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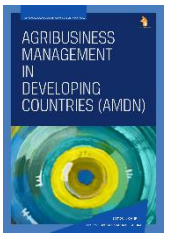

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RESEACH ARTICLE

FARMER'S PERCEPTION ON CITRUS POLLINATION AND ECONOMIC ANALYSIS OF CITRUS IN SYANGJA DISTRICT, NEPAL

Bipana Chaulagain, Sushil Awasthi*, Astha Thapa Giri, Sujana Lohani, Lekha khadka, Chandra Bhusal

Agriculture and Forestry University.
Corresponding Author Email : sushilawasthi70@gmail.com

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ABSTRACT

Study was carried out to assess the farmer's perception on the importance of pollination and profitability analysis of citrus farming in Syangja district. A multistage random sampling technique was used to select the study areas and respondents from the study areas. Putalibazaar Municipality, Bhirkot Municipality and Waling Municipality of Syangja district were selected in consultation with the PMAMP of Syangja district. Similarly, 66 respondents were selected using the purposive random sampling to collect the data using the semi-structured questionnaire. The collected data were processed tabulated and analyzed using SPSS and MS-Excel. Descriptive statistics were used to analyze data. It was found that male population (80.3%) was dominant over female population (19.7%). The average cultivated land for citrus was found to be 9.984 ropani. Average productivity and average price per kg of citrus of sampled household was found to be 6.13 mt and Rs. 55/kg respectively. Benefit-cost ratio was found to be 2.51 where Labor cost account as the major cost among the total cost of production with average of Rs. 47735. Study found that only 19.7% of the farmers possessed a strong understanding of the concept of pollination. However, 56.1% of the population were found to keep beehive i.e action was taken to manage pollination knowingly or unknowingly but primary motive was to rear bee for honey rather than for managing the pollinators while remaining of the population took no action. Study conducted in Syangja district, Nepal revealed that substantial proportion. exceeding 63.6% of the local farmers lacked knowledge regarding crops dependent on pollinators for reproduction. Study found that 51.3% of participating farmers exhibited a low level of knowledge concerning climate change. Additionally, none of the respondents reported implementing practices specifically aimed at mitigating the impacts of climate change on their agricultural operations. A study investigating agroecological practices among farmers revealed that 71.2% employed both intercropping and mulching techniques. In contrast, 28.8% of the farmers solely utilized mulching as their ecological practice.

KEYWORDS

Citrus, Pollination, Pollinator, Beehive

1. INTRODUCTION

Nepal has suitable agro-climatic conditions for quality citrus fruits production in mid-hills ranging from 800-1500m altitude. There are many citrus species grown in Nepal but only few are produced in commercial scale; mandarin (Citrus reticulate), sweet orange (Citrus sinensis), acid lime (Citrus aurantifolia) and hill lemon (Citrus pseudolimon). Citrus is one of the most important fruit crops of Nepal in terms of area coverage, production and export potential. Citrus fruits being cultivated in about 60 districts of the country contributes 22.37 % to total fruit production and share 3 % of total fruit export by volume (Dahal, Shrestha, Bista, & Bhandari, 2020). In the year 2018/19, the area and production of citrus in Nepal was recorded to be 28411 ha and 272,620 mt, respectively with the productivity of 9.60 mt/ha (MOALD, 2075/2076). It shows that cultivation area in 2018/19 has been increased by 9.4% as compared to 2017/18 while production has been increased by 10.9% and productivity has been increased by 1.8% during this course (MOALD, 2075/2076). In the year 2020/21, the area and production of citrus in Nepal was recorded to be 32,188 ha and 311,188 mt respectively with productivity of 9.67 mt/ha (MOALD, 2077/78). Mandarin is major citrus fruit having high market potentialities and is widely grown in mid-hills of Nepal. Mandarin is best suited to the mid-hill and it is becoming increasingly attractive source for cash generation in the high hills also. Some popular mandarin varieties among Nepalese farmers are Syangja local, Khoku, Morcot, Kinno, Ansu etc. Among citrus, mandarin is predominant which shares more than two-third of the total citrus production in the country. The national figures showed that mandarin was cultivated on a total 17,457 ha producing 1,64,593 mt in 2016 and increased to 27,150 ha producing 1,61,434 mt in 2017. Average productivity was reported to be 10 mt/ha in 2017 (MOALD, 2075/2076). Syangja is a hilly district is one of the potential districts for mandarin cultivation. Majority of farmers in Syangja district are being attracted towards mandarin production as their main source of income generation. In the year 2077/78, the production scenario of mandarin in Syangja district was 18530 mt under the production area of 1225 ha with productivity of 15.13 mt/ha (MOALD, 2077/2078).

2. POLLINATION

According to Encyclopedia Britannica "Pollination refers to the transfer of pollen grains from the stamens, the flower parts that produce them, to the ovule-bearing organs or to the ovules (seed precursors) themselves."

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According to (Ollerton, 2017), pollination is responsible for the creation of an estimated 87.5% of the world's angiosperm species. 35% of which are directly used as food sources by people all over the world (Klein, et al., 2006). The primary ecosystem function responsible for the production of the majority of single crops, insect-mediated pollination, has the largest share in the ecosystem (Klein, et al., 2006).

Pollination is essential for crop production, as many crops rely on pollinators to set fruit. In fact, over 75% of the world's food crops are pollinated by animals, primarily insects (Potts et al., 2010). Some crops, such as citrus, apples, and mustard, are particularly dependent on pollinators. For example, a study in California found that citrus yields increased by 40% when honeybees were present (Alattat, et al., 2018). Farmers rely on pollinators to produce a wide range of crops, including citrus fruits, apples, mustard, and many others. A study by the Food and Agriculture Organization of the United Nations (FAO) found that insect pollination contributes an estimated US$235 billion to global agricultural production each year. Pollinators help to reduce the need for pesticides. Pollinated crops are less susceptible to pests and diseases than non-pollinated crops. A study by the University of Maryland found that pollination by honey bees reduced the use of pesticides on apples by 20%(Gallai et al., 2009).

Citrus fruits are self-incompatible, meaning that they cannot pollinate themselves. Therefore, they rely on pollinators, such as bees and butterflies, to transfer pollen from male flowers to female flowers (Kreijger et al., 2002). Pollination has a significant economic value for citrus growers. In the United States, pollination services for citrus crops are estimated to be worth $150 million annually (Gallagher et al., 2018). This value is based on the fact that pollination can increase citrus yields by up to 30% (Gallagher et al., 2018).

2.1 Citrus and Mandarin Statistics: Trend analysis

Table 1: Comparative analysis of Area, Production and Productivity of Citrus in Nepal

Fiscal Year	Total Area (ha)	Productive area(ha)	Production (mt)	Yield (mt/ha)
2017/18	44,424	25,964	245,176	9.44
2018/19	46,392	28,411	272,620	9.60
2019/20	46,715	27,339	274,140	10.03
2020/21	50,235	32,188	311,188	9.67
2021/22	49,306	32,317	306,149	9.47
Citrus in Nepal				

Source: MOALD 2078/79

Table 2: Comparative analysis of Area, Production and Productivity of Mandarin in Syangja

Fiscal year	Area(ha)	Productive area (ha)	Production (mt)	Yield (mt/ha)
2017/18	1793	1283	14,073	11.0
2018/19	1882	1347	14,776	10.97
2019/20	1793	745	10,073	13.52
2020/21	1655	1225	18,530	15.13
2021/22	1969	1380	13,800	10
Mandarin in Syangja				

Source: Statistical information on Nepalese Agriculture from 2017-2022.

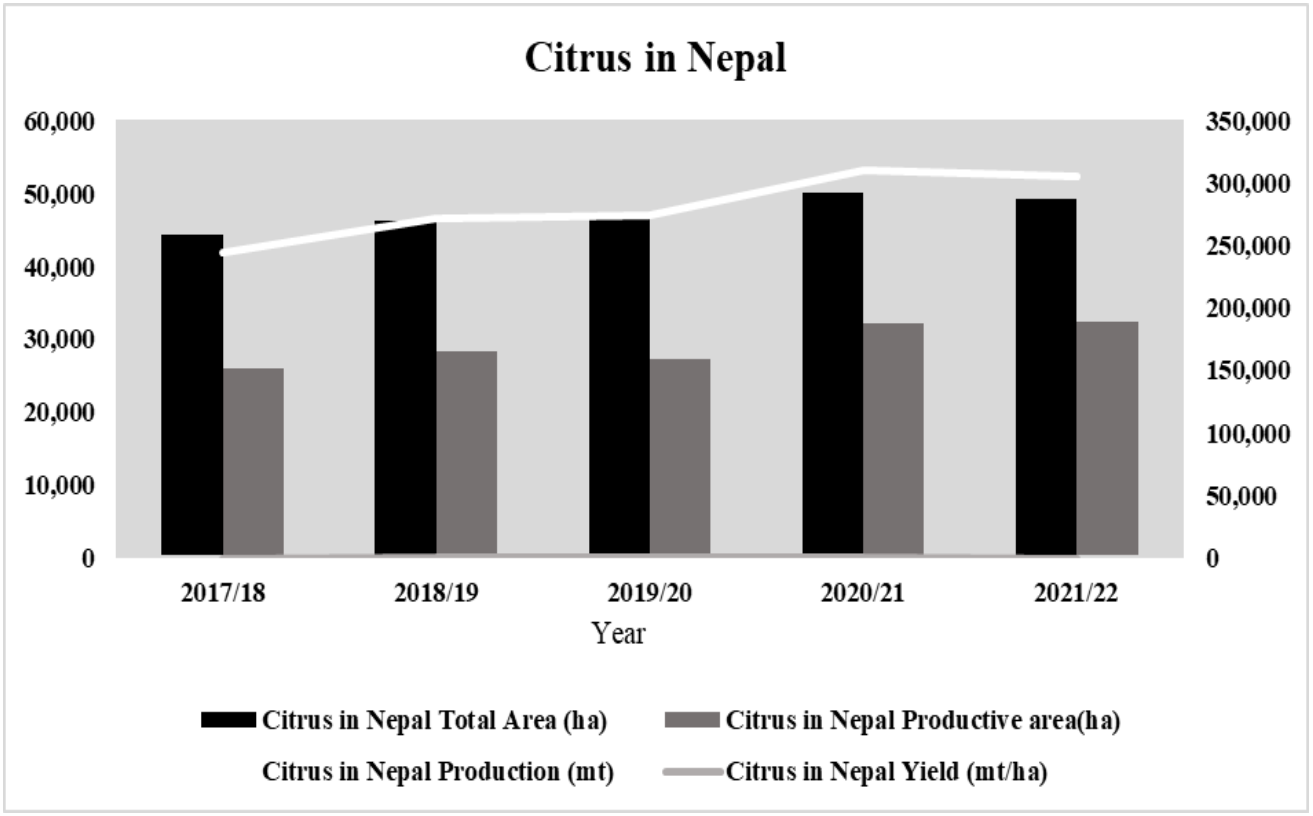


Figure 1: Area, Production and productivity of Citrus in Nepal (2017/18-2021/22)

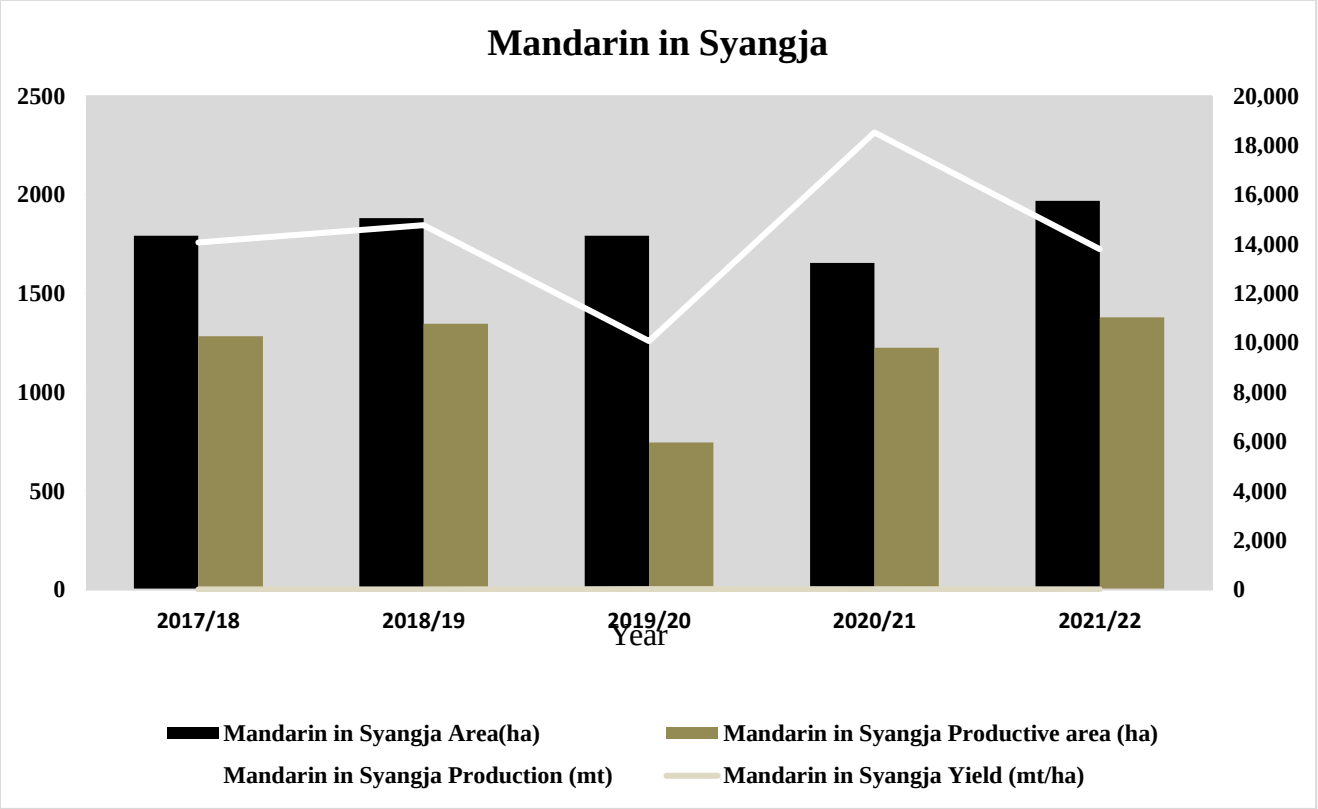


Figure 2: Area, Production and Productivity of Mandarin in Syangja (2017/18-2021/22)

3. RESEARCH METHODOLOGY

3.1 Site selection

The study was conducted on Syangja District, which exhibits immense climatic potentialities to produce different type of crops, especially suited for citrus production. Due to large production of Citrus, GoN has declared Syangja as Citrus super zone under PMAMP.

Different sites at Syangja were purposively selected for the study. The study was conducted on Putalibazaar, Waling and Bhirkot municipalities of Syangja District. These areas were purposely selected as they are the command area of the PMAMP Citrus Super Zone, Syangja with highest production potential in the district. The research was conducted in 3-5 wards of each municipality of Syangja. The major criterion of these ward being major mandarin producing areas; designated as Citrus block by AKC.

Figure 3: Map of study site

3.2 Preliminary Study

A preliminary study was carried out to gather information about the socioeconomic, demographic, and topographic characteristics of the study site. This helped the surveyors become familiar with the study area, making the subsequent survey process smoother. Additionally, the preliminary study aided in formulating an effective questionnaire.

3.3 Sample and Sampling Technique

For the questionnaire survey, a total of 103 households engaged in Citrus production were purposively selected. Survey was carried out among 103 household who cultivate citrus as an important part of cropping system, was purposively selected since the data and information provided will be more reliable and valuable to address the problem. Farmers were selected after consulting previous data of citrus production in Syangja, published by Super zone and AKC.

3.4 Sources of Data

a) Primary Data: Primary data was collected through methods such as direct field observation and surveys. Questionnaires, key informant interviews, and focus group discussions were used to collect primary data. Formal interviews were conducted with selected farmers using a questionnaire to obtain data regarding the research topic.

b) Secondary Data: Secondary data was collected by reviewing relevant literature on the subject, including profiles from the District Agriculture Development Office, annual reports, newsletters, bulletins, journals, data from Central Bureau of Statistics, Agriculture Research Council, reports from PMAMP office, proceedings from various NGOs and INGOs, and internet sources.

3.5 Survey Design And Data Collection Technique

This survey was focused on farmer's perspective towards pollination deficit in citrus. Following methodology were employed for data collection:

I. Preparatory Phase: At preparatory phase, desk review of documents was done. Questionnaire for the study relating to farmer's perspective towards pollination deficit in citrus was done. Sampling criteria and process of methodology was finalized.

II. Literature review: Different literature regarding the study areas and other relevant documents were reviewed.

III. Key Informants Interview: Major KII were farmers, stakeholders, Gyan kendra and super zone officer. They were asked about present scenario of Citrus production.

IV. Questionnaire survey: Field survey was conducted in target site during which series of questions were asked to gather some useful data. Only the questionnaire survey, informal discussion and field visit were done.

V. Socio-demographic and Farm Characteristics: It was used for descriptive analysis of the study areas and study populations. Different variables like family size, ethnicity, land holding used etc. was analyzed by using descriptive statistical tools such as %, mode, means etc.

VI. Focus group discussion: FGD was conducted to target group to ensure the information collected via questionnaire survey.

3.6 Data Analysis

The completion of the survey was followed by the processing and analysis of data. First, the information collected from the field entered into computer followed by coding and tabulation. Simple statistical analytical tools were used for data analysis. The data analysis for assessing farmer's perception in pollination deficit involved the use of Statistical Package for Social Science (SPSS) and Microsoft Excel Software package (MS-Excel). Descriptive statistics will be used, including frequencies, percentages, mean scores, median, standard deviation.

3.6.1 Socio-Economic And Farm Characters

Variables like gender, age group, education status of respondents, Family size were analyzed by descriptive statistics such as mean, frequencies, percentages, and standard deviation.

3.6.2 Cost of Production

The cost of production was analyzed by considering variable cost items associated with citrus production. These included expenses related to planting materials, organic manure, chemical fertilizers, pesticides, irrigation, labor, and power use. The total cost of production was calculated by summing up the expenditures on these variable inputs.

3.6.3 Benefit-Cost Analysis

The benefit-cost ratio, which indicates the ratio between gross return and total cost, was calculated to understand the recovery of costs through product returns. This ratio provided insights into the economic feasibility of the citrus production enterprise. Mathematically,

B/C Ratio = Total Cash Inflow/Total Cash Outflow

4. Result and Discussion

This section deals with key findings and results based on the analysis of information gathered during the survey period.

4.1 Socio-demographic Characteristics

Socio-demographic characteristics include total population, sex, family size, education status.

4.1.1 Gender/Sex

We found the majority of the respondents were male (80%) followed by female (20%) as shown in the Figure 4.

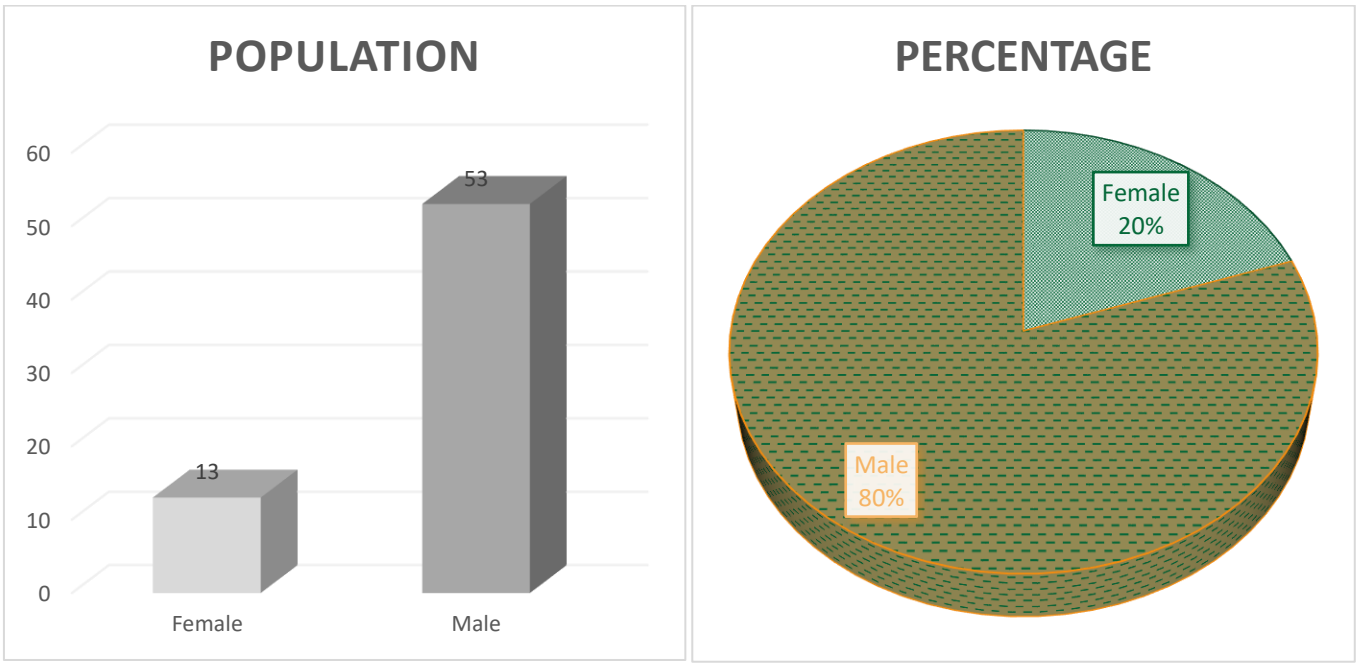


Figure 4: Distribution of respondent by Gender in the study area

4.1.2 Age

The majority of the respondent fell into age of above 55, comprising 53.03% of the total. Those aged between 45-54 made up the second-largest group, accounting for 30.30% of the respondents. The 35-44 age group followed with 25-34 age range constituted 3.03% as shown in Figure 5.

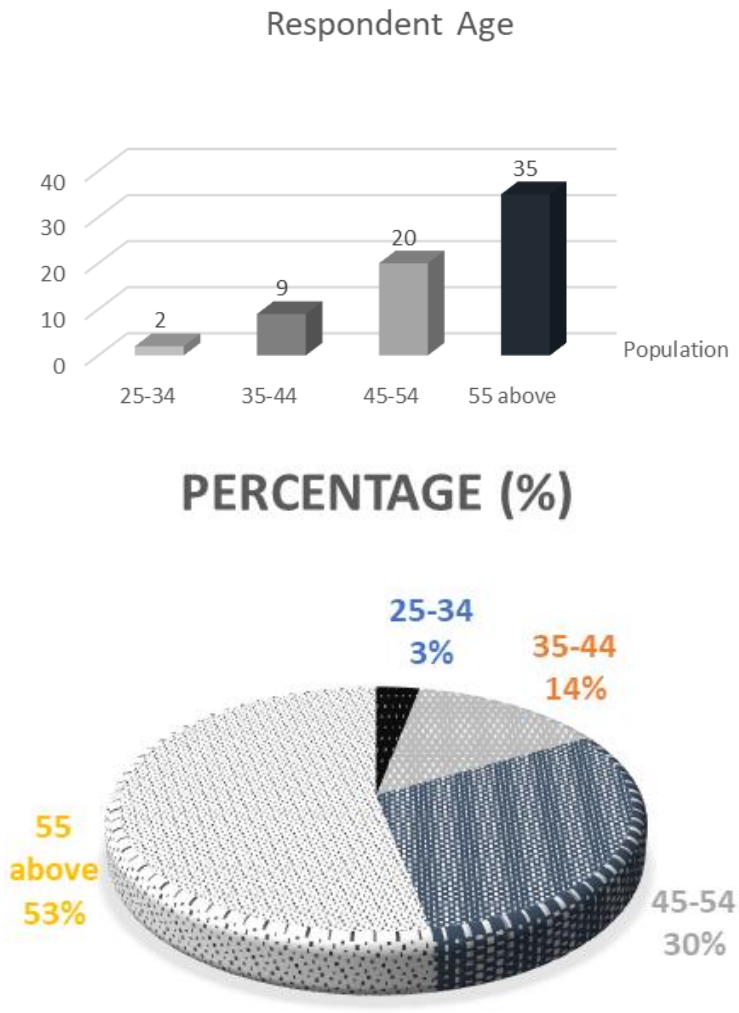
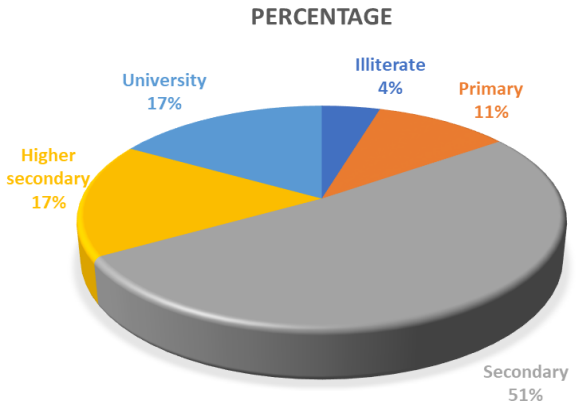


Figure 1: Distribution of respondent by their age group in study area

Table 1: Distribution of respondent age	
Respondents age	**Frequency**
Average (SD)	56 (11.96)
Median	55.5
Minimum	26
Maximum	84

4.1.3 Education

Majority of the respondents were found to have Secondary education level, comprising more than half (51%) of the total, followed by Higher secondary and University education level with 17% each, primary education level with 11%, Illiterate with 4% of the total as shown in Figure 6.



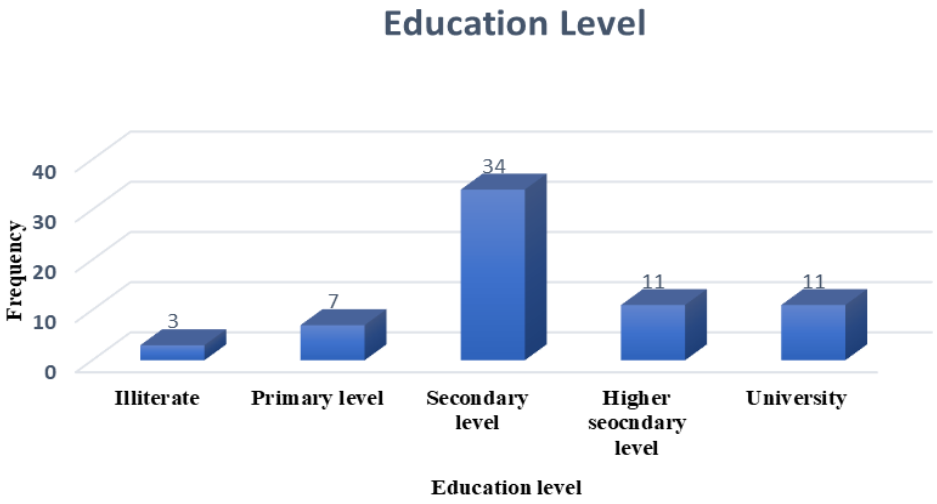


Figure 2: Distribution of respondent by Education level in the study area

4.1.4 Family Size (Number of members in Respondent Family)

Family size is an important variable that determines the supply of labors to perform farm

operations. Table (4) revealed that the average family size of the respondents was 5.061.

Table 2: Distribution of family size of sampled households in study area	
Family size	**Frequency**
Average (SD)	5.061 (2.353)
Median	5
Minimum	2
Maximum	14

4.2 Farming Practices

4.2.1 Size of Citrus farm (Ropani)

Approximately 34.84% of respondents had mandarin farms of less than 5 ropani, 25.75% had farms ranging from 5 to 10 ropani, another 31.81% owned farms in the range of 10 to 20 ropani, and 7.57% had mandarin farms exceeding 20 ropani in size. 100% of the respondents were found to be farmed on their own land as shown in Table 5.

Table 3: Distribution of respondent by total land farmed owned in study area	
Size of citrus farm (ropani)	**Frequency (Percentage)**
<5 ropani	23 (34.84%)
5-10 ropani	17 (25.75%)
10-20 ropani	21 (31.81%)
>20 ropani	5 (7.57%)

The table below shows that the average land farmed is 9.84 ropani, with a standard deviation of 10.28 ropani. The median land farmed is 6.5 ropani, meaning that half of the farms have less than 6.5 ropani of land, and the other half have more than 6.5 ropani of land. The minimum land farmed is 2 ropani, and the maximum land farmed is 60 ropani.

Table 4: Total land Farmed for citrus	
Total land farmed	**Ropani**
Average **(SD)**	9.894 (10.279)
Median	6.5
Minimum	2
Maximum	60

4.2.2 Total income from Citrus farming

The average income from farming is Rs. 221333.33. The median income is Rs. 141000 meaning that half of all farmers earn more than this amount and half earn less. The minimum income is Rs. 16000 and the maximum income is Rs. 848000. The standard deviation is Rs. 211264.64 which indicates that there is a high degree of variation in income among farmers.

Table 5: Income from citrus farming	
Income from citrus farming	**Cost (Rs.)**
Average (SD)	221333.33 (211264.64)
Median	141000
Minimum	16000
Maximum	848000

4.2.3 Total cost of Citrus farming

The average cost of farming is Rs. 92,818.18, but the standard deviation is Rs. 75,463, which means that there is a wide range of costs among different farms. The median cost is Rs. 62,500, which means that half of the farms have costs below this amount and half have costs above this amount. The minimum cost is Rs. 10,000 and the maximum cost is Rs. 326,000.

Table 6: Total cost of citrus Farming	
Total cost of citrus farming	**Cost (Rs.)**
Average (SD)	92818.182 (75463)
Median	62500
Minimum	10000
Maximum	326000

4.2.4 Total profit from Citrus farming

The average profit is Rs. 218257.58, but there is a wide range of profitability among farms, with a standard deviation of Rs. 234517.12. The median profit is Rs. 117000, which means that half of the farms had profits above this amount and half had profits below this amount. The minimum profit is Rs. 0, and the maximum profit is Rs. 920000.

Table 7: Total profit from citrus farming	
Total profit from citrus farming	**Cost (Rs.)**
Average **(SD)**	218257.576 (234517.118)
Median	117000
Minimum	0
Maximum	920000

4.2.5 Total revenue from Bee-keeping

The average revenue from beekeeping is Rs. 2772.727, but there is a wide range of profitability among beekeepers, with a standard deviation of Rs. 12828.808.

Table 8: Total revenue from bee-keeping	
Total revenue from Bee keeping	**Cost (Rs.)**
Average **(SD)**	2772.727 (12828.808)

4.2.6 Yield as compare to normal

Table below shows that the most common outcome is a higher yield than normal, with a frequency of 66, means 100% of the respondent's yield is higher than the normal. There are no cases of a lower yield than normal, and no cases of no change.

Table 9: Yield as compare to normal	
Yield as compare to normal	**Frequency**
Higher	66
Lower	0
No change	0

4.2.7 Cost of Cultivation of Citrus

Cost of production referred to the outlay of funds for the procurement of necessary inputs and labor employed. Cultivation of citrus incurs various types of cost, as it requires various kinds of input in terms of labor, machinery, manure, fertilizer, seed, irrigation, pesticides, etc. In the study area, human labor was largely used as input in the production of citrus. Human labor was required for performing different operations such as land preparation, fertilizer application, irrigation, harvesting, etc. Citrus production in the study area has been found labor intensive. FYM is the main source of fertilizer in the study area. Use of chemical fertilizers, micronutrients, and pesticides was not found in the study area. The citrus farmers used completely organic methods for growing citrus in the area. The cost of irrigation is included in the labor costs as the growers use natural source of water for irrigation using human labor.

The result showed that the cost of production was NRs. 92818.182. Similarly average total return was NRs.221333.33. The benefit-cost ratio of the study area was found to be 2.51 which was higher than 1 which indicates that one rupee invested in citrus cultivation gives 2.51 rupees. Thus, citrus cultivation was a profitable enterprise in the study area.

Labor cost incurred in citrus farming accounted for NRs. 47734.85 and machinery use accounted for about NRs. 9287.879. Similarly, cost of seed contributed NRs. 3163.636, organic manures contributed NRs. 27734.85.

The study revealed that the total cost of citrus production was NRs. 92818.182. The details of the average cost of citrus production in the study area are presented in Table 10. Table 11 represents the indicators for productivity and profitability of citrus farming in the study area.

Table 10: Cost distribution of citrus in study area	
Particulars	**Cost (Nrs.)**
Labor cost	47734.85
Power Use	9287.879
Seedling cost	3163.636
Fertilizer cost	27734.85
Bordeaux paste	3881.80
Irrigation cost	939.40
Total variable cost	**92818.182**

Table 11: Economic indicators showing productivity and profitability of citrus farming	
Particulars	**Value**
Total cost (Nrs.)	92818.182
Average price (Rs/kg)	54.682
Gross revenue (Nrs)	221333.33
Productivity (Mt)	6.13
B:C ratio	2.51

4.2.8 Total Quantity of production (kg) of Citrus

The average of the quantity is 6128.03 kg. The standard deviation is 5485.478 kg, which is relatively large, indicating that there is a wide range of values in the data set.

Table 12: Quantity of Production (kg)	
Quantity	**Kilogram (kg)**
Average **(SD)**	6128.03 (5485.478)

4.2.9 Price per Kilogram (kg) of Citrus

The average price per kg is Rs. 54.682. The standard deviation is Rs. 7.154, which is relatively small, indicating that most of the prices are close to the average.

Table 13: Price per kg of citrus	
Price per kg	**Rs/kg**
Average **(SD)**	54.682 (7.154)

4.2.10 Home consumption of citrus (kg)

The home consumption data in the table shows that the average home consumption is 522.12 kg. The standard deviation is 685.187 kg, which is relatively high, indicating that there is a wide range of home consumption values.

Table 14: Home consumption (kg)	
Home consumption	**Kilogram (kg)**
Average **(SD)**	522.12 (685.187)

4.2.11 Amount of citrus sold (kg)

The table below shows the amount of citrus sold. The data is displayed in kilograms (kg). The average amount of citrus sold per year is 5605.909 kg. The standard deviation is 5210.302 kg. The median amount of citrus sold is 3775 kg which means that half of the respondent sold more than 3775 kg and half of the respondent sold less than 3775 kg. The minimum amount of citrus sold is 440 kg. The maximum amount of citrus sold is 22000 kg.

Table 15:Amount of citrus sold (kg)	
Amount of citrus sold	**Kilogram (kg)**
Average **(SD)**	5605.909 (5210.302)
Median	3775
Minimum	440
Maximum	22000

4.2.12 Expenditure On Chemical Insecticide

The table shows the expenditure on chemical insecticides in Rupees. The average expenditure is 3972.727, with a standard deviation of 2323.098.

Table 16: Expenditure On Chemical Insecticide	
Expenditure on chemical insecticide	**Rupees (Rs.)**
Average **(SD)**	3972.727 (2323.098)

4.2.13 Expenditure on chemical Fertilizer

The table below shows the expenditure on chemical fertilizer in Rupees. The average expenditure on chemical fertilizer is 712.121, with a standard deviation of 2371.

Table 17: Expenditure on chemical fertilizer	
Expenditure on chemical Fertilizer	**Rupees (Rs.)**
Average **(SD)**	712.121 (2371)

4.2.14 Expenditure on FYM

The average expenditure on FYM is Rs. 27,022.72. This means that on average, farmers spent Rs. 27,022.72 on FYM. The standard deviation of the expenditure on FYM is Rs. 2,560.36. This means that there is a significant variation in the amount of money that farmers spent on FYM.

Table 18: Expenditure on FYM	
Expenditure on FYM	**Rupees (Rs.)**
Average **(SD)**	27022.72 (2560.36)

4.2.15 Purpose of Farming

The table shows the purpose of farming and the frequency of each purpose. The data is presented as a percentage of farms. The most common purpose of farming is mainly to sell for income but some to feed family, which is done by 100% of farms.

Table 19: Purpose Of Farming		
Purpose of Farming	**Frequency**	**Percentage (%)**
To feed the family	0	0
Mainly feed family, but sell some	0	0
Mainly sell but some to feed family	66	100
To sell for income	0	0
To feed livestock	0	0

4.3 Agroecological Awareness

4.3.1 Positive Values Of Insects, Worms, Birds, Wild Plants And Animals

The figure below reveals that still majority of farmers are unaware about the ecological benefits that the wild plants, animals, insects, birds, worms provide for the farm and majority only view them in negative context.

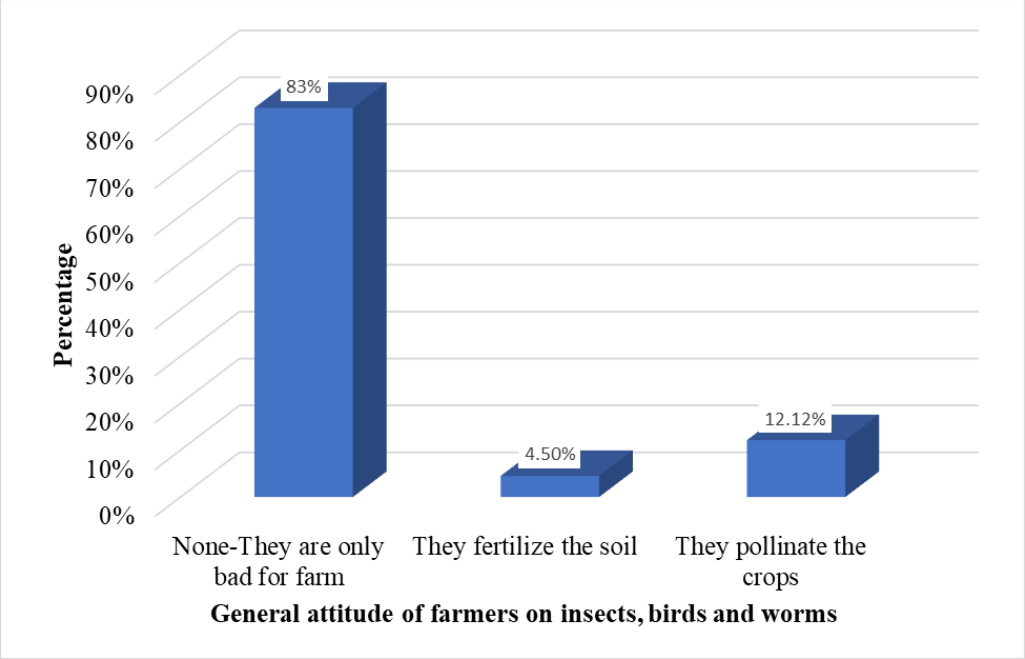


Figure 8: Positive values of Insects, Worms, Wild plants and animals

4.3.2 Knowledge on Pollination

Findings revealed that 19.7% of the respondents demonstrated a basic understanding of pollination, while 13.6% exhibited a good understanding. Conversely, a significant portion, 54.5%, had no prior knowledge of pollination and 12.1% remained unsure about the concept.

Table 20: Knowledge on Pollination		
Knowledge on pollination	**Frequency**	**Percentage**
Basic understanding of pollination (e.g Bees need to visit crops)	13	19.7
Good understanding of pollination (e.g Pollen carried between plants)	9	13.6
Never heard about pollination	36	54.5
Not sure what it is	8	12.1
Total	**66**	**100**

4.3.3 List of pollinator dependent crops identified by farmers

Table 21: Pollinator dependent crops	
Pollinators Dependent crops	**Frequency**
Unable to identify	42
At least 2 pollinators dependent crops	1
At least 3 pollinators dependent crops	10
At least 4 pollinators dependent crops	12
5 or more pollinators dependent crops	1
List of Pollinator dependent crops	**Percentage (Frequency)**
Citrus	39% (26)
Lime	33% (22)
Cucurbits	19% (13)
Vegetables	3% (2)
Mustard	6% (4)

4.3.4 List of Pollinators

Table 22: List of Pollinators	
Pollinators identified by Farmers	**Frequency**
Unable to identify	11
At least 2 pollinators	9
At least 3 pollinators	32
At least 4 pollinators	8
5 or more pollinators	6
List of Pollinator	**Frequency**
Bee	55
Butterfly	54
Bumblebee	37
Wasp	19
Flies	10

4.3.5 Knowledge on Climate Change

A recent study revealed a knowledge gap regarding climate change within the population. 51.3% of participants demonstrated a fundamental understanding, while a concerning 18% had no prior exposure to the topic. Additionally, 11% expressed uncertainty about the definition of climate change and only a limited segment, 3%, exhibited a comprehensive grasp of the subject.

Table 23: Knowledge on Climate change		
Knowledge on climate change	**Frequency**	**Percent**
Not sure what it is	11	16.7
Understand it quite well	3	4.5
Have some very basic understanding	34	51.5
Not heard of climate change	18	27.3
Total	**66**	**100.0**

4.3.6 Action to reduce climate change

The table below seems to show that no actions have been taken (100%) to reduce the impact of climate change on their farm.

Table 24: Action to reduce climate change		
Action to reduce climate change	**Frequency**	**Percent**
No	66	100.0
Yes	0	0

4.3.7 Action to manage Pollination

Out of the 66 responses, 37 (56.1%) respondents were found to keep beehive i.e action was taken to manage pollination knowingly or unknowingly but primary motive was to rear bee for honey rather than for managing the pollinators while 29 (43.9%) of respondent took no action.

Table 25: Action to manage pollination		
Action to manage Pollination	**Frequency**	**Percent**
Keep Beehives	37	56.1
No actions	29	43.9
Total	**66**	**100.0**

4.3.8 Agroecological Farming practices

This study found that 71.2% of citrus orchard farmers employed a combination of intercropping and mulching as agroecological practices. In contrast, 28.8% of farmers solely utilized mulching as their primary agroecological approach.

Table 26: Agroecological farming practices		
Agroecological Farming practices	**Frequency**	**Percentage**
Intercropping (Ginger, Cardamom), Mulching	1	1.5
Intercropping (with bean, maize, pea), Mulching	1	1.5
Intercropping (with ginger, Turmeric, Cauliflower), Mulching	1	1.5
Intercropping (with ginger, turmeric, Yam, Millet), Mulching	1	1.5
Intercropping (with Ginger, Turmeric), Mulching	1	1.5
Intercropping (with Chilly, spices), Mulching	1	1.5
Intercropping (with Maize, Chilly), Mulching	3	4.5
Intercropping (with Maize, Cucumber, Tomato, Millet), Mulching	1	1.5
Intercropping (with Maize, Cucumber), Mulching	1	1.5
Intercropping (with maize, garlic, turmeric, ginger, millet), Mulching	1	1.5
Intercropping (with Maize, Ginger, Turmeric, Bean), Mulching	1	1.5
Intercropping (with Maize, Ginger, Turmeric), Mulching	5	7.6
Intercropping (with Maize, Millet), Mulching	1	1.5
Intercropping (with Maize, Pea), Mulching	1	1.5
Intercropping (with Maize, Vegetable), Mulching	4	6.1
Intercropping (with Maize), Mulching	14	21.2
Intercropping (with pumpkin, ginger, turmeric, pea), Mulching	1	1.5
Intercropping (with pumpkin, vegetable, chilly), Mulching	1	1.5
Intercropping (with Yam, Ginger), Mulching	1	1.5
Intercropping (with Yam, Turmeric, Ginger), Mulching	1	1.5
Intercropping (with Yam, Chilly, Ginger), Mulching	1	1.5
Intercropping (Maize, Ginger), Mulching	1	1.5
Intercropping (Maize, Turmeric), Mulching	1	1.5
Intercropping (with minor vegetable, ginger, turmeric), Mulching	2	3.0
Mulching	19	28.8
Total	**66**	**100.0**

5. RESULT AND DISCUSSION

Several studies were carried out on Farmer's perception on pollinators and role of pollination in enhancing crop yield. Factors for decline in quantity and yield are influenced by the knowledge and perception of farmers toward pollination and pollinators (Dorji et al., 2022).

Improvement of yield needs understanding of farmers' perceptions and

knowledge on pollination services and the importance of insect pollinators for agricultural production among other key production and management factors considered. Education, knowledge on pollen and/or nectar, and source of information significantly affected knowledge of farmers about pollination and the importance of insect pollinators (Misganaw, 2017). Differences in perceptions and knowledge of pollination constitute a major obstacle in farmer–researcher cooperation and collaboration which is necessary for management of pollination services in rural farmlands (Munyuli, 2011).

Aim of this study was to understand the knowledge and perception surrounding the significance of pollinators and pollination services for citrus crop and the economic analysis of Citrus in Syangja district, Nepal. The primary focus was on farmer's perspectives towards importance of pollination and action took by them to manage pollination on their Citrus orchard. Despite the benefits of pollination, the perceptions of farmers on pollination management have been largely overlooked. Large mass of population was found to keep beehive in their orchard, knowingly or unknowingly, as primary motive was to rear bee for honey rather than for pollination management services which somehow indirectly contributed to the pollination management in the orchard to help increase Citrus production.

It is there recommended to citrus farmers in Syangja district to adopt and preserve at least 20% of their land as pollinator reservoir to make citrus production system remain ecologically and economically sound and viable on a long-term basis. There is a need for local communities to get involved in sustainable management of semi-natural and natural habitats on farm landscapes to protect pollinators.

This study also investigates the economic viability of Citrus production in Syangja District, Nepal. The analysis reveals a gross margin of NRs. 2,21,333.33 and B:C ratio of 2.51. These findings are compared to similar study conducted in Gulmi, Sindhuli district, Nepal, which reported a gross margin and B:C ratio of Nrs. 388,040.43 and 2.59, NRs. 72634 and 2.81 for Mandarin Production respectively.

6. Conclusion

Most of the farmers in the study area were male, middle-aged, educated, and production was done for the commercial purpose and few households were found to keep the citrus as species for house hold purpose. The socio-economic attributes of the farmers like education, commercial farming in the larger area, and access to extension services had a positive influence on the knowledge of pollination of citrus. The major problem in production of citrus was adverse climate and major pest were bird, monkey, deer, which can damage fruits and reduce overall yield. The productivity of the Citrus orchard, in turn, is positively and significantly increased under improved management practices such as, intercropping, mulching, farmyard manure application, irrigation. This shows that farmers with better socio-economic conditions are more likely to adopt good agricultural practices in Citrus orchards enhancing their productivity.

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