and area under protected farming were found statistically higher among the adopters of temporary structure while the years of farm registration and experience in protected vegetable farming were found statistically higher among the adopters of semi-permanent structures. This shows graduation process of growers from temporary to semi-permanent structure. The productivity of vegetables under protected structure in the study area was found 191.55 mt./ha/year. The yield was found most satisfying factor, whereas the availability of technician was found to be the factor with highest index of difficulty. The findings of the study will have implication for the policy makers, suppliers and farmers regarding the promotion and adoption of different types of protected structures.

Keywords: Financial analysis, Protected structure, Semi-permanent, Temporary

INTRODUCTION

The worldwide production of vegetables has tremendously gone up during the last two decades and the value of global trade in vegetables now exceeds that of cereals. The harvested global amounts of vegetables were about 1.13 billion metric tons in the year 2019 out of which around 879.3 million metric tons (78 percent) were produced in Asia. Vegetables crops, which are the integral part of Nepalese farming system and are considered very important for food security and income source for smallholder farmers. Contributing around 11.92 percent (MoALD, 2021) on National AGDP, fresh vegetable is one of the important sector of agriculture in the country. Over the 20 years' period, vegetable area and yield grew at an annual rate of 3.6% and 5.42 % respectively. Although the area and yield under vegetable has increased, the import of vegetable have also increased over the last decade with decreased exports. The demand for vegetables is increasing due to population growth, economic progress, and increased spending power from income growth and migrant remittances (Vegetable Sector Strategy-Nepal, 2020). The increasing demand of vegetables and its fulfilment from import points the oppourtunity for furthur commercialization of vegetable sector.

The estimated global protected agriculture area is 5,630,000 hectares, whereas the protected area under vegetables is 496,800 hectares (cuestaroble, 2019), which is around 0.83 percent of the total

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area under vegetable cultivation (FAO, 2019). Among more than 115 countries cultivating under protected structure, China is leading country with around 2.5 million hectares of land under protected cultivation (Jiang & Yu, 2008) while India has around 0.04 million hectares (Singh, 2014). Nepal has a young history in protected farming which started with the development of rain shelter type bamboo plastic houses by Agriculture Research Center, Lumle in 1996, for off season production of vegetables especially tomato. The further advancement of protected structures remained stagnant until the projects like Project for Agriculture Commercialization and Trade (PACT), High Value Agriculture Project (HVAP), High Mountain Agribusiness and Livelihood Improvement Project (HIMALI), Raising Income of Small and Medium Farmers (RISMFP), Integrated Water Resource Management Project (IWRMP), Agriculture and Food Security Project (AFSP), and Prime Minister Agriculture Modernization Project (PMAMP) intervened some permanent protected structures. Since last 4-5 years investment in protected structures has been gaining momentum with an area of around 700 hectares till 2018 (Subedi, 2020).

High installation cost, difficulty in availability of installation materials, and poor technical knowhow are major limiting factors for benefiting from this technology. Quality and timely availability of inputs such as seeds and water soluble fertilizers is also one of the important factor hindering the development of protected vegetable farming (Atreya et.al., 2019). Although some basic techniques of protected farming are in use, they are not organized and little study have been done on their efficacy. This study aims to determine the profitability of vegetable farming in different types of protected structures, and determine the perception of farmers regarding protected vegetable farming.

METHODOLOGY

STUDY SITE AND SAMPLING DESIGN

The study was conducted in seven districts of Nepal namely Kathmandu, Makawanpur, Dhading, Sindhupalchok, Kaski, Lalitpur and Nuwakot. The districts were selected purposefully to include the districts with highest area under protected cultivation. The roster of the farmers registered as adopter of the protected farming was prepared with the help of Agriculture Knowledge Center (AKC) and Agriculture Section of the local levels of the respective districts. The farmers adopting protected farming were categorized into clusters according to local level in the respective districts and the local levels were purposefully selected. Thus stratified simple random sampling technique was adopted. Primary data was collected through household survey with the help of structured and semi-structured interview schedule, focal group discussion and key informant interview. To supplement the data from the primary sources various published and unpublished secondary sources of data, proceedings of NCPVSCD[1], AKC[2], related reports, journals and books were consulted. A total of 90 households were surveyed and to make a comparative study 50 households adopting temporary protected, 20 households adopting semi-permanent and 20 households adopting permanent structures were decided to include in the sample.

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METHODS AND TECHNIQES OF DATA ANALYSIS

Data collected were entered in SPSS and analysis was done using SPSS, STATA and Microsoft excel. Mean, standard deviations, ordinary least square (OLS) technique of multiple regression and likert scale technique was done to derive inference needed.

To determine level of difficulty of availability and satisfaction towards various factors of protected vegetable farming five point Likert scaling technique used. It compares most important, somewhat important, important, less important and least important using the scores of 1.00, 0.80, 0.60, 0.40 and 0.20 respectively (Joshi, Kale, Chandel, & Pal, 2015). The formula is:

$$I = \Sigma I = \frac{S_i F_i}{N}$$

Where,

- I = Index value for Satisfaction/difficulty
- S_i= Scale value of i^{th} intensity
- F_i = Frequency of i^{th} response
- N = Total number of respond

COMPONENTS OF ANALYSIS

Net Present Worth (NPW)

The NPW is defined as the difference between present worth of savings and cost of investment. The formula used to calculate the NPW is

$$NPW = \sum_{t=1}^{t=n} \frac{(B_t - C_t)}{(1+i)^t}$$

Where,

B_t= Benefit in the year t

C_t= Cost in the year t

i = discount rate

t = number of years

Benefit cost ratio

This ratio was obtained when the present worth of the benefit stream was divided by the present worth of the cost stream. The mathematical benefit-cost ratio (Sengar & Kothari, 2008) can be expressed as:

$$Benefit\ Cost\ Ratio = \frac{\sum_{t=1}^{t=n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{t=n} \frac{C_t}{(1+i)^t}}$$

Payback Period

The payback period is the length of time from the beginning of the project until the net value of the incremental production stream reaches the total amount of the capital investment. It shows the length of time between cumulative net cash outflow recovered in the form of yearly net cash inflows.

$$Payback\ Period\ (PP) = \frac{Investment\ cost\ (IC)}{Annual\ Net\ Income\ (ANI)}$$

RESULT AND DISCUSSION

SOCIO-DEMOGRAPHIC CHARACTERISTICS (CONTINUOUS)

Table 1 presents the socio demographic (continuous) characteristics of the respondents by structure type. The result of ANOVA showed that among various socio-demographic characteristics, age, years of farm registration, experience in protected farming and area under protected farming were found statistically different between the farmers adopting different types of protected structures.

The average age of the respondent was found statistically higher among farmers adopting temporary structure (40 years) than that of farmers adopting semi-permanent structure (34.30 years) which was significant at 10 % level of probability this could be explained that younger farmers are more associated with extension services and access to extension service directly influence the adoption of modern technologies. (Ahmad, 2012), in similar study regarding adoption of protected tomato farming found that majority of respondents adopting protected tomato farming were young aged. The years of farm registration was statistically higher among farmers adopting semi-permanent structure (5.40) than that of farmers adopting permanent structure (34.30 years) and temporary structure (2.44), which was significant at 1% level of probability. The experience in protected farming was statistically higher among adopters of semi-permanent structure (4.00 years) than that of adopters of temporary structure (2.64 years) at 5% probability level and then that of permanent structure (3 years) at 10% probability level. The higher experience in semi-permanent structures than that of temporary could be explained that majority of the temporary structure holders in the study area were on rented land which had uncertain future, thus their profession would be of short period. The lower experience of farmers on permanent structures could be explained it being recently adopted technology. The area under protected farming was statistically higher among adopters of temporary structure (4120.24 square meters) than that of adopters of semi-permanent structure (1568 square meter) at 5% level of probability and then that of permanent structure (1427.20 square meter) at 1 % probability level. The higher area under temporary protected area could be justified by the lower cost of installation and lower life of the project as compared to that of semi-permanent and permanent structures.

Table 1. Socio-demographic characteristics of respondents by type of protected structure

Variable	Type of Structure	N	Mean	Standard Deviation	ANNOVA Comparison	Tukey HSD	
						1	2
Age (Years)	0	50	40.00	10.62	*p=0.055*	*p=0.062**	*p=0.986*
	1	20	34.30	7.62			*p=0.106*
	2	20	40.40	7.40			
	Overall	90	38.82	9.60			
Members in Agriculture (Number)	0	50	2.44	1.21	*p=0.867*		
	1	20	2.30	1.30			
	2	20	2.30	1.21			
	Overall	90	2.38	1.223			
Years of Farm Registration	0	50	2.44	1.74	*p=0.000*	*p=0.000***	*p=0.000***
	1	20	5.40	1.53			*p=0.363*
	2	20	4.60	2.34			
	Overall	90	3.58	2.24			

Experience in Protected Farming (Years)	0	50	2.64	2.09	*p=0.021*	*p=0.017***	*p=0.710*
	1	20	4.00	1.62			*p=0.076**
	2	20	3.00	1.02			
	Overall	90	3.02	1.87			
Area under protected farming (Square Meter)	0	50	4120.24	3623.21	*p=0.000*	*p=0.030***	*p=0.002****
	1	20	1568.00	1171.37			*p=0.986*
	2	20	1427.20	1241.61			
	Overall	90	2954.62	3093.42			

*Note: 0= temporary structure, 1= semi-permanent structure, 2= permanent structure *, ** and *** denotes significance at 10%, 5% and 1% levels respectively*

SOCIO-DEMOGRAPHIC CHARACTERISTICS (CATEGORICAL)

The result of chi-square test showed that there was a statistical difference in the major source of income in various categories of adopters of protected structure, which was significant at 5% level of probability. Majority of respondents having agriculture as a major source of income had adopted temporary and semi-permanent structures. This can be justified with the cost of installation of structures as the cost of installation of permanent structures was found high and the respondents whose major source of income was agriculture would be reluctant invest higher cost for the installation of permanent structures. Other variables namely, gender, education of household head, ethnicity, religion and family type were statistically similar among the adopters of different types of protected structures.

Table 2. Socio-demographic characteristics of respondents by type of protected structure

Variable	Overall (N=91)	Temporary Structure (N=50)	Semi-Permanent Structure (N=20)	Permanent Structure (N=20)	Chi-square value	p-value
Gender						
Male	82.22	76	90	90	2.980	0.225
Education of HH Head						
Higher Secondary	55.56	48	70	60	3.006	0.222
Ethnicity						
Brahmin/Chhetri	51.11	44	60	60	1.853	0.396
Religion						
Hindu	62.22	56	70	70	2.276	0.32
Family Type						
Nuclear	46.67	48	30	60	3.696	0.158
Source of Income						
Agriculture	97.78	100	100	90	7.159**	0.028

*Note: ** denotes significant at 5% probability level.*

CROPPING PATTERN IN PROTECTED STRUCTURE

Majority of farmers (20%) followed Tomato-Cole cropping pattern followed by tomato only (17.5%). The least practiced cropping pattern was found to be Tomato-Capsicum followed by 2.5% of sampled households.

Table 3. Cropping pattern in protected structure

S.N.	Cropping Pattern	Percentage (N=90)
1	Tomato-Cole	20
2	Tomato-Fallow	17.5
3	Tomato+ Cole-Cole	12.5
4	Tomato-Leafy green-Bean	7.5
5	Tomato-Leafy green	7.5
6	Tomato+ Cole-Leafy green	7.5
7	Cucurbit-Leafy green	7.5
8	Tomato-Leafy green-Cole	5
9	Cucurbit-Cole	5
10	Tomato-Beans	5
11	Beans/Tomato/Leafy green	2.5
12	Tomato-Capsicum	2.5

PRODUCTIVITY OF VEGETABLES UNDER PROTECTED STRUCTURES

The average productivity of vegetables under protected structure in the study area was found to be 191.55 mt./ha/year. The productivity of vegetables was found higher in semi-permanent structures (218.87) followed by permanent structure (197.24) and temporary structure (178.35). However, the productivity of vegetables under different structures were found to be statistically similar. (Duhan, 2016), (Engindeniz & Tuzel, 2002), and (Diab, Magdi, & Hassan, 2016) in their studies comparing the productivity of different vegetables in open field and protected structure found three to five times higher productivity of vegetables in protected structures.

Table 4. Productivity of the protected vegetable farming based on structure type

Type of Structure	Productivity (mt./ha/year)					ANNOVA Comparison
	N	Mean	Standard Deviation	Minimum	Maximum	
0	50	178.35	89.363	46.250	437.500	p=0.208
1	20	218.87	90.019	120.000	350.000	
2	20	197.24	77.715	133.333	395.585	
Overall	90	191.55	87.686	46.250	437.500	

Table 5 shows the productivity of vegetables under protected structure in the study area based on cropping pattern. The average productivity of vegetables under protected structure in the study area was found to be 191.55 mt./ha/year. Farmers producing more than two crops in a year had experienced more productivity (250.86) than that of farmers producing two crops (175.78) and single crop (164.16) which

were found to be statistically different at 1 percent level. Please discuss your results with relevant literatures.

Table 5. Productivity of the protected vegetable farming based on cropping pattern

Cropping Pattern	Productivity (mt./ha/year)					ANNOVA Comparison
	N	Mean	Standard Deviation	Minimum	Maximum	
Single crop	20	164.16	42.134	120.000	250.000	p=0.01
Two crops	48	175.78	87.056	46.250	395.580	
More than two crops	22	250.86	95.138	77..333	437.500	
Overall	90	191.55	87.686	46.250	437.500	

FARMERS PERCEPTION ON AVAILABILITY OF INPUTS FOR PROTECTED VEGETABLES FARMING

Table 6 presents the difficulty of farmers regarding the availability of various inputs required for protected vegetable farming. It was calculated using five point likert scale. The difficulty index showed that availability of technician for installation of the structure was the most difficult task while constructing protected structure with the difficulty index of 600.

Table 6. Farmers Perception regarding difficulty in availability of inputs

Materials	Very Difficult	Neutral	Easy	Very Easy	Index of Difficulty	Rank
Cladding Material	0%	40%	49%	9%	0.339	IV
Bamboo	0%	16%	76%	0%	0.330	V
MS Pipe	0%	40%	60%	0%	0.350	III
GI Pipe	0%	75%	15%	0%	0.488	II
Technician for Installment	2%	13%	24%	0%	0.600	I
Inputs for Crop Production	0%	12%	82%	0%	0.308	VI

FARMERS PERCEPTION REGARDING VARIOUS FACTORS THAT AFFECTS PROTECTED VEGETABLE FARMING

Table 7 presents the satisfaction of respondents in the study area with respect to various factors that affect the protected vegetable cultivation. The index of satisfaction of respondents was calculated using five point likert scale. The satisfaction index showed that performance of the crops under the protected structure was the most satisfying factor with the index of satisfaction of 0.511. The least satisfying factor regarding the vegetable production under protected structure was found to be the cost of materials for the construction of protected structure with the index of satisfaction of 0.172.

Table 7. Farmers Perception regarding various factors that affects protected vegetable farming

Factors affecting protected farming	Extremely Satisfied	Very Satisfied	Moderately Satisfied	Slightly Satisfied	Not at all Satisfied	Index of Satisfaction	Rank
Availability of Materials	0%	29%	24%	42%	4%	0.444	III
Cost of Materials	0%	0%	2%	64%	33%	0.172	IX
Availability of Technicians	0%	2%	40%	33%	24%	0.300	VII
Cost of Technicians	0%	11%	29%	20%	40%	0.278	VIII
Quality of work performed by Technicians	0%	13%	49%	27%	11%	0.411	IV
Quality of Inputs	0%	11%	33%	33%	22%	0.333	VI
Performance of Crops	0%	29%	53%	11%	7%	0.511	I
Price of the produce	2%	22%	56%	16%	4%	0.506	II
Guidance of Extension staff	0%	16%	24%	51%	9%	0.367	V

PROFITABILITY OF VEGETABLE PRODUCTION IN TEMPORARY STRUCTURE FOR 10 YEARS

Table 8 presents the cost and benefit components of vegetable cultivation based on the average yield according to the cropping pattern presented in Table 3 in temporary structure along with the indicators of financial analysis. The calculations were done for 1 Ropani (500 square meter) of protected structure. For the ease of comparison, the 3 years' project life was converted to 10 years' project. Highest cost was incurred for structure installment (NRs. 109000). The financial analysis of vegetable production under temporary structure for 10 years found net present value (NPV) of NRs. 1753000. The benefit cost ratio (BCR) was found to be 2.89. Since the cash inflows in the first year were sufficient to cover the cash outflow internal rate of return was not applicable. The payback period was found to be 0.78 years (around 9 months).

Table 8. Profitability of vegetable production in temporary structure Per 500 square (Cost and Benefits in thousand NRs.)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Structure Installment Cost	109	0	0	109	0	0	0	109	0	0	327
Fixed Asset Cost	58	0	0	0	0	0	0	0	0	0	58
Variable Cost	92	92	92	92	92	92	92	92	92	92	923
Total Cost	260	92	92	201	92	92	92	201	92	92	1309
Income from Production	397	397	397	397	397	397	397	397	397	397	3971

Book Value of Fixed Asset	0	0	0	0	0	0	0	0	0	6	6
Total Income	397	397	397	397	397	397	397	397	397	403	3977
Discount Factor	0.93	0.86	0.79	0.74	0.68	0.63	0.58	0.54	0.50	0.46	-
Discounted Cost	241	79	73	148	63	58	54	109	46	43	914
Discounted Benefit	368	340	315	292	270	250	232	215	199	187	2667
Net Present Value (NPV)											1753
Benefit Cost Ratio (BCR)											2.89
Internal Rate of Return (IRR)											NA
Payback Period											0.78

PROFITABILITY OF VEGETABLE PRODUCTION IN SEMI-PERMANENT STRUCTURE

Table 9 presents the cost and benefit components of vegetable cultivation based on the average yield according to the cropping pattern presented in Table 3 in semi-permanent structure along with the indicators of financial analysis. The calculations were done for 1 Ropani (500 square meter) of protected structure. The life of the project was assumed to be of 10 years. Highest cost was incurred for structure installment (NRs. 544000). The financial analysis of vegetable production under semi-permanent structure for 10 years found net present value (NPV) of NRs. 2272000. The benefit cost ratio (BCR) was found to be 2.47. The internal rate of return (IRR) was found to be 264%. The payback period was found to be 1.91 years (around 23 months).

Table 9. Profitability of vegetable production in semi-permanent structure Per 500 square meter (Cost and Benefits in thousand NRs.)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Structure Installment Cost	544	0	0	0	0	0	0	0	0	0	544
Maintenance Cost	0	0	0	0	300	0	0	0	0	0	300
Fixed Asset Cost	56	0	0	0	0	0	0	0	0	0	58
Variable Cost	112	112	112	112	112	112	112	112	112	112	1120
Total Cost	712	112	112	112	412	112	112	112	112	112	2020
Income from Production	560	560	560	560	560	560	560	560	560	560	3496
Book Value of Fixed Asset	0	0	0	0	0	0	0	0	0	49	6691
Total Income	560	560	560	560	560	560	560	560	560	609	10187
Discount Factor	0.93	0.86	0.79	0.74	0.68	0.63	0.58	0.54	0.50	0.46	-
Discounted Cost	659	96	89	82	280	71	65	60	56	52	1511
Discounted Benefit	519	481	445	412	381	353	327	303	280	282	3784
Net Present Value (NPV)											2272
Benefit Cost Ratio (BCR)											2.47
Internal Rate of Return (IRR)											264%
Payback Period											1.91

PROFITABILITY OF VEGETABLE PRODUCTION IN PERMANENT STRUCTURE

Table 10 presents the cost and benefit components of vegetable cultivation based on the average yield according to the cropping pattern presented in Table 3 in permanent structure along with the indicators of financial analysis. The calculations were done for 1 Ropani (500 square meter) of protected structure. The life of the project was assumed to be of 10 years. Highest cost was incurred for structure installment (NRs. 1293000). The financial analysis of vegetable production under permanent structure for 10 years found net present value (NPV) of NRs. 1342000. The benefit cost ratio (BCR) was found to be 1.60. The internal rate of return was found to be 30%. The payback period was found to be 3.16 years (around 38 months).

Table 10. Profitability of vegetable production in permanent structure Per 500 square meter (Cost and Benefits in thousand NRs.)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Structure Installment Cost	1293	0	0	0	0	0	0	0	0	0	1293
Maintenance Cost	0	0	0	0	300	0	0	0	0	0	300
Fixed Asset Cost	52	0	0	0	0	0	0	0	0	0	52
Variable Cost	107	107	107	107	107	107	107	107	107	107	1070
Total Cost	1452	107	107	107	407	107	107	107	107	107	2715
Income from Production	501	501	501	501	501	501	501	501	501	501	5010
Book Value of Fixed Asset	0	0	0	0	0	0	0	0	0	319	319
Total Income	501	501	501	501	501	501	501	501	501	820	5329
Discount Factor	0.93	0.86	0.79	0.74	0.68	0.63	0.58	0.54	0.50	0.46	-
Discounted Cost	1344	92	85	79	277	67	62	58	54	50	2167
Discounted Benefit	464	430	398	368	341	316	292	271	251	380	3510
Net Present Value (NPV)											1342
Benefit Cost Ratio (BCR)											1.6
Internal Rate of Return (IRR)											30%
Payback Period											3.16

COMPARISON OF NET PRESENT VALUE OF DIFFERENT TYPES OF STRUCTURES

Table 11 presents the result of analysis of variance (ANOVA) for discounted net present value of different types of protected structures. The discounted net present value for 10 years of agricultural project for vegetable production under temporary, semi-permanent and permanent structure were found to be NRs. 1753368.226, NRs. 2272357.420, and NRs. 1342210.064 respectively. The result of ANOVA showed no significant difference among the net present value in different types of structure

Table 11. Comparison of net present value of different types of protected structures

Type of Structure	Net Present Value					ANNOVA Comparison
	N	Mean	Standard Deviation	Minimum	Maximum	
0	50	1753368.226	1305765.908	159274.096	5244997.892	p=0.178
1	20	2272357.420	2479170.355	-188785.096	6847396.091	
2	20	1342210.064	881413.035	375219.973	3421842.925	

Note: 0= temporary structure, 1= semi-permanent structure, 2= permanent structure.

COMPARISON OF BENEFIT COST RATIO OF DIFFERENT TYPES OF STRUCTURES

Table 12 presents the result of analysis of variance (ANOVA) for discounted benefit cost ratio of different types of protected structures. The mean discounted benefit cost ratio for 10 years of agricultural project for vegetable production under temporary, semi-permanent and permanent structure were found to be 2.89, 2.47, and 1.60 respectively.

Table 12. Comparison of benefit cost ratio of different types of protected structures

Type of Structure	Benefit Cost Ratio					ANOVA Comparison	Dunnett's test	
	N	Mean	Standard Deviation	Minimum	Maximum		1	2
0	50	2.89	1.1556	1.146	6.457	p=0.000	p=0.636	p=0.000***
1	20	2.47	1.5713	0.883	5.162			p=0.070*
2	20	1.60	0.2770	1.138	1.979			

Note: 0= temporary structure, 1= semi-permanent structure, 2= permanent structure
* and *** = significant at 10% and 1% probability level

Since there was significant difference among the benefit cost ratio of different protected structures, Dunnett's test (assuming non equal variance) was applied. The result of the Dunnett's test showed that benefit cost ratio of temporary structure was statistically different from that of permanent structure at 1% probability level and the benefit cost ratio of semi-permanent structure was significantly different from that of permanent structure at 10% probability level. However, there was not statistical difference in benefit cost ratio between temporary structure and semi-permanent structures. (Murthy, Prabhakar, Hebbar, Srinivas, & Prabhakar, 2009) in their study of economic feasibility tomato and capsicum production under poly house found benefit cost ratio of 1.80 which was slightly lower than the findings of this study. Similarly, (Kumar, Singh, & Chaudhari, 2018) found the 1.18 benefit cost ratio of capsicum production in naturally ventilated greenhouse.

(Engindeniz & Tuzel, 2002) found benefit cost ratio of 2.66 for netted cabbage and benefit cost ratio of 1.58 for rain shelter type of protected structure.

COMPARISON OF PAYBACK PERIOD OF DIFFERENT TYPES OF STRUCTURES

Table 13 presents the result of analysis of variance (ANOVA) for payback period of different types of protected structures. The payback period for vegetable production under temporary, semi-permanent and permanent structure were found to be 0.78, 1.91, and 3.16 years respectively.
Since there was significant difference among the payback period of different protected structures, Dunnett's test (assuming non equal variance) was applied. The result of the Dunnett's test showed that payback of each type of protected structure were statistically different at 1% probability level.

Table 13. Comparison of payback period of different structures

Structure Type	Pay Back Period					ANNOVA Comparison	Dunnett's test	
	N	Mean	Standard Deviation	Minimum	Maximum		1	2
0	50	0.78	0.302	0.288	1.557	p=0.000	p=0.004***	p=0.000***
1	20	1.91	1.350	0.546	5.013			p=0.006***
2	20	3.16	1.011	1.750	4.475			

Note: 0= temporary structure, 1= semi-permanent structure, 2= permanent structure
*** = significant at 1% probability level

CONCLUSION

This study indicates that socio-demographic characters like age, years of farm registration, experience in protected farming, area of household under protected farming, and major source of income affects the adoption of different types of protected structures. The lower productivity in high tech (permanent) structures than that of semi-permanent and temporary structures clearly pictures the weak technical knowhow of operating permanent structures to exploit their production potential. Looking at the profitability ratios, mainly benefit cost ratio and payback period temporary structures were found more profitable than that of semi-permanent and permanent structures. In conclusion, given the existing condition of technical knowhow about the operation of permanent structures, investment in such structure was not found to be economically conducive.

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