

SOCIOECONOMIC STUDY OF TOMATO AND POTATO CULTIVATION IN NUWAKOT DISTRICT OF NEPAL

गोलभेडा र आलु बालीको उत्पादन लागत र आर्थिक समाजिक विश्लेषणको अध्ययन



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Ministry of Agriculture and Livestock Development

Prime Minister Agriculture Modernization Project

Project Implementation Unit, Nuwakot

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**SOCIOECONOMIC STUDY OF TOMATO AND POTATO
CULTIVATION IN NUWAKOT DISTRICT OF NEPAL**

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Table of Contents

ACRONYMS AND ABBREVIATION	1
SOCIO-ECONOMIC ANALYSIS OF TOMATO PRODUCTION UNDER PERMANENT PLASTIC HOUSE: A CASE FROM VEGETABLE ZONE OF NUWAKOT DISTRIC	3
ABSTRACTS	4
1. INTRODUCTION	5
1.1 Background information	5
1.2 Statement of problem	5
1.3 Rationale of the study	6
1.4 Objective	6
1.4.1 General objective	6
1.4.2 Specific objectives	6
1.5 Limitations of the study	7
2. LITERATURE REVIEW	8
2.1 Production status of seasonal vegetables in Nuwakot district	8
2.2 Major vegetables growing in Nuwakot district	8
2.3 Offseason tomato production	9
2.4 Production and marketing constrains	10
3. METHODS AND METHODOLOGY	11
3.1 Research site and sub-sector	11
3.2 Sample and sampling technique	12
3.3 Research instruments	12
3.3.1 Household survey	12
3.3.2 Focus group discussions (FGD)	12
3.3.3 Key informant interview (KII)	12
3.3 Data type and data collection	12
3.4 Data analysis	13
3.4.1 Problem indexing	13
3.4.2 Economic analysis of the enterprise	14
3.4 SWOT analysis	16

4. RESULT AND DISCUSSION	17
4.1 Socioeconomic and Demographic Information	17
4.1.1 Gender of the respondent	17
4.1.2 Age of the respondent	17
4.1.3 Ethnic composition of respondents	18
4.1.4 Religious composition of respondents	18
4.1.5 Education of respondents	18
4.1.6 Family type	19
4.1.7 Family size of respondent	19
4.1.8 Primary occupation of respondents	20
4.1.9 Migration status of respondents household	20
4.1.10 Land holding of respondents	21
4.1.11 Status of wages rate	22
4.2 Scenario of tomato production using permanent plastic house and marketing	22
4.2.1 Years of commercial tomato cultivation under permanent plastic house ...	22
4.2.2 Factors influencing for commercial tomato cultivation	23
4.2.3 Training on commercial tomato cultivation and visit of extension workers	24
4.2.4 Access to credit	24
4.2.5 Source of credit for commercial tomato cultivation	25
4.2.6 Satisfaction status and willing to tomato farming in future	25
4.2.7 Method of irrigation followed under permanent plastic house	26
4.2.8 Source of labor	26
4.2.9 Status of record keeping	27
4.2.10 Packing and transportation materials	27
4.2.11 Respondents having their own tractor and sprayer	28
4.2.12 Sources of price information	29
4.2.13 Marketing system followed	29
4.3.1 Major Disease and insect/pest	30
4.3.2 Average production and selling price for various years	31
4.3.3 Price of tomato	31

4.4 Production and marketing problem	32
4.4.1 Production problems	32
4.4.2 Marketing problems	33
4.3.1 Experience of respondents about new insect/disease which were not economically important 10 years ago	35
4.3.2 Distribution of respondents based on their response towards climate change and tomato production	36
4.4 Economics of tomato production under permanent plastic house	36
4.5 Pandemic disease Covid-19 and its impact in tomato production	37
4.5.1 Distribution of respondents based on situation of farm labor availability and their wages rate	37
4.5.2 Distribution of respondents based on situation of availability of farm inputs during lockdown	37
4.5.3 Effect of lockdown on sales of farm produce and its reasons	38
4.6 SWOT analysis	38
5. SUMMARY AND CONCLUSION	40
5.1 Summary	40
5.2 Conclusion	42
6. BIBLIOGRAPHY	43
7. LIST OF ANNEXES	45
Annex1. Average cost of construction of permanent plastic house of size 12*6 m2 in 2020	45
Annex 2. Average cost of cultivation of tomato inside plastic house of size 12*6 m2 in 2020	45
Annex 3. Gross returns from tomato cultivation under permanent plastic house condition	46
Annex 4. Investment appraisal	47
A. Benefit cost ratio calculation	48
B. Net present value calculation	48
C. Internal rate of return calculation	49
D. Payback period calculation	49
ECONOMIC ANALYSIS OF POTATO CULTIVATION	51

Executive Summary	53
1. INTRODUCTION	54
1.1. Background information	54
1.2. Statement of Problems	55
1.3. Rationale of Study	55
1.4. Objectives	56
1.4.1. General objective	56
1.4.2. Specific objective	56
2. LITERATURE REVIEW	57
2.1. Production and marketing problems	58
2.2. PM-AMP Zone for potato	58
2.3. Trend of Potato Cultivation	58
4. RESEARCH METHODOLOGY	61
4.1. Research Site	61
4.2. Sample and Sampling Techniques	61
4.2.1 Selection of respondents	62
4.3. Sources of data	62
4.3.1 Primary data	62
4.3.2 Secondary data	62
4.3. Data collection procedure	62
4.3.1 Key informant interview (KII)	62
4.3.2 Telephone Survey	63
4.3.3 Household survey	63
4.2. Data analysis techniques	63
5 RESULTS AND DISCUSSIONS	65
5.3 Area under potato cultivation	65
5.4 Cost of production	65
5.5 Benefit Cost Ratio	66
5.6 SWOT Analysis	67
6 SUMMARY AND CONCLUSIONS	68
Bibliography	69

ACRONYMS AND ABBREVIATION

ABPSD: Agri-Business Promotion and Statistic Division

AGDP: Agriculture Gross Domestic Product

AKC: Agriculture knowledge center

BCR: Benefit cost ratio

CBS: Central Bureau of Statistics

DAP: Di-ammonium Phosphate

DF: Discounting Factor

DTDR: Difference of Two Discount Rate

FAO: Food and Agriculture Organization

FGD: Focus Group Discussion

GDP: Gross Domestic Product

GSM: Gram per Square meter

GI: Galvanized Iron

Ha: Hectare

INB: Incremental Net Benefit

INGOs: International Non-Governmental Organizations

IRR: Internal Rate of Return

KII: Key Informant Interview

Kg: Kilogram

LDR: Lower Discount rate

m: meter

Masl: Meter above sea level

ml: millilitre

Mop: Muriate of Potash

MoAD: Ministry of Agriculture Development

Ms-pipe: Mild steel pipe

MS-Excel: Microsoft Excel

mt: metric tonnes

NARC: Nepal Agriculture Research Council

NGOs: Non-Governmental organizations

NPV: Net Present Value

PIU: Project Implementation Unit

PMAMP: Prime Minister Agriculture Modernization Project

PV: Present Value

RS: Rupees

SPSS: Statistical Package for Social Science

Sq. m: Square meter

SWOT: Strength Weakness Opportunity and Threats

UDR: Upper Discount Rate

%: Percentage

**SOCIO-ECONOMIC ANALYSIS OF TOMATO PRODUCTION UNDER
PERMANENT PLASTIC HOUSE: A CASE FROM VEGETABLE ZONE
OF NUWAKOT DISTRICT**

ABSTRACTS

Prime Minister Agriculture Modernization Project (PMAMP) of vegetable zone was initiated in Nuwakot district since 2017. Now, PMAMP is touted as game changer for the development of agriculture in the country and seeks to modernize the agricultural system through concentrated efforts on production, processing and marketing. A socio-economic study of tomato production under permanent plastic house was carried out to assess the marketing system, profitability and impact of Covid-19 in tomato production. Fifty-one respondents, growing tomato under permanent plastic house were randomly selected from the inventory of PMAMP-PIU, Nuwakot and surveyed through KII and FGD. Secondary data were collected from the reports of PMAMP, NARC, MOAD, CBS and research articles. The Primary data obtained from field survey were coded, tabulated and analyzed by using SPSS and Microsoft Excel. Simple indexing method was used for problem ranking, and Benefit cost ratio, NPV, IRR and payback period was calculated by using formula. Most of the respondents were involving in commercial offseason tomato production by using permanent plastic tunnel since 2-5 years, practiced flooding as a major method of irrigation and had their own farm equipment. They were using plastic crate as major packing and transportation material. Late blight and *Tutaabsoluta* were the major production constraints of tomato production. Firstly, price variation then trader monopoly in price fixation was the major constraints of marketing. Traders were major source of price information. Price of offseason tomato was highly fluctuating, it was highest during September to November and lowest during June/July and December/January. The cost of construction for a permanent plastic house of size 12*6 Sq. m was Rs. 64,870 and average cost of production was Rs. 25,000 which produces annual gross revenue of Rs. 67500. Benefit cost ratio, NPV, IRR and payback period is 1.841, 184420, 47.06% and one year and seven months respectively. During lockdown because of pandemic disease Covid -19, farmers were facing problem in getting farm inputs and selling of farm produce at reasonable price. Conversely, they were getting farm labor more easily at usual wages rate.

Key words: Cost benefit analysis, Covid-19, Marketing, Socioeconomic information

1. INTRODUCTION

1.1 Background information

Agriculture is the backbone of Nepalese economy contributing 26.50 % to total GDP (AITC, 2020) and, 65.7% of total population is involved in agriculture where vegetable subsector has the most significant role in AGDP which shares 9.71%, (MoAD, 2015). Tomato is the second largest vegetable both in terms of production and consumption globally (FAO, 2016). China, India, US, Spain, Italy, Poland are the major tomato growing countries of the world with higher yield ranking in 2016/2017. In 2016/2017, China was the largest producer of tomato production that amount to 52.6 millions of tons which was 31% of worldwide production. India and the United States followed with the second and third highest production of tomatoes in the world (Nag, 2017). Tomato is also one of the major vegetables produced and consumed in Nepal. It occupies 5th position in terms of area coverage and second in terms of productivity (Directorate, 2009). The year round demand of tomato is increasing due to its multiple uses as a vegetable, salad, and pickle. Open cultivation of tomato during the rainy season is almost impossible because of heavy rainfall. Now a day's many farmers have started to construct plastic houses to protect it from rain. The regional agriculture research station at Lumle, Kaski developed an offseason tomato cultivation technology using plastic house (Kumar, 2017). Now days, this technology is being popular in mid hill region of Nepal and number of offseason tomato growers are increasing year by year. Tomato cultivation by using plastic house is one of the major modes of agro-entrepreneurship in Nuwakot district.

1.2 Statement of problem

Although Nepal is an agricultural country still huge proportion of agricultural commodities have been imported, among them tomato is also one of the major. Tomato production in Terai during rainy season is very hard and it has high price fluctuation all round the year which is peak during late rainy season. Farmers are facing the problems like high infestation of insect and disease, price variation and low technical knowledge, insufficient farm labor, irrigation and fertilizer availability during production

which has lowered productivity of tomato. According to report published by NARC, production constraints for tomato production are poor technical knowledge among farmers, limited availability of quality seeds, limited availability of wage labors, crop damage due to climatic change, fruit dropping, viral and fungal disease and the pest such as Leaf miner, white fly, fruit borers and loppers.

1.3 Rationale of the study

The main purpose of this study is to assess the socio-economic analysis of tomato cultivation under permanent plastic house in Nuwakot. Farmers from study area will be aware about their social status, land suitability, labor availability and wages rate. Through this study, farmers will be able to know about cost of production of tomato under permanent plastic house and returns from it. They can estimate financial requirement for tomato cultivation by using permanent plastic house and can fix reasonable price by having profit. This study will give information about major strength, weakness, opportunities and threats in tomato cultivation under plastic house in Nuwakot. Moreover, it will provide information about major production and marketing constraints of tomato. This research will provide information to policy intervention for effective implementation of development programs in vegetable zone of Nuwakot district.

1.4 Objective

1.4.1 General objective

- To assess the socio-economic analysis of tomato production under permanent plastic house in Nuwakot district.

1.4.2 Specific objectives

- To determine the existing production and marketing practices of off-season tomato in Nuwakot district;
- To assess the scope for production, marketing system and the challenges;
- To determine the profitability/economics of tomato production in study area;

- To assess impact of pandemic disease Covid-19 on tomato production and its marketing;
- To know strength, weaknesses, opportunities and threats to tomato cultivation in study area.

1.5 Limitations of the study

Nuwakot district has wider diversity in terms of geography and socio-culture. The altitude has a range from 457 m to 5144 m and considered as a mid-hill district of Nepal. In specific, acquired data represent the present situation of the offseason tomato growers inside the vegetable zone of Nuwakot. Due to the small sample size, limited time and budget constraints; information gathered was also limited. The research findings cannot be generalised the overall scenario of the country because of its distinct characteristics, small coverage of research area and selection of beneficiaries of the vegetable zone, Nuwakot only as respondents. But even with the limited information, this study will prove to be an effective reference material for the other researchers in the study area, and in similar areas of Bagmati province. In addition, it will be beneficial for the policy formulators in Nuwakot district.

2. LITERATURE REVIEW

2.1 Production status of seasonal vegetables in Nuwakot district

Area and production of seasonal vegetables is increasing but at slow rate from 2011 to 2013/14, production is not linear in relation to area. In year 2014/15, both area and production are increasing drastically as compared to previous years.

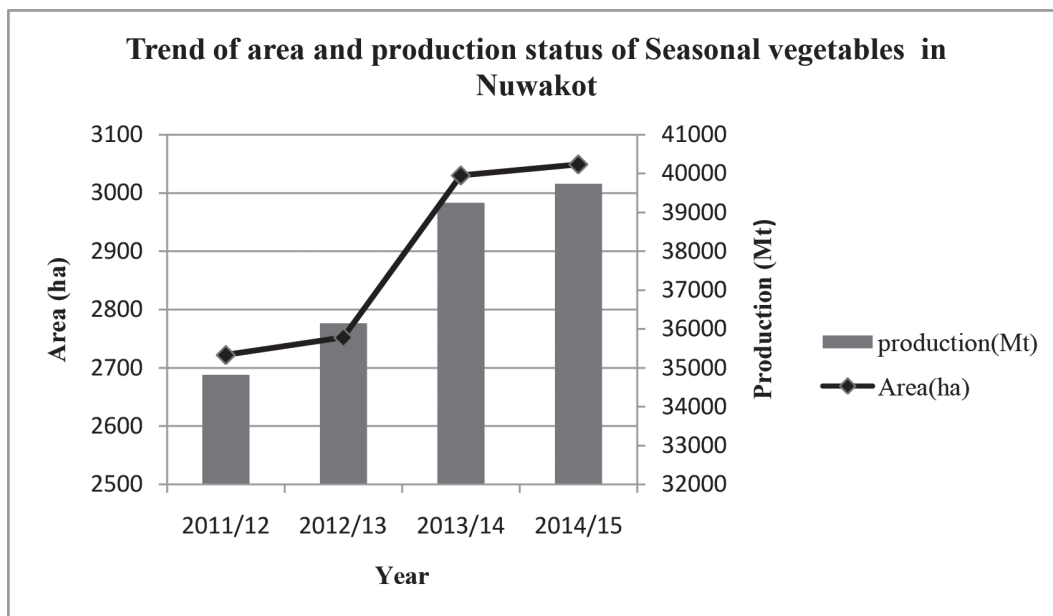


Fig: 1 Trend of area and production status of major seasonal vegetables in, Nuwakot district Source: (ABPSD, Statistical Information of Nepal Agriculture, 2011-15)

2.2 Major vegetables growing in Nuwakot district

The major vegetables grown in Nuwakot district are radish, cabbage, cauliflower, pumpkin, broad leaf mustard cucumber, peas etc. Total area, production, and productivity of vegetable is 3049 ha, 39741Mt and 13034 kg/ha respectively. However tomato comes under ninth position both in terms of cultivated area and production, which is shown in figure 2.

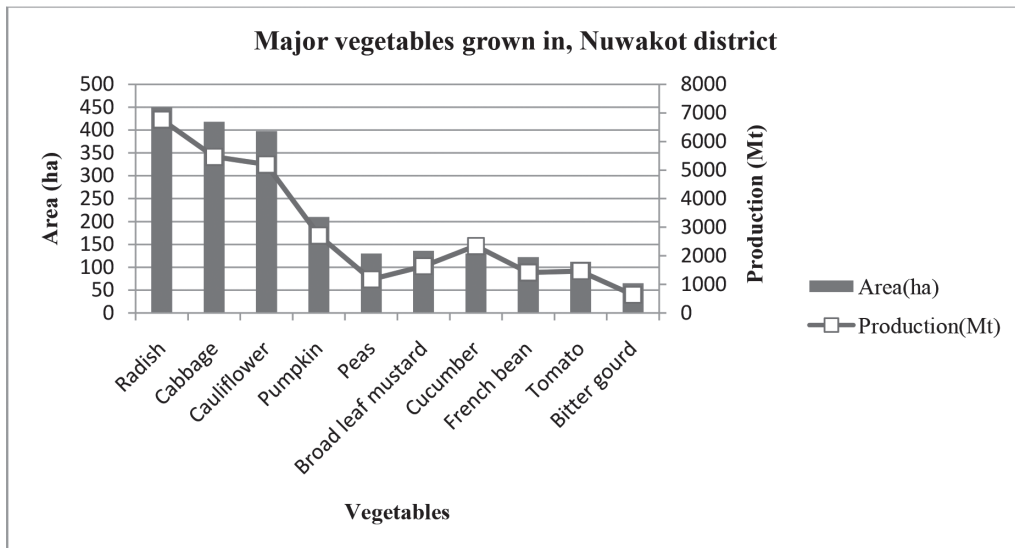


Fig: 2 Status of major vegetables growing in, Nuwakot district source (ABPSD, Statistical Information of Neplease Agriculture, 2016/17)

Table1. Status of tomato production in Nuwakot district

S.N.	Year	Area(ha)	Production(Mt)	Productivity
1.	2011/12	90	1170	13
2.	2012/13	92	1200	13
3.	2013/14	101	1317	13
4.	2014/15	105	1375	13
5.	2015/16	110	2140	19.5
6.	2016/17	112	1468	13

(ABPSD, Statistical Information of Neplease Agriculture, 2011-17)

From above table we can conclude that the area under tomato cultivation and productivity is increasing but for last six years in Nuwakot district. Productivity of tomato was constant in spite of increasing the land under tomato cultivation. Conversely, the productivity was higher in 2015/16 and increase4d by 50%.

2.3 Offseason tomato production

Tomato (*Lycopersiconesculentum*), taxonomically belongs to family Solanaceae. It has edible fruits which is berry type in nature. Currently tomato is an important food

component globally. The tomatoes are the second largest vegetable both in terms of production and consumption (FAO, 2016). The year round demand of tomato is increasing due to its multiple uses as a vegetable, salad, and pickle, sauces etc (Kumar, 2017). Tomato production in Terai during rainy season is hard due to unfavorable environment cause by heavy rainfall in open and even not feasible to cultivate under plastic house due to higher temperature (FAO, 2013). Temperature fluctuations during summer make the vegetable crop susceptible to insects, pests and diseases and similarly, cold temperature during winter creates favorable conditions for diseases. During rainy season plastic tunnel protects tomato from intensive rainfall and its detrimental effect. Between 15-19th century, wood and bamboo were the favorite materials for greenhouse structural frame construction which were later replaced with galvanized iron pipes and channels (Bhatnagar, 2014). Presently, all over the world, GI pipes or channels are most preferred material with varying specifications, while MS pipes angles are also being used at some locations with required paints / coatings (Bhatnagar, 2014).The greenhouse technology can be a key for sustainable crop production and to achieve food security in the regions facing the problems of food scarcity (K.A, 2017).

Offseason tomato cultivation by using plastic tunnel is suitable for the area of altitude 1000 masl to 1400 masl (Regmi, 2005). Tomato, Cucumber, zucchini, sweet pepper, and bitter gourd are among the vegetables that can be profitably grown in plastic houses (Budhathoki, 2006). Different studies conducted by Horticulture Research Division, Khumaltar in kathmandu valley shows that productivity of tomato per ropani of field had range of 4-10 ton under plastic house where as in open condition it was just 1-2 ton. From a research conducted in Hemja, Kaski production cost per ropani of cultivation in the first year was Rs. 1, 14,507. Cost of cultivation from the second year onwards was Rs 40,827. The gross average income was Rs1, 08,275. Thus the benefit- cost ratio in first year was negative and it was 1.65 from the second year onward (Kumar, 2017). Metal frame has its economic life of 10-12 years whereas changing of silpaulin plastic (150 GSM) and painting of metal frame need to be done in every 5 years (Rajan, 2020).

2.4 Production and marketing constrains

During offseason tomato cultivation there were several production constrains among them lack of quality seed was most severe problem followed by disease and insect/pest respectively in Hemja, Kaski (Kumar, 2017). Similarly major marketing constrain was

price variation followed by traders monopoly in price fixation in Hemja (Kumar, 2017). Tuta was becoming an economically important pest of tomato resulting about half of the production loss in Kathmandu and Kavre area (Joshi D, 2017).

3. METHODS AND METHODOLOGY

3.1 Research site and sub-sector

Nuwakot is a central hilly district in the northwestern part of Bagmati province consisting of 2 municipalities and 10 rural municipalities. It covers an area of 1,121 sq. km and has a population of 277,417 in 2011. The population density of the district is 248 people per sq. km with a population growth rate of -0.38% (CBS, 2011). It is situated at 27.9194° N latitude and 85.1661° E longitude covering a total cultivable area of 32,996.5 ha. Out of the total cultivable area, 3,049 ha has been used for vegetable cultivation (Gaire, 2074/75). Under PMAMP- PIU, Nuwakot has two zones – vegetable zone and potato zone. Nuwakot district has been identified as a potential district for vegetable production and the command area of the vegetable zone consists of ward No. 6, 7 & 8 of Shivapuri Rural-Municipality, ward No. 3, 4 & 5 of Panchakanya rural municipality, ward No. 1 to 7 of Kakani rural municipality and ward No. 3 & 4 of Dupcheswor rural municipality of the district as the vegetable zone.



Fig: 3 Map of Nepal depicting Nuwakot district

3.2 Sample and sampling technique

From the inventory of farmers growing tomato under permanent plastic house condition 51 farmers were selected purposively. Five tomato retailers were selected for market price survey

3.3 Research instruments

3.3.1 Household survey

Household surveys were carried out through telephone contact by using semi-structured pre-tested interview schedule. Total of 51 farmers producing tomato under permanent plastic house condition of the study area were interviewed. Respondents were asked to seek information about demographic, educational, socio-cultural, behavioral and economic on offseason tomato cultivation by using permanent plastic house.

3.3.2 Focus group discussions (FGD)

Focus Group Discussion was carried out to collect additional information from household survey. Qualitative data collected were and considered to analyze the SWOT of sub-sector and measures to strengthen the development of sub-sector. Members of zone conduction committee, members of agriculture co-operatives, and farmers groups were involved in FGD.

3.3.3 Key informant interview (KII)

The farmers who have been living in the village since years long were identified and interviewed. They were local resource persons, progressive farmers, social workers, staff of PMAMP-PIU, Rural Municipality, political leaders, and other concerned stakeholders on concerned subject matter. The information collected was reliable and contextual.

3.3 Data type and data collection

Primary data and data collection

Pretested semi-structured questionnaires were used to get information about socio economic status of respondents, cost of construction, production amount, modes of selling, pricing mechanism, and problems in production and marketing. Focus group discussion, key informant survey, and individual farmer interview were used to get additional information.

Secondary data and data collection

The secondary information was obtained through reviewing different publications of Department of Agriculture, Ministry of Agriculture Development (MoAD), Central Bureau of Statistics (CBS Nepal Agriculture Research Council (NARC), Manuals of PIU, Agriculture Knowledge Centre (AKC) Nuwakot.

3.4 Data analysis

Statistical Package for Social Science (SPSS) and Microsoft Excel were used to analyze the data. The ten point indexing technique (1 for minor, 5 for mild, and 10 for major) was used to prioritize production and marketing problems. Most of the farmers in Nuwakot used permanent plastic houses of dimension 6×12 sq. m for tomato production and this was considered as the standard size. Economic analysis was done based on the basis of this size. For economic analysis following parameter were calculated and analyzed.

3.4.1 Problem indexing

Indexing was used in the ranking of tomato production problems, marketing problems and important insect pest and disease decreasing the production. Indexing was computed by using following formula:

$$I_{\text{prob}} = \Sigma (S_i F_i) / N$$

Where,

I_{prob} = Index value for intensity

Σ = Summation

S_i = Scale value of i^{th} intensity(I =0 to 10) where 10 problems were selected.

F_i = Frequency of i^{th} response

N = Total number of respondents

On the basis of ranking of each problem by the individual respondent final index value was obtained which revealed the severity of each of the farmer's problems.

3.4.2 Economic analysis of the enterprise

Benefit cost ratio

It is a discounting measure of economic analysis. The purpose of benefit cost ratio analysis is to find the investment made on the resources will yield a reasonable return to the resources engaged. BCR compares the benefit per unit of cost. Thus, BCR calculated by using the following formula:

$$B/C = \sum B_t [1 / (1+i)^t] / \sum C_t [1 / (1+i)^t]$$

Where,

\sum = summation

B_t = Gross income at single period t^{th} year

C_t = Total cost at single period t^{th} year

I = Discount rate

t = time period in year

Decision criteria

- When, $BCR < 1$. Then, reject the project.
- When, $BCR > 1$. Then, accept the project.
- When, $BCR = 1$. Then, indifference

Net present value (NPV)

NPV is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project.

$$NPV = \sum B_t [1 / (1+i)^t] - \sum C_t [1 / (1+i)^t]$$

Where,

Σ = summation

B_t = Gross income at single period t^{th} year

C_t = Total cost at single period t^{th} year

I = Discount rate

t = time period in year

Internal rate of returns

The internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows from a particular project equal to zero. It refers the earning power of the project i.e. this project can pay interest rate only below the IRR. If IRR is more than discount rate project is acceptable whereas if IRR is less than discount rate project is reject.

$IRR = LDR + DTDR \left[\frac{NPV \text{ at } LDR}{\text{Absolute sum of NPV at UDR and LDR}} \right]$

Where,

IRR = Internal rate of return

LDR = Lower discount rate

UDR = Upper discount rate

DTDR = Difference between two discount rate

Payback period

The payback period refers to the period of time it takes to recover the cost of an investment. It doesn't consider the discounting factor. It is non discounting measure of project appraisal.

3.4 SWOT analysis

SWOT analysis is the powerful tool in economic analysis of agricultural products. The strengths, weaknesses, opportunities and threats related to tomato in the study area were analyzed from the focus group discussion, interview and key informants survey. All the information obtained was thus studied in SWOT analysis.

4. RESULT AND DISCUSSION

The information collected from the study area was analyzed as per objective by use of statistical tool such as MS-Excel and SPSS and the results are presented in this section.

4.1 Socioeconomic and Demographic Information

The socio-economic characteristics of the respondents include population distribution, gender distribution, family size, education, ethnicity, religion, primary occupation and land holding status.

4.1.1 Gender of the respondent

In terms of gender, there were more male respondents (36) than female respondents (15) in the study area. It was found that male and female respondent were 70.6% and 29.4% respectively.

Table: 2 Gender distribution of respondents in Vegetable Zone, PMAMP, Nuwakot district

Gender		Frequency	Percent
	Female	15	29.4
	Male	36	70.6
	Total	51	100.0

Source: Field survey, 2020

4.1.2 Age of the respondent

The age of the respondents was classified into three categories- (i) less than 36 years of age, (ii) 36-59 years of age and iii) more than 59 years using frequency distribution. The study has revealed that majority of the respondents in study area were between the age group 36-59 years (62.7%). These were followed by less than 36 years (29.4%) and more than 59 years (7.8%).

Table: 3 Distribution of respondents based on age

Age group		Frequency	Percent
	<36 years	15	29.4
	36-59 years	32	62.7
	> 59 years	4	7.8
	Total	51	100.0

Source: Field survey, 2020

4.1.3 Ethnic composition of respondents

The respondents were categorized into 4 groups based on their caste namely Brahmin/Chhetri, Janajati, Dalit and Others. It was found that the majority of the respondents in the study area were Janajati (49%) followed by Brahmin/Chhetri (43.1%) and Dalit (7.8%) as shown in Table From this, we can conclude that major portion of the area was covered by the Janajati society.

Table: 4 Distribution of respondents based on ethnic group

Ethnic group		Frequency	Percent
	Brahamin/Chhetri	22	43.2
	Janajati	25	49.0
	Dalit	4	7.8
	Total	51	100.0

Source: Field survey, 2020

4.1.4 Religious composition of respondents

The respondents were categorized into 4 groups based on their religion namely Hindu, Buddhist, Muslim and others. It was found that the majority of the respondents in the study area were Hindu (70.6%) followed by Buddhist (29.4%).

Table: 5 Distribution of respondents based on religion

Religion		Frequency	Percent
	Hindu	36	70.6
	Buddhist	15	29.4
	Total	51	100.0

Source: Field survey, 2020

4.1.5 Education of respondents

The educational status of the respondents was assessed in five categories – illiterate, literate, basic level, secondary level, and university level. The term illiterate referred to those who could not read or write. Literate referred to those who can read and write with understanding but did not have any formal education. Basic means who have

formal education up to 8th grade, Secondary meant those who have passed 12th grade. Similarly correspondent attaining graduate or university were grouped separately.

Table: 6 Education of respondent

Education level		Frequency	Percent
	Illiterate	2	4.0
	Literate	9	17.6
	Primary	13	25.5
	Secondary	16	31.4
	University level	11	21.5
	Total	51	100.0

Source: Field survey, 2020

Table 6 showed that majority of the respondents attended schools up to Secondary level (31.4%) then followed by Primary level (25.5%), literate (21.6%), Secondary (21.6%) and illiterate (4%). This revealed that the literacy rate of the correspondents was high.

4.1.6 Family type

It has been revealed that more respondents were having joint family (70.6%) than nuclear family (29.4%) Table 7.

Table: 7 Family types of respondent

Family type		Frequency	Percent
	Joint	36	70.6
	Nuclear	15	29.4
	Total	51	100.0

Source: Field survey, 2020

4.1.7 Family size of respondent

The family size of the study area determines the availability of labors to the farm operations. The overall average family size of the study area was found to be 6.31, which was higher than that of national average family size (4.6) according to record

of 2015 CBS (CBS, 2016). The overall mean male size was nearly similar to that of average female size in the study. The average economically active members working in tomato cultivation was about 4.62. This shows that tomato farming has provided an opportunity of employment in study area.

Table: 8 Distribution of respondents based on family size

	N	Minimum	Maximum	Mean
Total family members	51	2.00	14.00	6.3137
Male in family	51	1.00	6.00	3.2132
Female in family	51	1.00	8.00	3.1569
Economically inactive members	51	.00	14.00	1.6863
Economically active members	51	.00	9.00	4.6275

Source: Field survey, 2020

4.1.8 Primary occupation of respondents

Occupation of local community people reflect the nature of micro-economy of any locality and various commercial, business as well as employment opportunity in the area and also determines the well -being of living standard .The table below reveals that the primary occupation of majority of the farmers in the study area was agriculture. Respondents in the study area were mainly involved in agriculture (88.2 %) followed by Business (11.8%).

Table: 9 Distribution of respondents based on primary source of occupation

Primary occupation	Frequency	Percent
Agriculture	45	88.2
Business	6	11.8
Total	51	100.0

Source: Field survey, 2020

4.1.9 Migration status of respondents household

Majority of the respondent's family members didn't have migration to other places (76.5%) and few respondents have migrated family members (23.5%).

Table: 10 Distribution of respondents based on migration status

Migration status	Frequency	Percent
No	39	76.5
Yes	12	23.5
Total	51	100.0

Source: Field survey, 2020

4.1.10 Land holding of respondents

The average landholding of the respondents was 21.86 Ropani in the study area Table 11 with minimum of 4 Ropani and maximum of 105 Ropani in total. In an average, 19 Ropani of land was used by the respondents for cultivation with average *khet land* and *bari land* 14 Ropani and 6 Ropani respectively. Average rental price of land was 8, 656 Rs/Ropani in the study area.

Table:11 Land holding of respondents

Area(Ropani)					
	N	Mini - mum	Maxi - mum	Sum	Mean
Total owned land	51	4.0000	105.0000	1115.0000	21.862745
Cultivated land	51	3.00	105.00	969.00	19.0000
Khet land	51	.00	90.00	760.00	14.9020
Bari land	51	.00	35.00	350.00	6.8627
Leased out	2	50.00	50.00	100.00	50.0000
leased in	10	2.00	60.00	222.00	22.2000
Rental price in Rs/ Ropani	16	3000.00	20000.00	138500.00	8656.2500

Source: Field survey, 2020

4.1.11 Status of wages rate

In an average wages rate was 900 Rs/day, 507.84 Rs/day, 1945.65 Rs/day and 675 Rs/hr for Mans, Women's, one pair of bullock and tractor respectively, which is shown in Table 12.

Table:12 Status of wages rate

	N	Minimum	Maximum	Mean
Wages rate for man/day(Rs)	51	600.000	1200.000	900.00000
Wages rate for female/day(Rs)	51	300.000	1000.000	507.84314
Wages rate for one pair of bullock/day(Rs)	46	1200.000	3000.000	1945.65217
Wages rate for tractor/hr(Rs)	46	400.000	900.000	675.00000

Source: Field survey, 2020

4.2 Scenario of tomato production using permanent plastic house and marketing

4.2.1 Years of commercial tomato cultivation under permanent plastic house

Although tomato cultivation in the study area was done since many years, history of commercial tomato cultivation under permanent plastic house was not longer. Years of tomato cultivation was categorized into 4 categories which are presented onto below figure 4. Majority of the respondents has done commercial tomato cultivation since 2-5 years (68.63%), followed by 5-10 years (13.73%), 10 years or more (9.80%) and less than 1 year (7.84%). It revealed that commercial tomato growers are rapidly increasing on recent years in the study area.

Period of involving in commercial tomato cultivation under Permanent plastic house

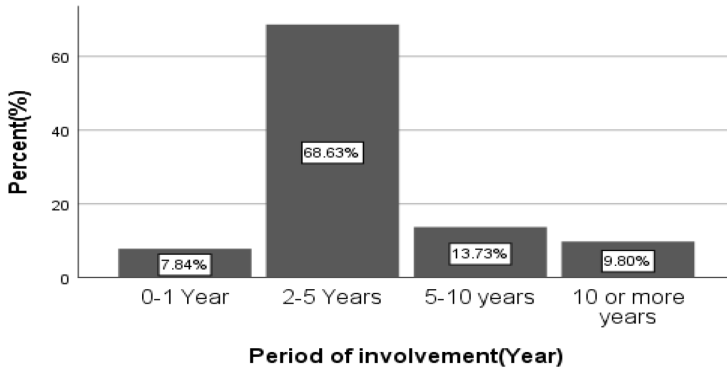


Fig: 4 Years of commercial tomato cultivation under permanent plastic house (Source: Field survey, 2020)

4.2.2 Factors influencing for commercial tomato cultivation

Factors influencing for commercial tomato cultivation were categorized into 5 groups as shown in fig (2). Majority of the respondents were influenced due to good market demand of tomato (27.45%), followed by neighbors influence (25.49%), good returns (19.61%), Government subsidies and extension services and land suitability and favorable climate respectively.

Influencing factors for tomato cultivation

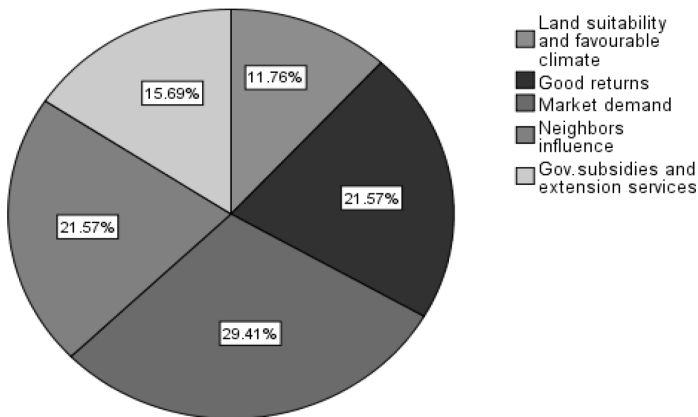


Fig: 5 factors influencing for commercial tomato cultivation (Source: Field survey, 2020)

4.2.3 Training on commercial tomato cultivation and visit of extension workers

Majority of respondents had taken training on commercial tomato cultivation (58.82%). Similarly most of the respondent's farms were visited by extension workers (62.75%), as shown in Figure 6.

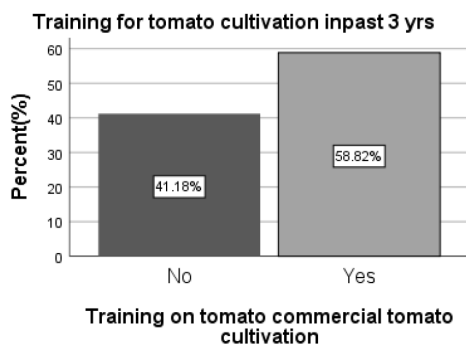


Fig: 6 (i)

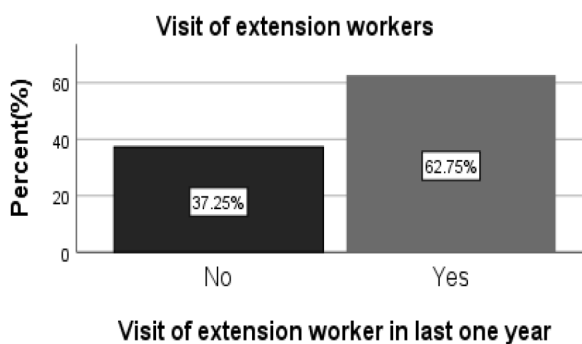


Fig: 6 (ii)

Fig: 6 Training on commercial tomato cultivation on past 3 years and visit of extension workers in last one year

4.2.4 Access to credit

Respondent access to credits was categorized into 4 categories as shown in Table 12. Majority of respondents reported that access to agriculture credit is hard (51%). 25.5% reported as easy, 13.7% reported as no problem, and 9.8% were satisfied with access to agriculture credit.

Table: 12 Access to credit for tomato cultivation

Access to credit	Frequency	Percent
No problem	7	13.7
Easy	13	25.5
Satisfactory	5	9.8
Hard	26	51.0
Total	51	100.0

Source: Field survey, 2020

4.2.5 Source of credit for commercial tomato cultivation

Respondents were categorized into five groups based on their sources of credit as shown in Table (12). Majority of respondents didn't received credit from any type of sources(41.2%). Among credit taking respondents majority of them taken from bank (25.5%) followed by co-operatives (21.6%), people (7.8%) and women's group (3.9%).

Table: 13 Different sources of credit for tomato cultivation

Source of credit		Frequency	Percent
	People	4	7.8
	Women's group	2	3.9
	Co-operatives	11	21.6
	Bank	13	25.5
	Total	30	58.8
	None	21	41.2
Total		51	100.0

Source: Field survey, 2020

4.2.6 Satisfaction status and willing to tomato farming in future

Majority of respondents were satisfied with commercial tomato farming under permanent plastic house as shown in figure 7. Whereas hundred percent of respondents were willing to continue tomato farming in coming years.

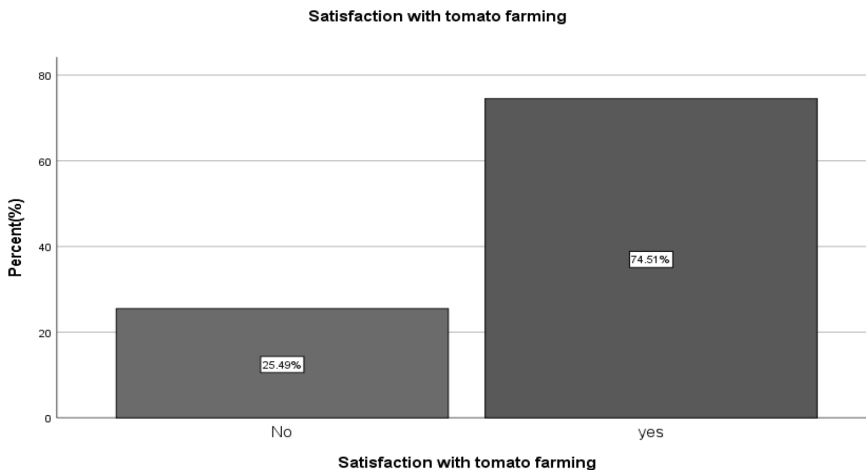


Fig: 7 Satisfaction status of respondents with commercial tomato cultivation (Source: Field survey, 2020)

4.2.7 Method of irrigation followed under permanent plastic house

More than half of the respondents were following flooding method of irrigation (50.98%). Although large numbers of farmers were following less costly, less laborious, natural resources conserving drip irrigation method (49.02%).

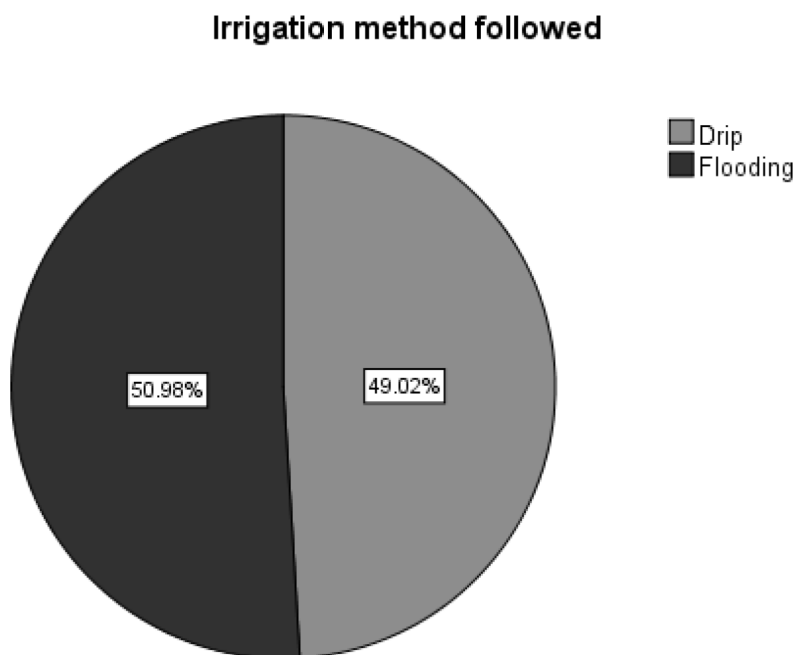


Fig: 8 Irrigation methods followed by respondents for commercial tomato cultivation under permanent plastic house (Source: Field survey,2020)

4.2.8 Source of labor

Majority of labors for tomato cultivation were managed by household labor (78.25%) while small proportion was managed by hired labor (21.75%), as represented in Table 15.

Table: 15 Source of labor

Source	Percent %			
	N	Minimum	Maximum	Mean
Hired labor	51	.000	100.000	21.75
Household labor	51	.00	100.00	78.25

Source: Field survey, 2020

4.2.9 Status of record keeping

Majority of respondents weren't keeping record of their farm expenditure and income (84.31%) where as only few proportion of respondents were keeping record (15.69%).

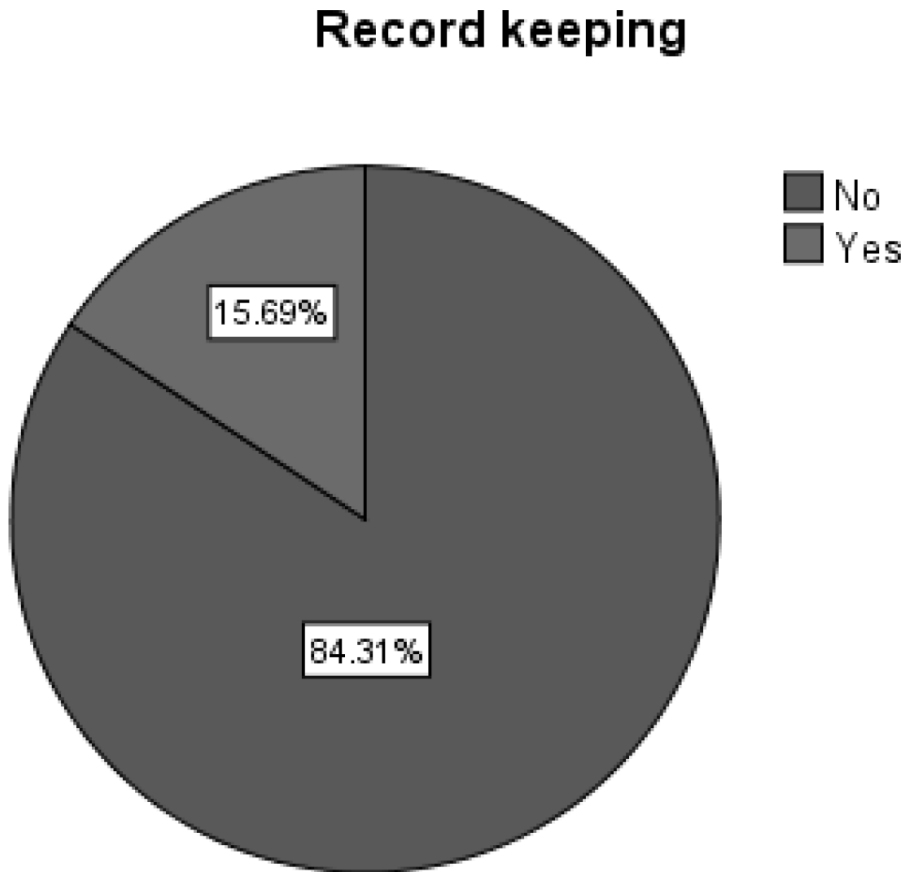


Fig: 9 Status of record keeping by respondents (Source: Field survey, 2020)

4.2.10 Packing and transportation materials

Among different types of packing and transportation materials as shown in figure 7, majority of respondents were using plastic crates as packing and transportation materials(84.31%) followed by doko (9.8%) and sacks(5.88%)

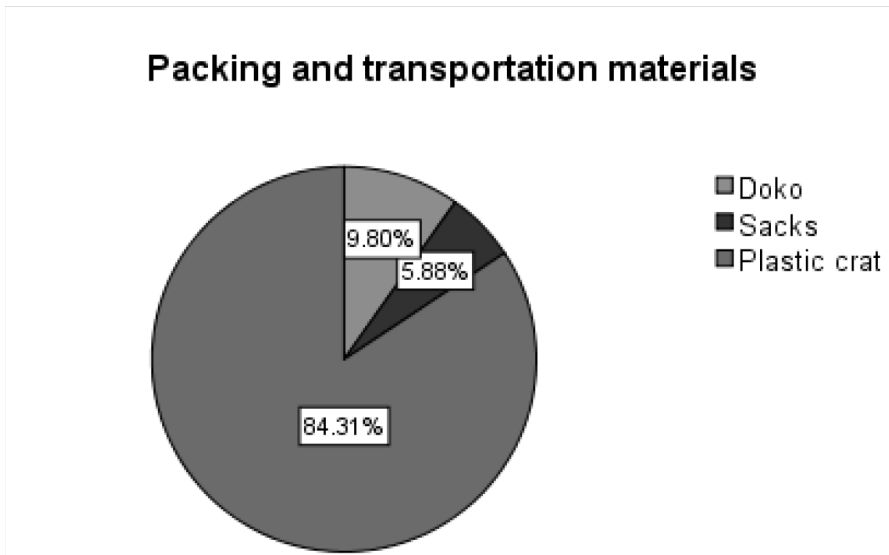


Fig: 10 Packing and transportation materials for marketing tomato(Source: Field survey, 2020)

4.2.11 Respondents having their own tractor and sprayer

Majority of respondents have their own sprayer (98.2%) and more than half of them have their own tractor (58.8%), as represented in Table 16.

Table: 16 Status of respondents based on farm machinery

		Percentage (%)		
Machine type		Yes	No	Total
	Tractor	58.8	41.2	100
	Sprayer	98.2	7.8	100

Source: Field survey, 2020

Table: 17 Physical assets

Physical assets	N	Minimum	Maximum	Mean
spade number	51	3.00	20.00	6.3137
sickle number	51	3.00	18.00	7.9216
shovel number	51	1.00	30.00	4.6667
Irrigation pipe in (m)	51	0	5000	272.35

Source: Field survey, 2020

In an average respondent have 6.31 spades, 7.92 sickles, 4.66 shovels and irrigation pipe of 272.35 m as shown in Table (17).

4.2.12 Sources of price information

Market information includes information on price, product demand and supply, buyers and sellers. It is very important to have up to date knowledge and access to timely market information in order to reduce the risk of losing money on a product transaction. It plays an important role in price among traders and producers. If the producers have prior information on market price, they can bargain with the traders for a higher price .Traders were most common source of information (64.71%), followed by F.M., Radio and magazines (29.41%) and friends (5.85%) as shown in Fig (8). Since they are more depending on traders so have less bargaining power.

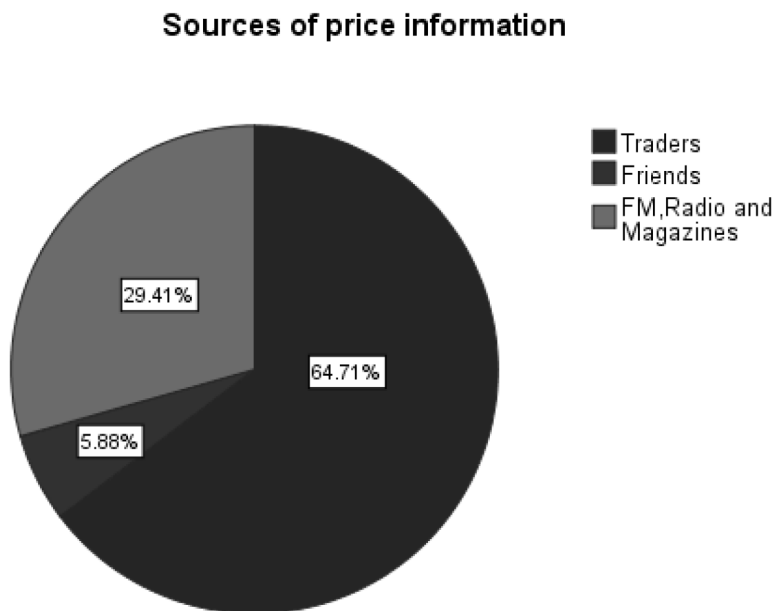


Fig: 11 Sources of price information (Source: Field survey,2020)

4.2.13 Marketing system followed

Marketing system is a crucial factor in determining the price of a commodity. The actors involved in the marketing system influence the price of commodities. Five types

of marketing practices were prevalent in the study area figure 12. According to respondents about 41.47% of tomato produce was marketed through local market, followed by local collector(32.45%), Neighborhood(20.29%), middleman (4.51%), wholesaler (1.27%).

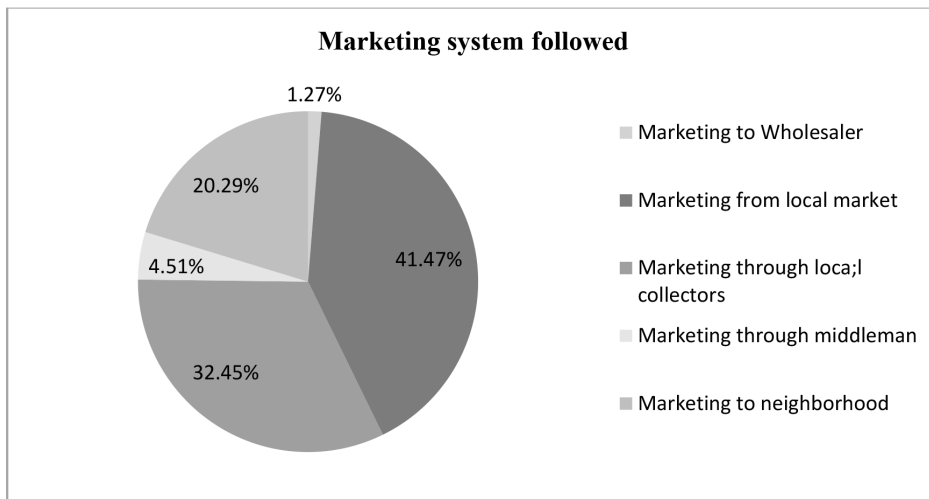


Fig: 12 Marketing system followed by farmers of Nuwakot to sell tomato

4.3.1 Major Disease and insect/pest

Disease and insects/pests are the major factors which limits the production of plastic house tomato. Tuta was the major pest problem (73.33%), followed by white fly (22.22%), Nematode (2.22%) and tomato fruit borer(2.22%). Whereas late blight (90%) and viral complexes (10%) were the major diseases in Vegetable Zone Nuwakot.

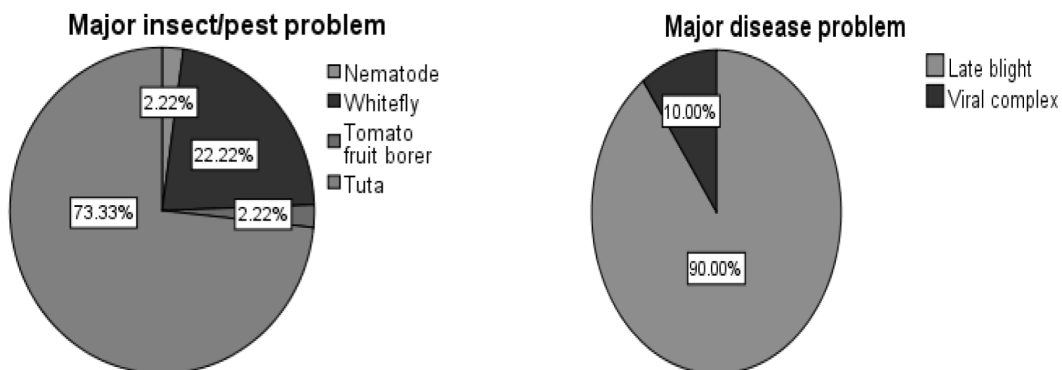


Fig:13 Major insect /pest and disease problem of tomato under plastic house (Source: Field survey, 2020)

4.3.2 Average production and selling price for various years

The commercial production of tomato under permanent plastic house was excessively increased since last four years. Hence the average production and selling price from 2073 was used for analysis. Average tomato production per ropani was 1.89 MT with an average gross income of Rs 1, 07,257 (Table18). Productivity was found decreasing year after year due to several problems.

Table: 18 Quantity of tomato produced and selling price

S.N.	Year	Production (MT/Ropani)	Selling price (Rs/MT)	Gross income (Rs/Ropani)
1	2073	1.2437	42,250	96,640
2	2074	2.20	50,470	1,11,064
3	2075	1.846	56,435	1,02,333
4	2076	1.985	59,920	1,18,992
	Average	1.89	52,269	107,257

Source: Field survey, 2020

4.3.3 Price of tomato

Tomato is perishable commodity, due to fluctuation in demand and supply pattern daily price of tomato is volatile in market. During rainy season it's very hard to produce tomato in Terai region due to heavy rainfall which is detrimental for tomato production and protected cultivation is also not possible due to high temperature. So, during this period of June to December, market is mostly dependent on tomato produced in plastic house from mid to high hills and market price is also high. So price of tomato was high from August to October. When tomato from open field starts to be supplied at cheaper rate from several parts of country market price was low from November to July.

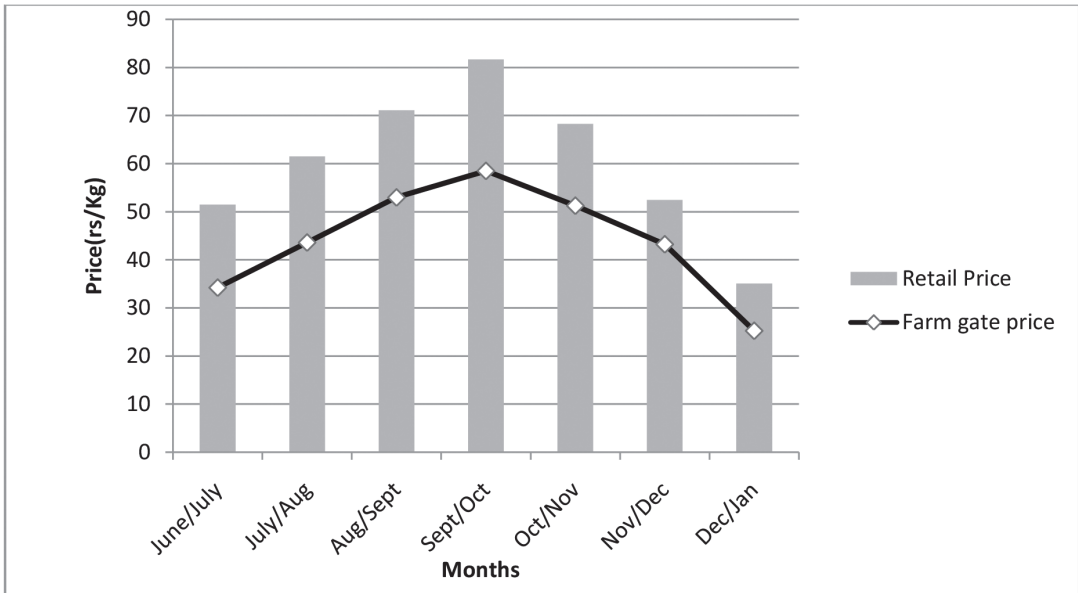


Fig: 14 Price of tomato in 2019 (Source: Field survey2020)

4.4 Production and marketing problem

4.4.1 Production problems

A simple indexing technique was used to analyze the major production problem which is presented in Table (19). Disease was the major problem in production. Most of the farmers are growing tomato in a same plastic house year after year. Due to improper crop rotation practice and lack of integrated pest management practice farmers are facing huge problems of disease and insects. Insects/pests and lack of technical knowledge were the next most important problems respectively.

Table: 19 Major production problems of tomato cultivation under plastic house

S.N.	Major Problems	Score										Total Score	Index Value ($\sum F_{isi}/N$)	Priority ranking	
		0	1	2	3	4	5	6	7	8	9				10
1	Disease	0	1	1	0	1	4	3	5	17	14	5	392	7.69	I
2	Insect	2	2	2	5	2	0	4	6	11	11	6	342	6.71	II
3	Lack of technical knowledge	2	5	11	2	1	0	3	8	13	4	2	271	5.31	III
4	Lack of loan facilities	2	7	3	0	6	2	13	6	9	3	0	266	5.25	IV
5	Lack of market	2	11	4	1	2	4	6	9	8	4	0	249	4.88	V
6	Lack of quality seed	10	5	4	3	2	3	5	6	8	5	0	226	4.43	VI
7	Timely un-availability of construction materials	4	9	9	7	1	3	6	5	4	3	0	197	3.86	VII
8	Lack of irrigation facilities	7	15	5	2	5	5	5	2	3	1	1	163	3.20	VIII
9	Lack of fertilizer	8	21	9	4	3	1	3	1	1	0	0	101	1.98	IX

Source: Field survey, 2020

4.4.2 Marketing problems

Production is considered as only half task of any enterprise half is marketing part. If marketing is worst even an excellent production may returns into zero revenue. Therefore farmers must be aware and well tackle with problems regarding marketing

of tomato. Price variation is major marketing problem in the study area. During same period of time price of tomato was vary, which depends upon type of marketing agents. When farmers sales their farm produce to middleman they take more margin as compare to local collector due to he is also a farmer among the producer. Local collectors take fewer margins from their neighbors. The next severe problem was monopoly of traders on price fixation which is due to farmers more dependence on traders for marketing and price information of their produce.

Table: 20 Major marketing problems of tomato

S.N.	Major problems	Score										Total score	Index Value ($\sum f_{isi}/N$)	Priority ranking	
		0	1	2	3	4	5	6	7	8	9				10
1	Price variation Traders	1	1	4	0	0	0	4	10	19	8	4	367	7.19	I
2	monopoly in price fixation Lack of	1	5	1	4	1	1	7	4	10	13	4	335	6.57	II
3	organized market Lack of	0	4	5	2	4	5	6	9	13	3	0	291	5.71	III
4	market price information Lack of	20	11	6	2	2	0	5	2	1	2	0	107	2.10	IV
5	quality packaging materials	10	15	20	5	1	0	0	0	0	0	0	74	1.45	V

Source: Field survey, 2020

4.3 Respondent's awareness towards climate change

Majority of respondents have heard about climate change (66.67%). Similarly majority of them have felt impact of climate change in their daily life (64.71%). Which is as shown in Figure 15.

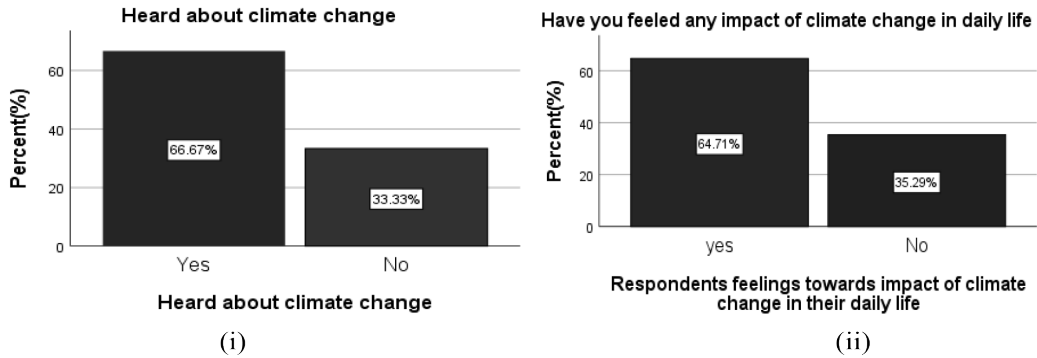


Fig: 15 Respondents awareness level and their attitude towards climate change

4.3.1 Experience of respondents about new insect/disease which were not economically important 10 years ago

Majority of respondents have experienced new insect or disease which were not economically important in past (81.25%). According to respondents insects/pest like Tuta, Whitefly, Nematode and disease like late blight was not economically important in past but at present are major insect and disease of tomato in the study area.

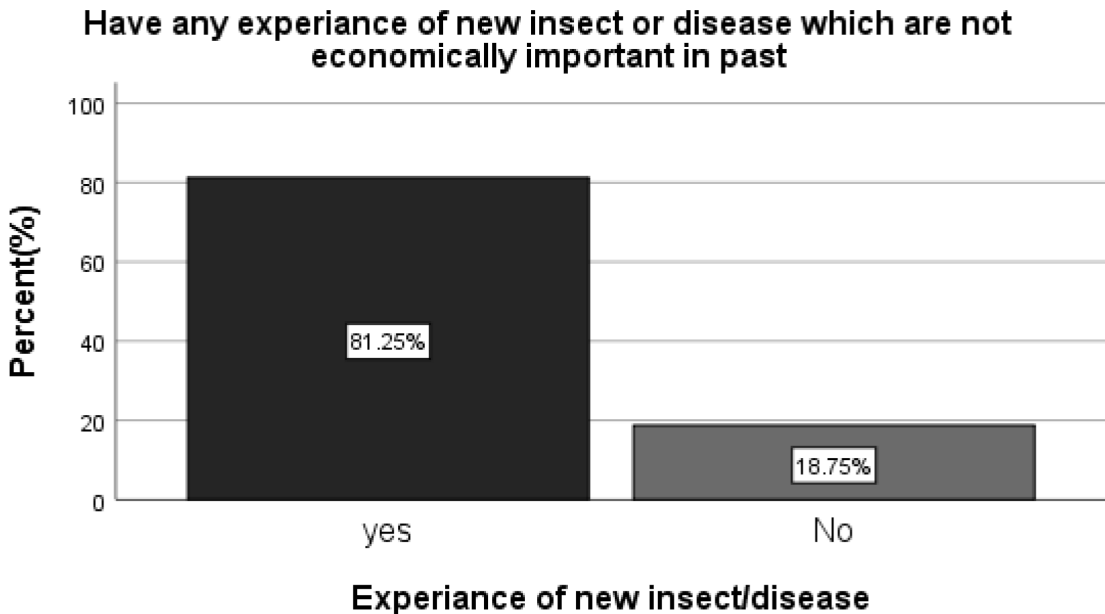
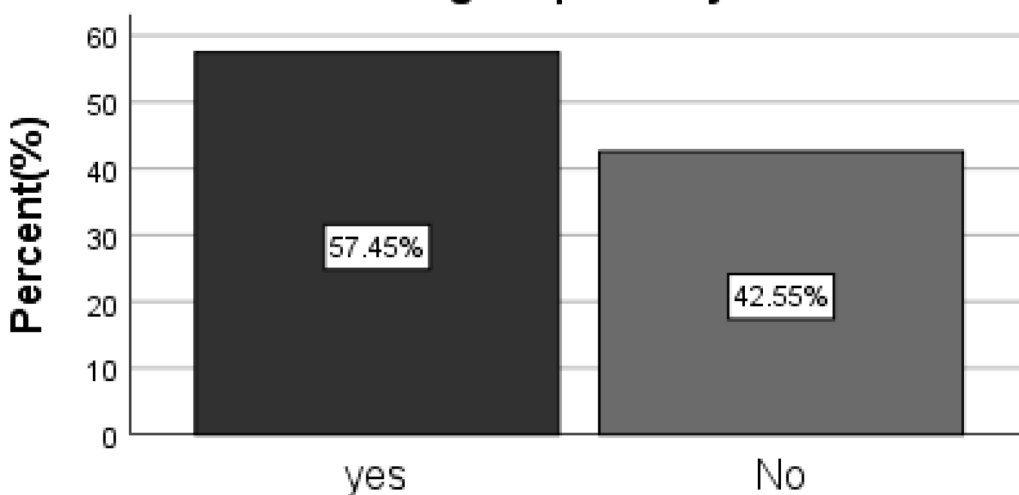


Fig: 16 Experience of respondents of new insect/disease which were not economically important in past 10 year

4.3.2 Distribution of respondents based on their response towards climate change and tomato production

Majority of respondents were feeling decrease of tomato production due to climate change (57.45%) in past 10 years. As represented in following figure.

Do you feel in decrease of tomato production due to climate change in past 10 years



Decrease in tomato production

Fig:17 Distribution of respondents based on their response towards climate change and tomato production

4.4 Economics of tomato production under permanent plastic house

Economic life of permanent plastic house was considered as 11 years where change of silpaulin plastic and painting of metal frame need to be done in every five years. For a permanent plastic house of size 12*6 sq. m cost of construction was Rs.64, 870. Cost of cultivation was Rs.25, 000 with considering bank interest of loan taken for construction. Cost of cultivation from the second year onwards was Rs 25, 000. The gross average income was Rs 67, 500 every year from single tunnel of size 12*6 sq.m. For its economic life benefit cost ratio, NPV and IRR were 1.841, Rs 1, 84, 412 and 47.06% respectively with payback period of one year and seven months (Annexes). Therefore the enterprise was highly acceptable.

4.5 Pandemic disease Covid-19 and its impact in tomato production

4.5.1 Distribution of respondents based on situation of farm labor availability and their wages rate

Majority of respondents were getting farm labor more easily during lockdown period than previous situation (80.39%). 13.33% respondent reported that availability of labor was as usual and only 5.88% reported shortage of labor. It is shown in figure 18. Whereas hundred percent of respondents were getting their labor at same wages rate of previous condition before lockdown.

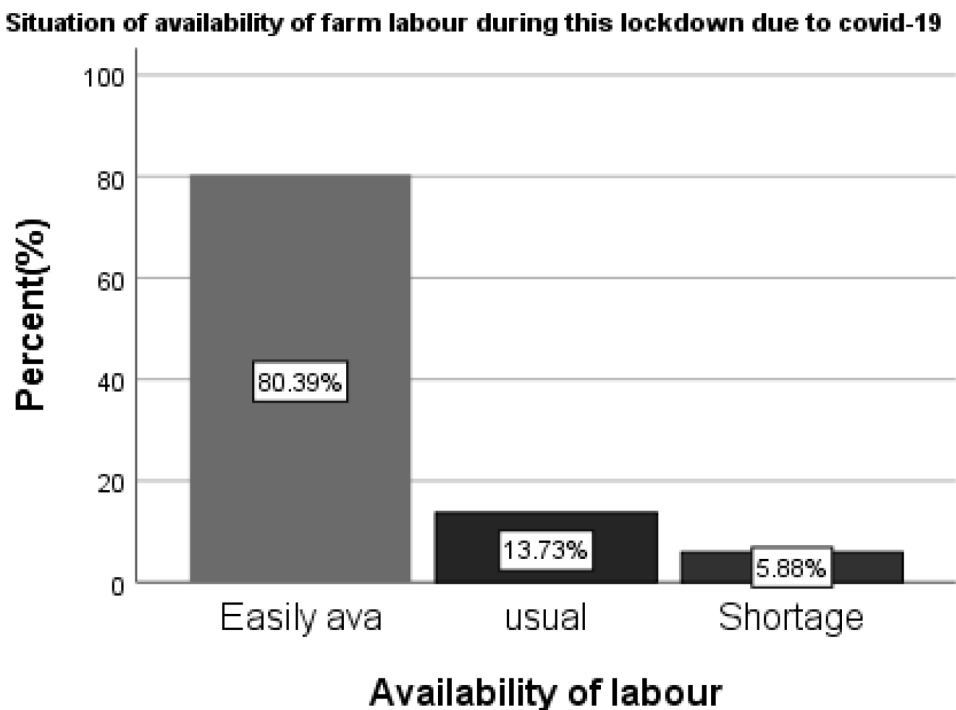


Fig:18 Distribution of respondents based on situation of farm labor availability and their wages rate

4.5.2 Distribution of respondents based on situation of availability of farm inputs during lockdown

Majority of respondents were getting their farm inputs with more difficulties than previous situation (43.1%), followed by usual (37.3%), and very difficult (19.6%) respectively. This is shown in Table 21.

Table:21 Distribution of respondents based on situation of availability of farm inputs during lockdown

Labor availability	Frequency	Percent
Usual	19	37.3
More difficult than previous situation	22	43.1
Very difficult	10	19.6
Total	51	100.0

Source: Field Survey, 2020

4.5.3 Effect of lockdown on sales of farm produce and its reasons

Majority of respondents sales of farm produce was decreased (54.9%) followed by increased (19.61%) and not much difference (19.61%) and few of their sales of farm produce was totally stagnant (5.88%). Those farmers whose farm were at rural area and having less commercial farmers in this area and their sales has increased due to buyers were migrated to rural area from city area due to fear created by pandemic disease Covid-19. This is shown in Fig 19(i). Among various reasons behind decrease in sale was due to unavailability of transportation (41.03%), followed by shops closed(33.33%) and Buyers migrated(25.64%).

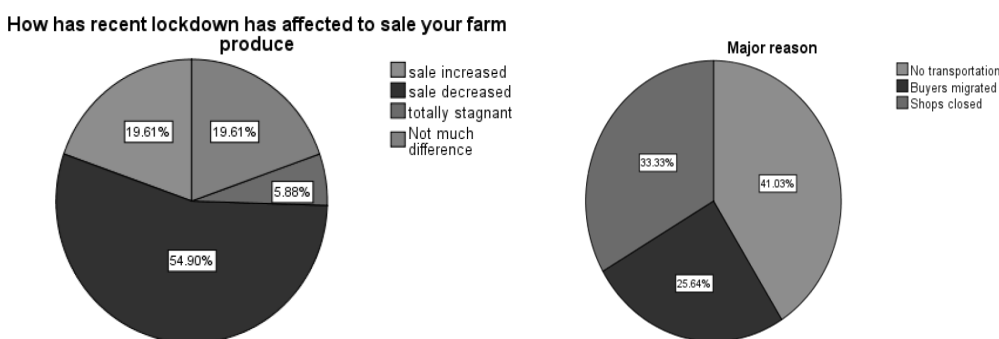


Fig: 19 (i) Affect of lockdown on sales of farm produce (ii) Major reasons behind decreased or totally stagnant sales of farm produce (Source:Field survey, 2020)

4.6 SWOT analysis

SWOT analysis is the powerful tool in economic analysis of agricultural products. The strengths, weaknesses, opportunities and threats related to tomato production under

permanent plastic house in the study area were analyzed from the focus group discussion, interview and key informants survey. All the information obtained was thus studied in SWOT analysis.

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Nearby market • Land availability and climatic suitability for offseason production • Labor availability • Timely availability of construction materials • Low transportation and handling loss 	<ul style="list-style-type: none"> • Lack of technical knowledge • High wages rate • No idea of value addition and grading • No record keeping, which limits them to evaluate cost of production per kg of tomato
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • Increasing demand of tomato all round the year • Establishment of vegetable Zone under PMAMP,PIU Nuwakot • Government subsidies to construct permanent plastic house and plastic pond • Availability of new technologies and farm machinery to make tomato production more profitable <p>transition towards commercial farming</p> <ul style="list-style-type: none"> • Establishment of farmer's groups and co-operatives • Product diversification and value addition like ketchup, juice, pickles sausage etc. • Change in consumer preference. • Provision of rewards to the farmers who produce higher quantity of produce 	<ul style="list-style-type: none"> • Outbreak of new disease and insect/pest • Climatic hazards • Increasing transportation cost • Fluctuation on price • Traders monopoly in price fixation

5. SUMMARY AND CONCLUSION

5.1 Summary

This study of socio-economic analysis of tomato production under plastic house was accomplished in Vegetable Zone of PMAMP, Nuwakot district. Pre tested semi structured questionnaire was administered to the off season tomato growers to obtain primary data. In addition, Focus Group Discussions, Key informants Interview were carried out to get qualitative data. Analysis was done by using SPSS and MS EXCEL.

There were more male respondents (70.6 %) than females (29.4 %) in the study area, for this research. Interviewed respondents were from age of 19 to 72 with majority of them belongs to age group 36-59 years (62.5%). Most of the respondents (31.4%) in the study area were found well educated up to secondary level and only 4 % of them were illiterate. Family size of the respondents was 6.3 which were more than national average size. Active population (16-59) revealed as 4.62 in study area from this research. Most of their family was joint type (70.6%). Janajati community was dominant population in the study area with 49.0% followed by Brahmin/Chettri (43.3%) and Dalit (7.8%) ethnic groups. Majority of them were following Hindu religion (70.6%) followed by Buddhist (29.4%). Main occupation of the respondents or major source of family income was found agriculture (88.2%) followed by business (18.8%) in study area. Majority of their family members were not migrated (76.5%). Average land holding of respondents was 21.8 ropani with average rental price of land was Rs.8656. Average annual family income was Rs.5,40,000 with income from the vegetable was Rs. 1,62,666 and average income from tomato production was Rs.95, 784. Average wages rate for man, women, and one pair bullock was Rs. 900, Rs. 507 and Rs. 1945 per day respectively. Whereas average wages rate for tractor was Rs 675 per hour.

Majority of respondents were involving in commercial offseason tomato production by using permanent plastic house since last 2-5 years (68.63%) followed by 5-10 years (13.73%). Most of them were influenced for commercial offseason production due to good market demand of tomato (29.41%) followed by neighbors influence (21.57%) and good returns (21.57%). Most of the respondents were trained on tomato farming (58.82%) and most of their farm was visited by extension workers in last one year (62.75%). It was hard to get credit for agriculture purpose for most of the respondents (51%). About half of the respondents were taking loan for agriculture purpose and majority of them were taking loan from bank (25.5%) followed by cooperative(21.6%). Majority of respondents were satisfied with tomato farming by using permanent plastic tunnel(74.51%). Almost half of them were adopting drip irrigation method (49.02%) whereas still more than half of the respondents were remains to adopt drip irrigation (50.98%). Most of the farm labours for tomato production were managed by their family members (78.25%). Only 15.69% of respondents were keeping record of their

daily income and expenditure for tomato farming in record book. Most of the farmers were used plastic crates as packing and transportation material (84.31%) followed by *doko* (9.80%). Majority of respondents (58.8%) had their own tractor and most of them (98.2%) had their own sprayer. Respondents were using an average of 272m irrigation pipe for tomato production. Most of them were getting price information from traders (64.71%) followed by FM, radio and magazine (29.41%) and friends (5.88%). Majority of farmers had sold their tomato through local market (41.47%) followed by local collectors (32.45%), neighbors (20.29%). Price of tomato was highly fluctuating with highest market price during Sept to Nov i.e. farm gate price (Rs50-60) and retail price (Rs.70-80) whereas lowest price for offseason tomato was during June/July and Dec/Jan and farm gate price (Rs.25-35) and retail price (Rs.40-55).

From index ranking major production problems with index value were disease infection(7.69) followed by insect infestation(6.71), lack of technical knowledge(5.31), lack of loan facilities(5.25), lack of market(4.88), lack of quality seed(4.43), timely unavailability of construction materials(3.86), poor irrigation facility(3.20) and unavailability of fertilizer respectively(1.98). Among disease, most of respondents (90%) have problems of late blight. Similarly, among insect; majority of them were suffering from problem of Tuta (73.33%) followed by whitefly (22.22%) and Nematode (2.22%). Similarly among several marketing problems, price variation was principal (7.19) followed by traders monopoly in price fixation(6.57), lack of organized market(5.71), lack of price information (2.10)and lack of quality packing and transportation materials(1.45).

Economic life of permanent plastic house was eleven years where silpaulin plastic covered need to be change in every five years. For a permanent plastic house of size 12*6 sq. m, cost of construction was Rs.64, 870. Cost of cultivation was Rs.25, 000 with considering bank interest of loan taken for construction. Cost of cultivation from second year was Rs 25, 000. The gross average income was Rs 67, 500 every year form single tunnel of size 12*6 sq.m. For its economic life benefit cost ratio, NPV and IRR were 1.841, Rs 1, 84, 412 and 47.06% respectively with payback period of one year and seven months. Average tomato produced was 1.89 MT/Ropani with selling price of 52, 269 Rs/Mt and gross income 1, 07, 257 Rs/Ropani

Majority of respondents were heard about climate change (66.67%) and most of them were feel about impact of climate change in their daily life (64.71%). Most of the respondents had experience of incidence of new insects and disease which were not economically important pest of tomato before 10 years (81.25%). Similarly, majority of respondents (57.45%) had experience of decreased in productivity of tomato in present years as compare to productivity of tomato before 10 years.

It was more difficulties in availability of farm inputs for majority of respondents (43.1%) during lockdown due to pandemic disease Covid-19. Most of the respondents were getting farm labors more easily as compare to previous condition (80.39%) with usual wages rate. Majority of respondents sales had been decreased (54.90%) followed by not much difference (19.6%), increased (19.6%) and totally stagnant (5.88%) during lockdown which was mostly due to no transportation (41.03%), followed by shops closed (33.33%) and buyers migrated (25.64%)

5.2 Conclusion

Tomato cultivation under permanent plastic house in Vegetable Zone, Nuwakot was excessively increasing in recent years. Majority of them still remains to adopt new technology for commercialization like drip irrigation and tractorization. Mostly plastic crate was used for packing and transportation of tomato so loss during transportation was very few. Most of them were satisfied with tomato farming and getting price information from traders. Most of the respondents were selling their tomato in local market. Majority of respondents were facing problems of new pests like Tuta and whitefly which were not economically important in past and facing problem of decreasing productivity in later years. Disease management followed by insect management were major production constrains. Major marketing problem was price variation followed by traders' monopoly in price fixation. During lockdown, farmers were facing problem in procurement of farm inputs, and selling of farm produce due to no transportation. Whereas during lockdown, they were getting farm labor more easily than previous condition at usual wages rate but price of tomato was drastically decreased. The enterprise has its economic life of eleven years. For a permanent plastic house of size 12*6 Sq. m, initial cost of construction was Rs. 64,870 and average cost of cultivation was Rs.25,000 and have gross revenue of Rs. 67, 500 per year. Enterprise has B/C ratio, NPV, IRR, and payback period 1.841, Rs. 1, 84, 412, 47.06% and one year and seven months respectively.

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7. LIST OF ANNEXES

Annex1. Average cost of construction of permanent plastic house of size 12*6 m2 in 2020

S.N.	Particulars of construction materials	Unit	Quantity	Per unit cost(Rs.)	Total cost(Rs.)
1	Materials				
1.1	Iron pipe (2*2 inch)	Piece (6m)	4	1250	5000
1.2	Iron pipe (1.5*1.5 inch)	Piece (6m)	22	1000	22000
1.3	Silpaulin plastic (120 GSM)	Sq. meter	90	80	7200
1.4	Net	Sq. meter	108	65	7020
1.5	Cement	Bag	2	800	1600
1.6	Sand	Bag	8	100	800
1.7	Gravel	Bag	4	120	2400
1.8	Rope	Meter	20	10	200
1.9	Nails	Piece	350	2	700
1.10	Paint	Liter	3	350	1050
1.11	Irrigation pipe	Meter	80	40	3200
1.12	Profile	Meter	40	125	5000
2	labor cost				
2.1	Skilled	Man days	5	900	4500
2.2	Unskilled	Man days	6	800	4800
3	Transportation cost				4400
	Total cost				64870
	Bank interest				5189.6
	Total cost of construction				70059.6

Annex 2. Average cost of cultivation of tomato inside plastic house of size 12*6 m2 in 2020

S.N.	Variable cost items	Unit	Quantity	Per unit cost (Rs.)	Total cost (Rs.)
1	Materials				
1.1	Seed	Packet (2gm)	2	250	500
1.2	Fertilizer				
1.2.1	Compost	Doko	10	50	500
1.2.2	Poultry manure	Bag (50 kg)	1	300	300
1.2.3	Urea	Kg.	2	20	40

1.2.4	DAP	Kg.	3	60	180
1.2.5	Mop	Kg.	2	50	100
1.3	Micronutrients (soil)	Kg.	0.5	120	60
1.4	Pesticides				
1.4.1	Diathene	Gm	250	2	500
1.4.2	Krilaxyl	Gm	100	1.5	150
1.4.3	Rogor	ml	100	2	200
1.4.4	Multiplex	ml	400	1.5	600
1.6	Training rope	Kg.	3	250	750
1.5	Plastic crates	Piece	2	300	600
2	Manpower				
2.1	Land preparation	Man days	2	600	1200
2.2	Seed sowing/Trans-planting	Man days	2	900	1800
2.3	Manure application	Man days	1	600	600
2.4	Intercultural operation	Man days	2	600	1200
2.5	Irrigation	Man days	2	600	1200
2.5	Spraying	Man days	1	900	900
2.6	Plucking	Man days	3	600	1800
2.7	Packing	Man days	2	600	1200
3	Transportation (fruits, fertilizer and pesticides)	Rs./Kg	1000	1.5	1500
4	Equipment Maintenance				3000
	Total variable cost				18880
	Fixed cost				
	Land tax				20
	Land rent				865
	Total cost				885
	Total cost of production				19, 765

Annex 3. Gross returns from tomato cultivation under permanent plastic house condition

Year	Quantity (kg)	Rate (Rs./kg)	Total amount (Rs.)
First	1500	45	67500

Annex 4. Investment appraisal

Year	Total cost	Total returns	Df (at i=12%)=1/ (1+i)^t	PV of cost	PV of gross returns	Incremental Net benefit	Df (at i=20)
0	64870	0	1	64870	0	-64870	1
1	25000	67500	0.892857143	22321.43	60267.86	37946.429	0.833333
2	25000	67500	0.797193878	19929.85	53810.59	33880.74	0.694444
3	25000	67500	0.711780248	17794.51	48045.17	30250.661	0.578704
4	25000	67500	0.635518078	15887.95	42897.47	27009.518	0.482253
5	25000	67500	0.567426856	14185.67	38301.31	24115.641	0.401878
6	36450	67500	0.506631121	18466.7	34197.6	15730.896	0.334898
7	25000	67500	0.452349215	11308.73	30533.57	19224.842	0.279082
8	25000	67500	0.403883228	10097.08	27262.12	17165.037	0.232568
9	25000	67500	0.360610025	9015.251	24341.18	15325.926	0.193807
10	25000	67500	0.321973237	8049.331	21733.19	13683.863	0.161506
11	25000	77000	0.287476104	7186.903	22135.66	14948.757	0.134588
Sum				219113.4	403525.7	184412.31	

Year	INB at i=20%	Df at i= 47 %	INB at I= 47 %	Df at i= 48%	INB at i=48%
0	-64870	1	-64870	1	-64870
1	31622.02381	0.680272	25813.9	0.67567568	25639.4788
2	23528.29152	0.46277	15678.99	0.45653762	15467.8323
3	17506.16929	0.31481	9523.199	0.30847136	9331.46252
4	13025.42358	0.214156	5784.256	0.2084266	5629.502
5	9691.535401	0.145684	3513.275	0.14082878	3396.1764
6	5268.245346	0.099105	1559.012	0.09515458	1496.86687
7	5365.300476	0.067418	1296.109	0.06429364	1236.03499
8	3992.039045	0.045863	787.238	0.04344165	745.677477
9	2970.267146	0.031199	478.1572	0.02935246	449.85369
10	2210.020198	0.021224	290.4259	0.01983275	271.388568
11	2011.92315	0.014438	215.8313	0.0134005	200.320883
			70.39479		-1005.40558

A. Benefit cost ratio calculation

$$B/C = \frac{\sum B_t [1 / (1+i)^t]}{\sum C_t [1 / (1+i)^t]}$$

Σ = Summation

B_t = Gross income at single period t^{th} year

C_t = Total cost at single period t^{th} year

I = Discount rate

t = time period in year

Now, $B/C = 403525.71 / 219113.4$

$= 1.841$ (Since, B/C ratio is > 1 project is accepted)

B. Net present value calculation

Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project.

$$NPV = \sum B_t [1 / (1+i)^t] - \sum C_t [1 / (1+i)^t]$$

Where,

Σ = summation

B_t = Gross income at single period t^{th} year

C_t = Total cost at single period t^{th} year

I = Discount rate

t = time period in year

Now, NPV = 403525.71 - 219113.4

=Rs. 1, 84, 412 (Since NPV was positive project is accepted)

C. Internal rate of return calculation

IRR= LDR+DTDR [NPV at LDR/Absolute sum of NPV at UDR and LDR]

Where, IRR= Internal rate of return

LDR= Lower discount rate

UDR= Upper discount rate

DTDR=Difference between two discount rate

Now, IRR= $47+1[70 / (70+1005.4)]$

= 47.065% (Since IRR was more than discount rate project is accepted)

D. Payback period calculation

Cost cover in 1 years = Total cost - total returns

= 67500-89870

= Rs. -22370

Net earning from second year = 67500 - 25000 = 42500

1 Rs can be earn in 12 months

Rs. 22370 Can earn in = $(12/42500)*22370$

= 6.3 months

Therefore, payback period of this project is one year and seven months.

ECONOMIC ANALYSIS OF POTATO CULTIVATION

Executive Summary

Potato is one of the most important staple crops cultivated in Nepal. Government of Nepal has launched a potato zone in Nuwakot since 20273 B.S, where a study was carried out to study about economics of potato production. 60 household respondents were selected using simple random technique from the command area of potato zone of PMAMP-PIU. Respondent farmers were selected among the registered list of PMAMP-PIU, Nuwakot. One farmer was selected from each group thus 60 farmers were selected. Secondary data were collected from PMAMP, journal articles, MOAD etc. Descriptive statistics and benefit cost analysis were carried out. Collected data were analyzed using Statistical Package for Social Science (SPSS) and Microsoft Excel. The average area for potato cultivation per household was found to be 9.3833 ropani. The average production was found to be 9195.33 kg. The productivity of potato was found to be 965.3219 kg/ropani. The cost per unit kh of potato was found to be Rs. 19.7121 and the BC ratio for potato per household was found to be 1.8474. Marketing channel of potato was relatively simpler as all the potatoes were sold to the middlemen at their own farm.

1. INTRODUCTION

1.1. Background information

Agriculture backs the national economy of Nepal although it is carried out in the subsistence basis in context of Nepal (Biggs, 2011). It is a matter of concern that the country relying excessively upon agriculture for economy if country, although, commercialization is lagging far behind (Sharma, 1999). The contribution of agriculture to the GDP is 27.10% and 65.6% people have been deriving their livelihood from this sector from the cultivable land of 3091 sq. km. (AITC, 2019)

Potato (*Solanum tuberosum*) is one of the most important staple crops cultivated in Nepal (Timsina, 2010). Nepal ranks ninth in the major potato producing countries in Asia (Potatopro, 2019). Regarded as the king of vegetables, potato is also a widely preferred vegetable. It is one of the important cash crops to reduce poverty while addressing food insecurities arising among smallholder farmers in the developing countries like Nepal (Bista, 2013). As potato is used as a subsidiary food as part of vegetable in terai region while staple one in hills and upper regions, potato is important in Nepalese context. However, the potato production is hindered by many factors such as unavailability of quality seeds, lack of proper fertilizers at the proper time, shortage of labor, poor marketing situation, lack of proper storage house, undulated topography that affect transportation as well as access and lack of proper management of pest and diseases (Maldonado, 1998).

Nuwakot district is situated in Bagmati Province towards North-west direction of Kathmandu valley. It is situated in the latitude of 27.9194° N, 85.1661° E and covers an area of 1,121 km² (433 sq. m). Headquarter of Nuwakot district is Bidur. The district contains 12 municipalities, out of which two are urban municipalities and ten are rural municipalities. Paddy, potato, vegetables, Trout fish, strawberry, honeybee, onion as well as marginalized crops – millet and sesame and cash crops such as tea, cardamom, coffee, ginger, strawberry are emerging agricultural attractants of this region (Potato Zone, 2076). The command area of the Potato zone, Nuwakot is 580 ha. Nuwakot is one of the major potato producing district in Nepal and majority of farmers are engaged in commercial potato farming, with huge area under potato cultivation. Thus, potato cultivation has immense possibility in this area.

1.2. Statement of Problems

Potato production is hindered by many economic and biological factors. However, the biological problems can somehow be overcome by management practices, but the economic constraints in production and marketing problems are uncertain, yet unavoidable. Most of farmers concentrated towards the maximum returns, therefore the price fluctuation is major problem over the region. Having an immense scope of potato production, the region bears range of weaknesses and outer threats. Because of the absence of enough information about pricing mechanism, the farmers are unable to obtain lucrative profit of their product. In Nuwakot, potato has high potential of production and marketing. But, due to the dominance of traders and middleman in pricing, farmers get insufficient price to cover the cost of production. Also, due to poor co-ordination between service providers, enablers and facilitators, farmers are unable to get proper market information and have to sell their best production in least price. Thus, the pricing mechanism has affected the potato growers that have hindered the enthusiasm of producers towards potato cultivation.

1.3. Rationale of Study

On this developing scenario, on the first step, self-sufficiency matters the most while quality matters for export. Thus, the maintenance of both quality and quantity is primary focus. Therefore cost of production, scale of production and gross margin needs to be understand. Various vegetables having varying scale of production causes variation in the cost of production and the gross margin as a whole. The marketing margin declination of vegetables causes reluctance in farmers to grow the specific ones.

Nuwakot district has enormous potential for commercial potato cultivation. Its climate and soil distinctly seems suited for the potato production. Moreover, despite the undulated way to reach, the distance from the largest market of the capital city is also lower. It supports the huge potato demand within the valley. However, the quality

lags far behind. The farmers are compelled for the early harvest about a week before the harvesting period of potato for obtaining proper price. Because of the absence of enough information about pricing mechanism, the farmers are unable to obtain lucrative profit of their product. Thus, the finding of this research will boost up the commercialization of potato in this very specific region. It is also necessary to find out various marketing constraints along with problem related to production to boost up potato cultivation and increase in farmers' satisfaction. . Hence, this research was carried out to analyze the economics of production and strength, weakness, opportunity and threats of potato production in Nuwakot district.

1.4. Objectives

1.4.1. General objective

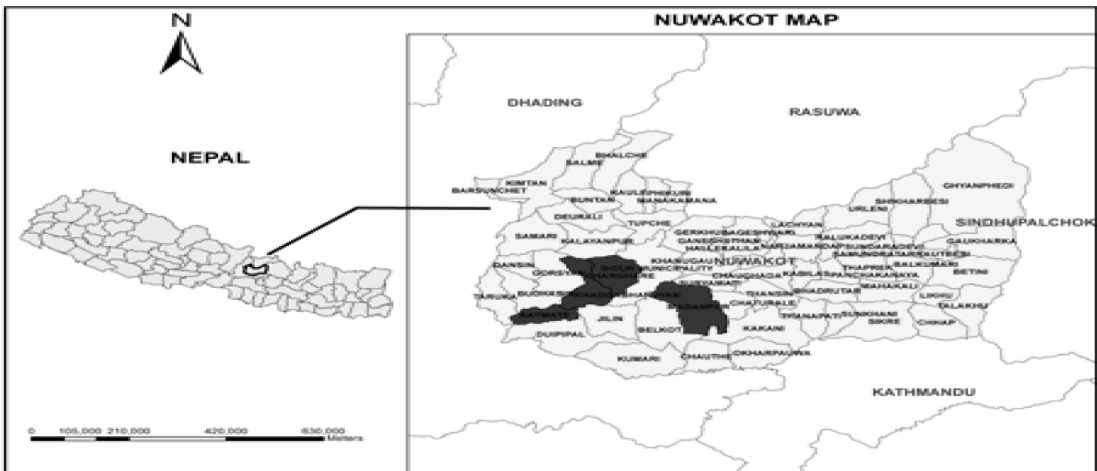
- To determine the economic analysis of potato production in Nuwakot, district.

1.4.2. Specific objective

- To study the productivity, cost and returns of Potato production.
- To study the cost per unit and benefit cost ratio of potato.

2. LITERATURE REVIEW

Nepal is an agricultural country. Most of the people in Nepal are engaged in agriculture (Chaudhary, 2016). Total cultivated land in Nepal being 3091 sq. km. (MOAD, 2012/13). Total area and production of potato in Nepal is 195173 ha and 2881829 MT (MoAD, 2075). Potato is considered as one of most important cash crops in Nepal. According to the statistics, potato ranks fifth in area, with an area of 185,342 ha, second in production , with production of 25,17,696 tons and first in productivity 13.58 t/ha among the major food crops grown in Nepal (MoAD, 2016). Nuwakot district lies in the Bagmati province, located just 75 km west of Kathmandu.



Source: Google.com

The Nuwakot district contains 12 Municipalities, out of which two are urban municipalities and ten are rural municipalities. The district is situated in the latitude of 27.9194° N, 85.1661° E and covers an area of 1,121 km² (433 sq. m). It touches Dhading, Kathmandu, Rasuwa and Sindhupalchowk districts as border. According to the national census, the population of Nuwakot is 277471.

Potato is grown in more than 150 countries of the world as staple food along with Nepal (RAP, 2008). Potato is an important cash crop in Nepalese agriculture system (Subedi, 2019). The different varieties of potato found to be grown in Nepal are: Cardinal, TPS, Khumal Rato, Arun Gold, Kanpure, Lal Gulab, C40, Kufri Sinduri, Desiree and so on. (AITC, 2019) . These improves varieties yield prominently higher compared to the local varieties (Subedi, 2109). Total potato consumed in year 2013 was 80.56 kg/capita/year (Potatopro, 2019) . Farmers prefer potato

cultivation because of its wider adaptability, high yield potential and high demand, thus it can be used to address food insecurity for poverty alleviation among smallholder farmers in the developing countries like Nepal. But, it is an interesting fact that per capita consumption has almost doubled since 1990 to 51 kg a year (Potatopro, 2019).

2.1. Production and marketing problems

The monopoly market of traders, unstable price, lack of market place, low prices and lack of good facilities at market place are major marketing problems of vegetables as well as lack of information exchange system, lack of coordination among different agencies and lack of assured input delivery (Bhattarai, 1992).

Inefficient supply of quality inputs in proper time along with diseases and pests, lack of technical knowledge affects production. Problem of marketing are higher price fluctuations, lower market price and lack of storage facilities which is further followed by road blockage (Poudel, 2003).

2.2. PM-AMP Zone for potato

PM-AMP was implemented as a ten years plan. It has established different super zone, zone, block and pocket areas in different districts of Nepal. Area with at least 1000 ha of land are termed as super zone, 500 ha of land as zone, 100 ha of land as block and 10 ha of land as pocket areas. Regarding the growing food demand and increasing food deficit, this project has conceptualized about establishing Fruits, cereal, grains, vegetable and seed production blocks, zones and super zones in line with the objective of ADS (2015-2035) to reduce hunger and poverty (PM-AMP, 2073). Potato production area under PM-AMP in different district are illustrate table below.

Table no 1. Potato production programs at different districts under different divisions of PMAMP

Program	District
Super zone	Kavre, Dadeldhura
Zone	Bhaktapur, Nuwakot, Okhaldhunga, Jhapa, Achham
Block	Bajura, Achham, Rasuwa, Solukhumbhu, Udayapur

2.3. Trend of Potato Cultivation

The productivity of potato in Nepal was gradually increasing from 2007 to 2011/12. Then, it is increasing, but in undulating pattern, with the productivity being maximum in year 2015/16 which declined slightly after that. Similarly, area under potato cultivation is gradually increasing, with the area being maximum in year 2013/14. However, the increment is in a slower rate.

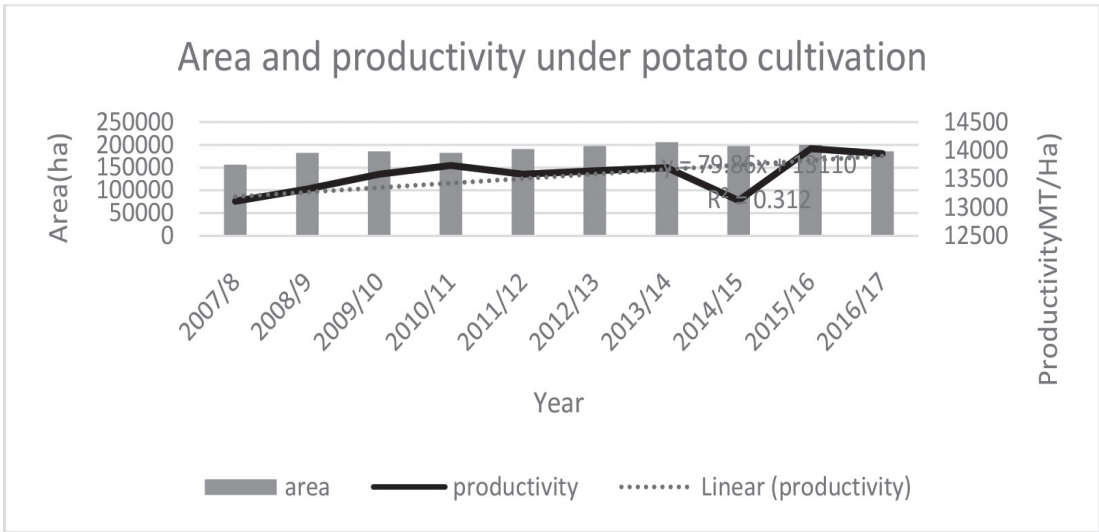


Fig1: Trend Analysis of Potato production in Nepal

Nuwakot ranks ninth among top ten potato producing districts of Nepal with productivity being 17,332 kg/ha which is led by Surkhet district with productivity being 21,682 kg/ha under area of 1177 ha.

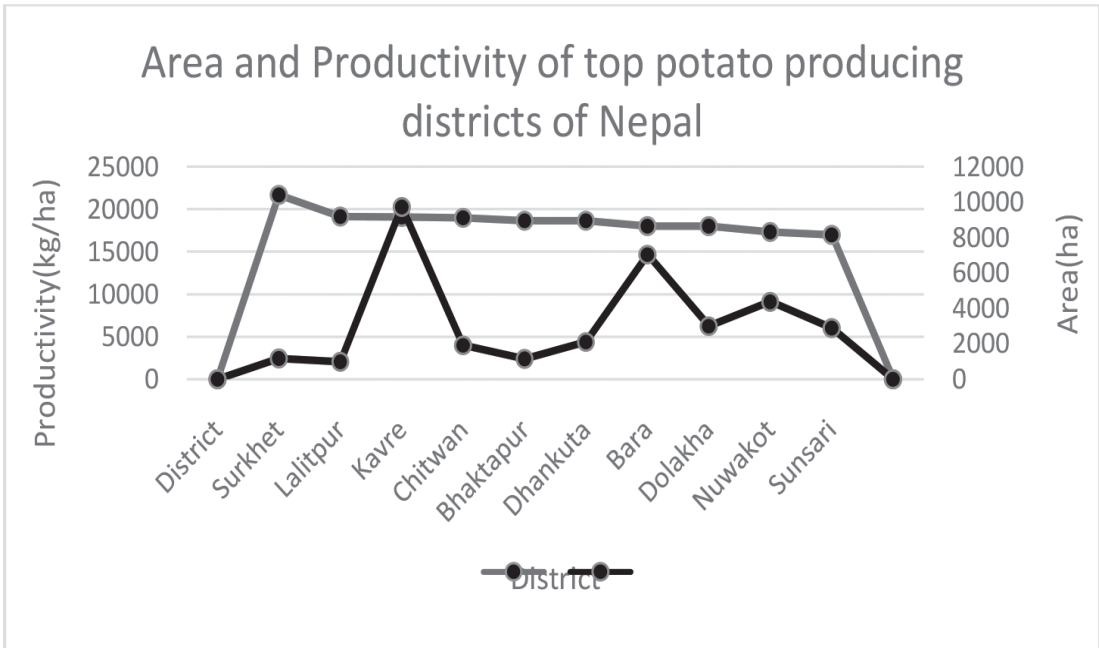


Fig. 2 : Trend analysis of top ten potato producing districts of Nepal

Table no 2: Area, production and productivity of potato in Nuwakot district

Year	Area	Production	Yield
2014/2015	4255	72330	16999
2015/2016	4070	63154	15517
2016/2017	4380	75914	17332

The area under potato cultivation is increasing at increasing rate in past five years in Nuwakot district. Similarly, the productivity of potato is in fluctuating pattern, however the production has increased. Thus, there is still immense possibility to develop potato producing scenario in Nuwakot district.

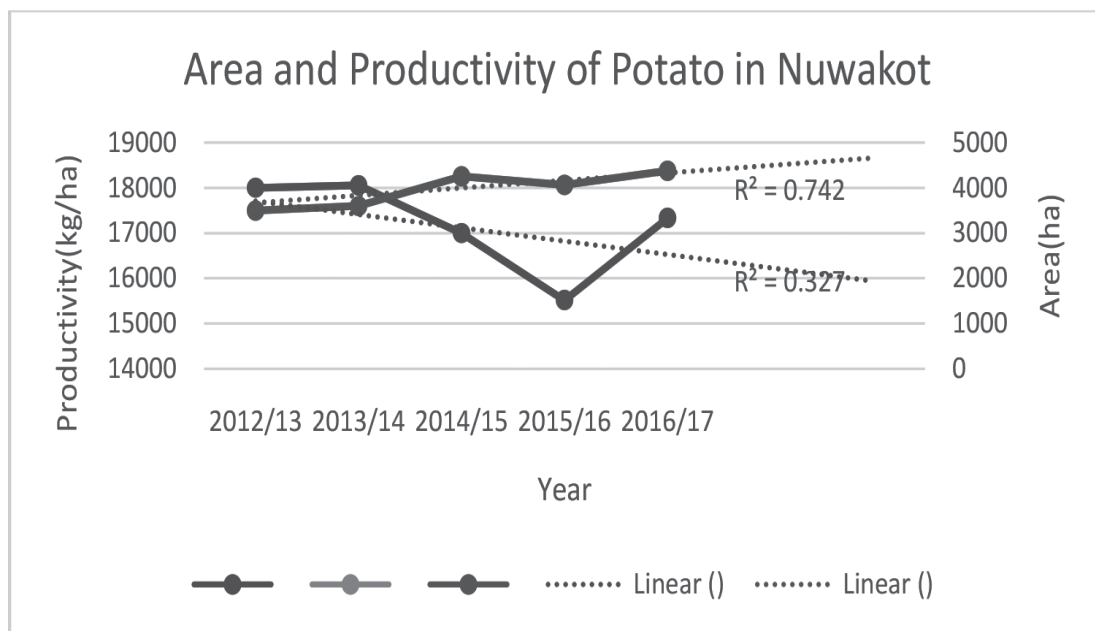


Fig. 3 : Trend analysis of potato production in Nuwakot district

3. THEORITICAL FRAMEWORK

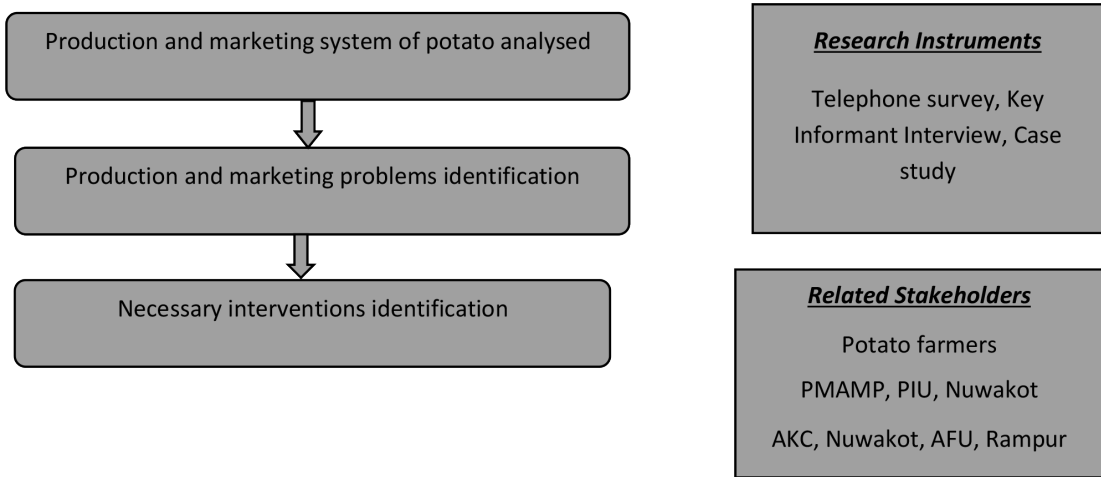


Figure 1: Conceptual Framework of research on economics potato production in Nuwakot district

4. RESEARCH METHODOLOGY

4.1. Research Site

The site of the survey research is Nuwakot district. It lies in Bagmati Province. The selected sites are areas of Likhu Village Municipality, Suryagadhi Village Municipality, Kakani Village Municipality and Panchakanya village Municipality which entirely covers PIU, Nuwakot. The reasons for selection were the favorable climatic conditions which provide comparative advantage to the crop, large scale potato cultivation in this area, large number of farmer groups and also being listed under PMAMP potato zone.

4.2. Sample and Sampling Techniques

60 samples were selected randomly from active farmers group from PMAMP-PIU Nuwakot through simple random sampling. The information about the status of production, production cost, their income status and the cost benefit of the potato farming is obtained.

1.1.1 Selection of respondents

Respondents are mainly the farmers actively engaged in commercial production. Altogether 60 respondents selected for the study and the selections of farmer are done as follows:

4.2.2 Selection of respondent

The potato grower's household of Nuwakot district constitutes the sample population for this research. Based on the group discussion in the research site of potato zone, total sample of 60 farmers were selected randomly.

4.3. Sources of data

4.3.1 Primary data

Both primary data and secondary data are used for study. The pre-tested interview schedule is administered to the sampled farmer for the collection of primary data. These data are obtained through telephone survey and key information interview for understanding cost of production, return, area coverage, mode of selling, marketing systems, marketing channels and existing problem of production and marketing.

4.3.2 Secondary data

The secondary information was obtained through reviewing different publications of Department of Agriculture, Ministry of Agriculture Development (MoAD), Central Bureau of Statistics (CBS) Nepal Agriculture Research Council (NARC), Manuals of PIU, Agriculture Knowledge Centre (AKC) of respective district.

4.3 Data collection procedure

4.3.1 Key informant interview (KII)

The persons who have been living in the village since years long are identified and interviewed. They are local resource persons, progressive farmers, social workers, staffs of PIU and agriculture related organizations as well as members of Village

Development Committee, political leaders, and other concerned stakeholders on concerned subject matter. The information collected is more reliable and contextual.

4.3.2 Telephone Survey

The imposition of lockdown due to the pandemic of covid-19 caused a huge problem in the basic household survey. Thus the contact number of the potato producing farmers were accessed and a 30 minutes long telephone interview was conducted per person. Most of the interviews conducted were conducted through telephone survey.

4.3.3 Household survey

Before the imposition of lockdown, household survey was conducted in some areas of Nuwakot site like Dhikure and Labdhu, Likhu-1. Household survey was carried out using Personal Interview Schedule (PIS). Some of the interviews were conducted using household survey methodology.

4.2. Data analysis techniques

The qualitative and quantitative data gathered were coded, and entered in Excel and SPSS software. The data are analyzed to draw meaningful inferences by using SPSS and MS-Excel software. Descriptive statistics, mean comparison, frequency distribution, trend analysis, are done to analyze the data. The findings are represented and demonstrated by using tables, figures, etc.

Cost of production

Variable cost of potato production = $C_{seed} + C_{manu} + C_{fert} + C_{labor} + C_{other}$

Where,

C_{seed} = Total cost of seed in NRs.

C_{manu} = Total cost of Farm Yard Manure (FYM) or poultry manure in NRs.

C_{fert} = Total cost of chemical fertilizer in NRs.

C_{labor} = Total cost of labor used in NRs.

C_{other} = Total cost on management and other aspects in NRs.

Benefit cost analysis

The purpose of benefit cost analysis is to find the investment made on the resources will yield a reasonable return to the resources engaged. Benefit cost ratio (BCR) is assumed as a quick and one of the easiest method for evaluating the economic performance of any farm (Dhakal, Thapa, Sah, & Khatri-Chhetri, 2015). BCR compares the benefit per unit of cost. Thus, BCR was calculated by using the following formula:

$$\text{BCR} = \text{Gross return (NRs)} / \text{Total variable cost (NRs)}$$

5 RESULTS AND DISCUSSIONS

5.3 Area under potato cultivation

The area under potato cultivation was categorized into uplands and lowlands. All of the farmers interviewed were found to cultivate potato in the upland area. Potato cultivated area was noted down. Average potato cultivated area was found to be 9.38 ± 5.57 ropani with the maximum and minimum area ranging from 2 ropani to 30 ropani.

Table: Area of potato cultivation

	N	Minimum	Maximum	Mean	Std. Deviation
Total area under potato cultivation (in ropani)	60	2.00	30.00	9.3833	5.57261
Valid N (listwise)	60				

5.4 Cost of production

Cost of production includes fixed cost and variable cost. Land rent, depreciation cost of machinery and repair maintenance cost are fixed cost whereas input cost, labour cost and other miscellaneous costs are included in variable cost. Cost of production of potato in average was found to be Rs. 131520.6 and the cost of unit production was found to be Rs 19.7121 per kg.

	N	Minimum	Maximum	Mean	Std. Deviation
Other cost of production	60	500	6000	2100.00	1330.222
Total rental cost	60	4000.00	60000.00	18766.6667	11145.21508
Total labour cost	60	10500.00	141750.00	47718.7500	26882.39083
Total input cost	60	11325.00	935650	65035.1833	120108.2042
Total cost of production	60	26464.00	992400.00	131520.6000	133756.37537
Cost per kg of production	60	5.69	275.67	19.7121	34.32369
Valid N (listwise)	60				

5.5 Benefit Cost Ratio

Gross return of production of potato and total cost for production were used to analyze the B/C ratio. Following formula is used to calculate B/C ratio;

$$\text{B/C ratio} = \frac{\text{Gross Return (Rs.)}}{\text{Total cost (Rs.)}}$$

Where,

Gross return was calculated from the income of sold product (NRs.)

The total cost of production was calculated by summation of variable cost and fixed cost incurred in the production process (NRs.)

If B/C ratio > 1, project is feasible/accept

If B/C ratio < 1, project is infeasible/reject

If B/C ratio = 1, neutral

The benefit cost ratio of potato was found to be 1.84 per household, which indicates the feasibility of the project. The total productivity of potato was found to be 985.32 kg/ropani. Similarly the cost for per kg production of potato and price sold per kg potato was found to be Rs. 19.71 and Rs. 24.47 respectively.

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Benefit cost ratio	60	.09	4.40	110.84	1.8474	.87160
Total Productivity	60	180.00	2250.00	57919.32	965.3219	434.99908
Cost per kg of production	60	5.69	275.67	1182.73	19.7121	34.32369
Price sold per kg potato	60	15	35	1469	24.47	3.456
Valid N (listwise)	60					

5.6 SWOT Analysis

<p>Strength</p> <ul style="list-style-type: none">• Adequate amount of fertile land• Government subsidies through PMAMP• Formation of active farmers group• High activity of cooperatives• Daily consumption in household	<p>Weakness</p> <ul style="list-style-type: none">• Poor availability of technical extension workers• Poor availability of improved varieties• Trader's dominance in price determination• Poor linkage between stakeholders
<p>Opportunities</p> <ul style="list-style-type: none">• Increasing number of service providers• Subsidy provision• Employment opportunities• Export potential• Use of modern agricultural tools for sustainable development and food security.• Development of Large scale potato production.	<p>Threats</p> <ul style="list-style-type: none">• Varietal degradation• Emergence of diseases and pest• Climate changes the main problem.• Migration of young generations to foreign countries.

6 SUMMARY AND CONCLUSIONS

Potato is considered as one of most important crops in Nepal. Although, economics of potato production are major concerns, so a study was designed to analyze the economics of production of potato in Nuwakot district of Nepal. This study was carried out in potato Zone of Nuwakot district where 6, 1, 1 and 2 wards respectively were taken from Likhu, Kakani, Suryagadhi and Panchakanya Rural Municipality respectively. 60 samples were selected by simple random sampling method.

The average area for potato cultivation was found to be 9.3833 ropani in average. The total cost of production was found to be Rs. 131520.6. Similarly, the cost per unit of production was found to be Rs 19.71 per kg in average. The total productivity was found to be 965.3219 kg per ropani. The price sold per kg of potato, that was mostly the farm gate price was found to be Rs. 24.47. Most of the farmers sell potatoes to the middlemen. The BC ratio was found to be 1.84.

The research suggests that agricultural commercialization is the major way of uplifting economic condition of the people in the research site. Due to average benefit cost ratio, we can say that potato cultivation is a feasible enterprise in Nuwakot district of Nepal. The factors affecting the commercialization of potato such as smaller land holding size, lack of training and economically active population. Appropriate change in these factors can give a significant contribution in the commercialization. Technical and managerial skills on cultivation practices and provision of technical knowledge to control diseases as well as proper allocation of inputs and available resources would help to increase profitability and productivity of potato. It is suggested to use disease-resistant improved varieties, high quality seed tubers and follow appropriate recommended cultural practices to increase the profitability of potato farming in Nuwakot district of Nepal.

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