

Citrus production management to support self-sufficiency in Afghanistan (a case study of district bati kot-nangarhar)

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ABSTRACT

Afghanistan is one of the countries with the highest hunger levels as per Global Huger Index 2021 ranks 103rd out of 116 countries which need additional efforts to eliminate the insecurity of food and switch towards self-sufficiency. The development of agriculture sector is mainly dependent upon the sharing of reliable information of agricultural extension workers which is necessary for agricultural production and enhancing the marketing and distributive strategies. The present study was conducted for citrus production management to support the self-sufficiency of citrus (sweet orange) in Afghanistan in the year 2023. Citrus growers were randomly selected from five villages of District Bati Kot by using proportional allocation method through pretested interview schedule in the coldest months of the year. Data were analyzed through SPSS V20 and results were presented as counts, graphs and percentages. Moreover, rank order, mean and standard deviation were used to know the extension workers' expertise, while chi-square test was used to find the association between the different variables. The results revealed that most of the citrus growers were in the middle age of 31-50 years where 55 percent citrus growers were illiterate and 45 percent of them have formal education from primary to intermediate level. About 43.3% of citrus growers in the study area were in the joint family system of above 12 members. Majority (73.3%) citrus growers practiced intercropping in their citrus orchards, whereas 64% citrus growers have knowledge of planting density. Maximum were cultivating the variety 7007 as told by the extension workers by giving them the knowledge of improved citrus varieties as per response of 41% citrus growers. Majority (61%) citrus growers revealed about the availability of extension services. Overwhelming majority sold their citrus fruits through middle man due to no marketing awareness. The ranking skills of extension workers as perceived by citrus growers in picking was the forecasting maturity and yield was on top with mean value 3.47 and standard deviation 1.099 while, in post picking, knowledge of post-harvest losses was on top priority with mean value 2.77 and standard deviation 1.11. The highly signification association was found between the age and literacy status with average yield along with picking of citrus production. Extending workers may be trained in collecting and processing of citrus fruits and understanding of post-harvest losses during marketing through various training sessions who in turn will train citrus growers to sell their products directly by not involving middleman and control the post-harvest losses by improving their socio economic status along with increasing their interest in citrus production to bring self-sufficiency in citrus fruit for battering the economy of Afghanistan.

Keywords: Citrus Production Management, post-harvest losses, marketing, Self-Sufficiency, Citrus Growers, Nangarhar, Afghanistan

INTRODUCTION

Citrus fruits including oranges, lemons, limes and grape fruits are a group of plants that produce juicy fruits. Citrus fruits are the key sources of vitamin C supporting immune system during cold and flu season along with provision of multitude of other essential nutrients. Citrus fruit quality is mainly influenced through nutrients of nitrogen, phosphorus and potassium. Fruit quality and yield are negatively affected when any other nutrient is more or less as nitrogen increases juice content and acid quality. Citrus production is sustainable if no significant damage to air, water, land, soil, forests by not using pesticides.

Agriculture is the most important part of the world's poorest nations' economy like Afghanistan. Most of Afghans' economic output comes from agriculture and especially fruits, so mostly Afghanistan's economy is based on agriculture sector. Afghanistan's agriculture sector accounted for around 22% of the Gross Domestic Product (GDP)

in 2023 and more than 60% of workforce depend on agricultural sector as well as 70% of rural residents depend on it for their living (Sarwary *et al.*, 2023). Citrus fruit is an important ever green fruit tree of Rutaceae family which is grown in both tropical and sub-tropical areas of the world. Citrus is cultivated in more than 140 countries and its worldwide production is 105 million tons. After mangos, tomatoes and bananas, citrus fruits are among the most consumed fruits in the world and their species are small to medium-size plants. Despite supplying an abundant number of vitamins, minerals, dietary fibers, and pectin, they have a number of active phytochemicals, such as Phyto phenolic, flavones and phenolic acids which is greatly recommended to protect health because of their biological properties, which contain anti-inflammatory, anti-tumor and anti-atherogenic activities (Aruoma *et al.*, 2012). Human beings are using and collecting citrus fruits for medicinal, herbal and agricultural purposes from centuries. Typically all citrus fruits have sweet and sour taste. They have refreshing juice which is accessible around the year (Sanofer, 2014). Historically, it has been thought that origination of citrus is from Southeast Asia and the Malay Archipelago, spreading from Northern India to China and in the south through Malaysia, the East Indies, and the Philippines by distant explorers, traders, and church missionaries. In the light of recent evidence it has been suggested that Yunnan Province in the Southwest China might be the center of origin because of the number of species that have been reported here (Gmitter *et al.*, 2007). China produced 44.6 million tons of citrus fruit which stood 28.07% of the world’s total citrus fruit production in 2020 and therefore, China is considered as the world's largest citrus fruit grower around the world. The top five countries account for 59.15% of it, while the other four of them are Brazil, India, Mexico and the USA. In 2020, 158 million tons of citrus fruits were expected to be produced around the world. The output of citrus fruit worldwide was increased significantly between 1971 and 2020, ranging from 42.1 million to 158 million tons, reaching at an increasing annual rate of 10.47% in 1980 and then declined to 0.47% in 2020 (Knoema, 2021) as shown in the Table 1.

Table 1 Position of Afghanistan among Citrus Producing Countries of the World

Rank	Country	Production (Tons)	Production per Person (Kg)	Acreage (Hectare)	Yield (Kg/Hectare)
1	China	44,063,061	31.612	2,879,238	15,303.7
2	Brazil	19,652,788	93.793	703,337	27,942.2
3	India	14,013,000	10.485	1,073,000	13,059.6
4	Mexico	8,756,488	70.199	641,899	13,641.5
5	United States of America	7,230,854	22.061	278,802	25,935.4
6	Spain	6,010,050	128.807	296,460	20,272.7
7	Egypt	4,638,980	47.581	191,298	24,250
8	Turkey	4,301,415	53.228	174,245	24,686
9	Nigeria	4,160,568	21.077	830,302	5,010.9
10	Iran	4,073,067	49.819	143,460	28,391.7
16	Pakistan	2,289,262	11.34	201,472	11,362.7
81	Afghanistan	43,515	1.378	4,364	9,971

Atlas Big (2021)

Afghanistan Fresh Citrus Market is estimated to be 146828 tons in size, with a total value of \$US 57.2 million. Based on accessible information, it seems that the growers in Afghanistan only shares 0.9 percent of the value market and 1.2 percent of the citrus are produced. The Afghan producers respond to market demand by focusing mostly on the sour oranges product and present consumption of Mandarin and sweet oranges is greater than sour oranges. In 2013 the total quantity of industrial citrus imports was 1139 tons of sweet orange juice and concentrate (grapefruit juice and concentrates were excluded), with a Cost Insurance and Freight (CIF) value of \$US 1.3 million and 66 tons of citrus jams and jellies with a combined value of \$US 0.2 million. At least 2476 tons of fresh citrus volumes are represented by the imported juice and concentrate. This volume is more than twice as large as the entire existing Afghan production (Booyens *et al.*, 2015). In 2020, Afghanistan exported \$1.93M in citrus, making it the 75th largest exporter of citrus in the world. At the same year, citrus was the 32nd most exported product in

Afghanistan. The main destinations of citrus exports from Afghanistan are: Pakistan (\$1.56M), Kazakhstan (\$244k), Senegal (\$102k), Tajikistan (\$17.5k), and Canada (\$10.5k). The fastest growing export markets for citrus of Afghanistan between 2019 and 2020 were Pakistan (\$1.16M), Kazakhstan (\$244k), and Senegal (\$74.2k), Afghanistan imported \$56.9M in Citrus, becoming the 47th largest importer of citrus in the world. At the same year, citrus was the 25th most imported product in Afghanistan (OEC, 2020). Nangarhar, the evergreen province in eastern region has been famous in its semi-tropical climate and conducive soil for growing citrus orchards. Citrus produced in Nangarhar is famous all over the country especially sweet orange. The eastern provinces of Nangarhar, Laghman and Kunar in Afghanistan have a Mediterranean climate and a climate conducive to citrus farming. Afghanistan has produced a total of 13,243 tons of citrus fruits (tangerine, orange, sour orange, and lemons) in 1399 (solar year), according to the Ministry of Agriculture, Irrigation, and Livestock (MAIL).

Key issues of citrus production in Afghanistan are knowledge of planting density, intercropping, varieties suitability, irrigation, marketing problem, picking and post picking, pre mature fruit drop by avoiding low yielding trees.

Objectives

The study has the following objectives:

- 1- To know the extension workers' skills in citrus production management to support self-sufficiency in citrus
- 2- To know the constraints of citrus growers in citrus production
- 3- To give policy recommendations for further improvement in citrus production

MATERIALS AND METHODS

The universe of the present study was Nangarhar Province-Afghanistan as shown in figure1 in December, January 2023. Multi Stage Sampling Technique (MST) was utilized to draw the required sample (Cochran, 1977). At stage I, out of twenty two Districts of the Province Nangarhar, District Bati Kot was selected purposively based on citrus cultivation consisting of 12 villages where 5 villages were purposively selected due to citrus cultivation at stage II. For selection of respondents at village level, a list of citrus growers was obtained from Agriculture Extension Department, which comprised of 200 citrus growers in the selected villages. Proportionate allocation technique was used to select 60% of the citrus growers for data collection, giving a total of 120 respondents. For collection of data, a well-developed interview schedule was used which was prepared in English but the interviews were conducted in local language "Pashto". The collected data was analyzed using Special Package of Social Sciences (SPSS). The results were presented in frequencies/counts and percentages. While Chi-square test was used to find association between different variables whereas, likert scale and rank order were used to assess the expertise of extension worker's capabilities regarding citrus production.



Fig 1: Map of Afghanistan showing the Provinces of Citrus Production

RESULTS AND DISCUSSION

Socio-Economic characteristics of the Citrus Growers

Age of the Citrus Growers

Age plays a significant role in both the ability to learn and comprehend new knowledge and skills along with problem-solving. Those who are older have more experience, with less physical strength than those who are younger in age. According to several reports, people in their early 20s, are more receptive to novel concepts. Several researches has reported that there is a strong relationship between adoption of innovations and age ([Afsar and Idrees, 2019](#)). Figure 2 shows that 31.7% of the citrus growers in the study region were in the age of 40-50 years, 25% of the citrus growers were in the age of 31-40 years, 20% respondents were found to have above 50 years age and 18.3% respondents were in the age of 21-31 years. Whereas only 5% of citrus growers were found under the age of 20 years. It is clear that the age of majority citrus growers were between the ages of 40 to 50 years. Age has a significant impact on modern farming practices which are adopted or rejected. Younger people are more willing to adopt and use innovations (Okwu *et al.*, 2007). As compared to older generations who take longer time for acceptance of new technology (Agwu *et al.*, 2008). Our results are similar with Okwu *et al.*(2007) who told that maximum are older having age of 40-50 year who were reluctant to adopt modern technologies in the study area.

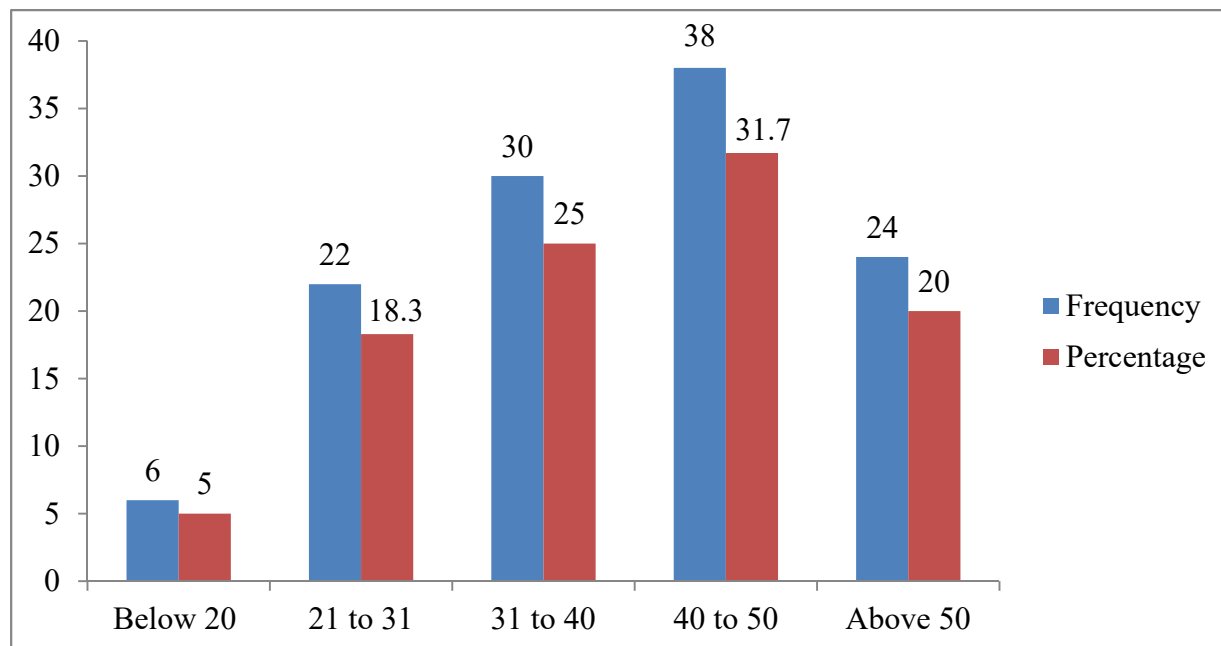


Fig 2: Distribution of the Citrus Growers according to their Age

Literacy Status

Education is regarded as the most important pillar in the growth of nations. Over 90% of people in industrialized countries are literate. Illiterate farmers are less likely to accept new technology because it is difficult to convince them while, literate farmers easily and quickly adopt modern methods (Sanaullah *et al.*, 2020). Education may have an impact on a person's willingness to adopt better farming techniques. An educated person is more likely to stay abreast of the most recent facts and is therefore, regarded to be more aware of agricultural breakthroughs and to approach farming practices more scientifically (Aziz *et al.*, 2018). Figure 3 shows that 55% respondents in the study area were found illiterate and remaining 45% were literate. Among literate, 20% were having primary level of education, 12.5% respondents had middle level of education, 8.3% respondents had matric level of education whereas and about 4.2% of the respondents were educated till intermediate level. These findings are consistent with Doudyal (2006) who found an overwhelming majority (97%) of the respondents as illiterate in his study area.

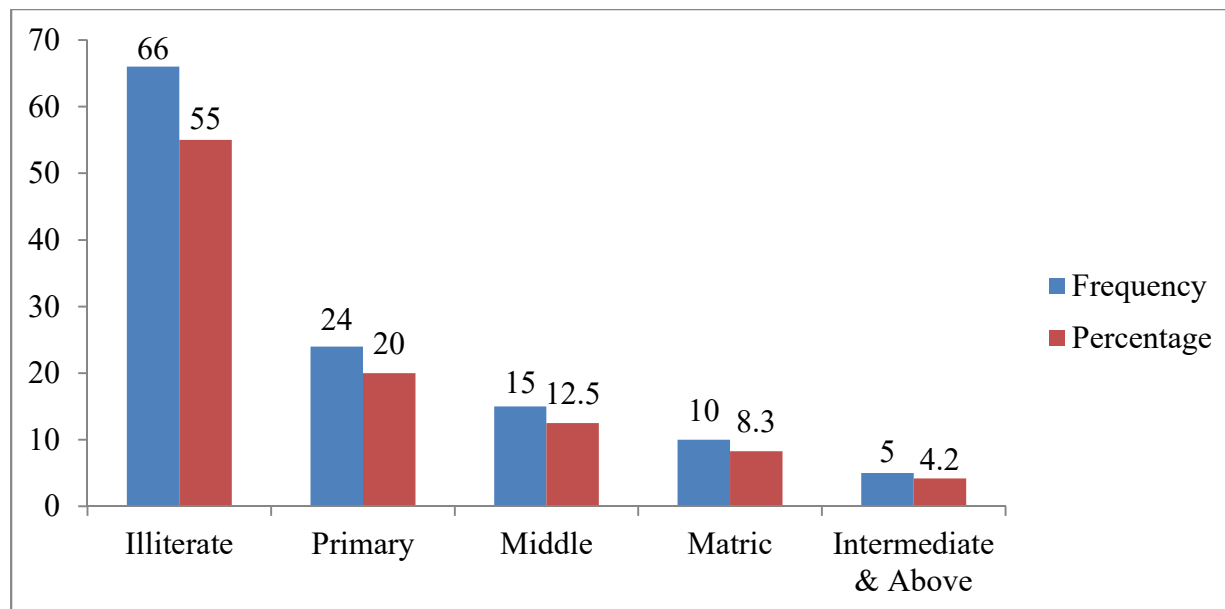


Fig 3: Distribution of Citrus Growers based on level of Literacy

Household Size

As a result of the world's rapidly growing population, there may be a shortage of food and other basic requirements. The population of the world needs to be controlled in order to resolve all these problems. In the adoption process, the size of the household is crucial (Sanaullah *et al.*, 2020). Data presented in figure 4 shows that only 9.2% citrus growers fall in the group of household size with four members, 43.3% of citrus growers have household size with 12 or more members. Furthermore, 20% respondents belong to household size of 5-8 members and 27.5% belongs to the household size of 9-12 members. As said earlier, large household size have a rich number of members by having sufficient persons and they will not require hiring labor for different field hiring activities. Our findings are similar with Ayat, (2014) who found that 38.8% were living in a size of 11-20 members as our results revealed that maximum citrus growers' household size was above 12 members.

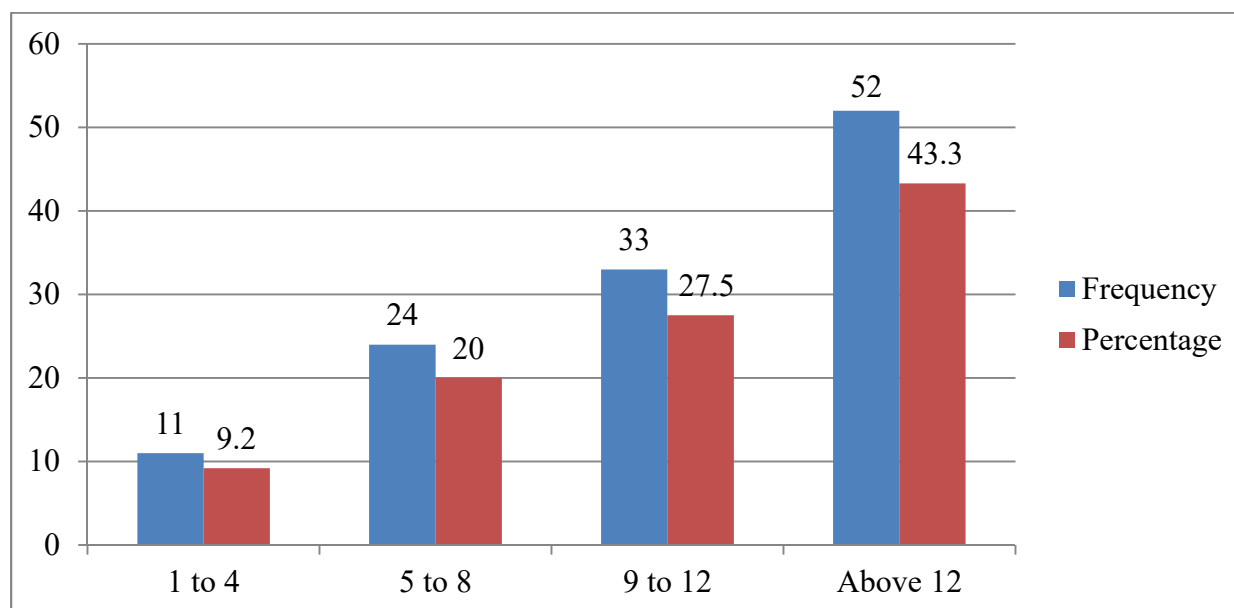


Fig 4: Distribution of Citrus Growers on the basis of their Household Size

Citrus Growers’ Perceptions about the Knowledge of Extension Workers in Citrus Planting Density

When planting the citrus trees, appropriate distance consideration between each tree by special care of row to row and plant to plant distances plays a vital role. This spacing will not only affect the health and growth of each individual citrus tree, but improves the overall yield of the entire row. Generally, citrus trees should be spaced at least 15 to 25 feet away, depending on the specific variety and growing conditions. Larger varieties, such as grapefruit and orange trees, may need more space, while smaller varieties like lemons or limes can be planted closer together. Proper spacing allows for adequate air circulation, sunlight exposure, and root development, while also minimizing competition for nutrients and water. Additionally, adequate spacing can help prevent the spread of diseases and pests, as well as allow for ease of maintenance and harvesting. Data in Table 2 shows that majority (64%) citrus growers revealed about extension workers that they have the knowledge of planting density where 43% citrus growers keep 324 sq. ft. plant to plant distance among their citrus trees, while 21% keep 378 sq. feet distance. This shows a very good trend of the citrus growers who keep the proper plant to plant and row to row distance for proper sunlight and other nutrients required for the growth of citrus plant and fruits. Moreover, maximum extension workers have educated the citrus growers about the planting density of citrus but needs more training in this particular aspect showing a very encouraging trend by the extension workers.

Table 2 Citrus Growers’ Perceptions regarding the Knowledge of Extension Workers about Citrus Planting Density

Villages	Knowledge of Ext. Workers about Citrus Planting Density					Total
	Yes	No	Total	If Yes Distance in Square feet		
				378 sq.ft	324 sq.ft	
Ghaze Abad	26(21.7)	4(3.3)	30	16(13.3)	10(8.3)	26
Shab Diyani	17(14.2)	7(5.8)	24	4(3.3)	13(10.8)	17
Lowarty	19(15.8)	5(4.2)	24	4(3.3)	15(12.5)	19
Anbar Khana	5(4.2)	16(13.3)	21	1(0.8)	4(3.3)	5
Barekab	10(8.3)	11(9.2)	21	0(0.0)	10(8.3)	10
Total	77(64.2)	43(35.8)	120	25(20.8)	52(43.3)	77

Source: field Survey, 2023 at District Bati Kot, Nangarhar-Afghanistan

Number of Plants per Acre

The number of citrus fruit trees per acre depends on several factors, including the variety of citrus, irrigation and fertilization practices. Typically, a range of 80 to 250 trees per acre is common for commercial citrus production (Spreen and Zansler, 2016). Table 3 shows that majority citrus growers (72%) have cultivated 134 trees per Acre, while 28% respondents have cultivated 115 trees per acre. This shows a very positive and creative development in the study area showing their interests in citrus cultivation of spacing which can be sensitized more with the passage of time and more people will be attracted towards citrus cultivation by having a positive and healthy impact of climate as per most burning issue of many nations. The data about the citrus growers regarding the number of trees per is depicted in Table 3.

Table 3 Distribution of Citrus Growers regarding Number of Trees (Acre)

Villages	Trees (Acre)		Total
	134 Trees	115 Trees	
Ghaze Abad	10(8.3)	20(16.7)	30(25)
Shab Diyani	19(15.8)	5(4.2)	24(20)
Lowarty	18(15.0)	6(5,0)	24(20)
Anbar Khana	18(15.0)	3(2.5)	21(17.5)
Barekab	21(17.5)	0(0)	21(17.5)
Total	86(71.7)	34(28.3)	120(100)

Source: field Survey, 2023 at District Bati Kot, Nangarhar-Afghanistan

Citrus Growers’ Information about the Cultivated Varieties

Information about citrus cultivated varieties in an orchard is crucial for maximizing yield and fruit quality aligning with market demand as per need of the community and reducing the risk of crop losses due to pests and diseases. It helps the orchard owners for making informed decisions about selecting the most suitable varieties for their specific climate conditions, optimizing management practices, and ensuring long-term success and profitability. Data in Table 4 illustrates that majority (83%) citrus growers knew the varieties name. However, variety 7007 was cultivated by 30% citrus growers. This is evident that more citrus growers were taking interest in the cultivation of 7007 citrus variety which may be due to safe and higher citrus production as well as less efforts are involved in the cultivation of this particular variety. Our results are at par with Sanaullah (2018) who revealed in his study regarding maize cultivation in District Bajawar Khyber Pakhtunkhwa-Pakistan that maximum maize growers were stick to one and two varieties due to their satisfied production. Data of citrus growers regarding the information of most cultivated varieties are presented in Table 4

Table 4 Information about Cultivated Varieties of Citrus by the Citrus Growers

Villages	Information about Cultivated Varieties of Citrus							
	Yes	No	If yes mention name					Total
			7007	Moro Blood	7009	Navelina	Taraco Galo	
Ghaze Abad	27(22.5)	3(2.5)	11(9.2)	3(2.5)	6(5)	5(4.2)	2(1.7)	30
Shab Diyani	21(17.5)	3(2.5)	7(5.8)	2(1.7)	4(3.3)	2(1.7)	6(5)	24
Lowarty	18(15)	6(5)	8(6.7)	4(3.3)	2(1.7)	2(1.7)	2(1.7)	24
Anbar Khana	17(14.2)	4(3.3)	7(5.8)	1(0.8)	5(4.2)	1(0.8)	3(2.5)	21
Barekab	16(13.3)	5(4.2)	3(2.5)	4(3.3)	3(2.5)	2(1.7)	4(3.3)	21
Total	99(82.5)	21(17.5)	36(30)	14(11.7)	20(16.7)	12(10)	17(14.2)	120

Source: field Survey, 2023 at District Bati Kot, Nangarhar-Afghanistan

Sources of Knowledge of Improved Citrus Varieties to the Citrus Growers

Improved varieties of citrus are essential for the citrus industry as they offer enhanced flavor profiles, disease resistance and improved fruit quality, leading to higher market value and consumer satisfaction. These varieties also contribute to the sustainability of citrus cultivation by reducing the reliance on chemical inputs, increasing crop productivity and expanding the geographic range of citrus production. Data presented in Table 5 shows that among the total growers of citrus, majority (78%) respondents in the study area reported that they know about the varieties of citrus where source of information was agriculture extension agents as per response of 41% citrus growers. The process of variety selection is contingent on scientific principle like soil suitability, topography and climatic variables. The agricultural research and extension departments’ work together for offering solutions to these problems which are most suited to each region's climatic conditions. The trend by the citrus growers to opt for advice of agriculture extension for relying on better production of citrus by knowing the mandate of agriculture extension who work for the betterment of farming community in Afghanistan like all over the world is interesting and healthy showing bright future of citrus production for self- sufficiency. Our results are at par with the results of Tariq (2021) who revealed in his study of maize production in District Shangala of Khyber Pakhtunkhwa Province-Pakistan that 48% of growers were getting maize variety information from extension department and similar results by Sanaullah (2018) who revealed that 59% maize growers in District Bajawar-KP, Pakistan were taking the help of extension department as a source of information for their higher production. The data regarding the sources of information about the improved citrus varieties in the study area is presented in Table 5.

Table 5 Distribution of Citrus Growers regarding the Knowledge of Improved Citrus Varieties

Villages	Knowledge about Improved Citrus Varieties						Total
	Yes	No	If Yes Sources of Information				
			Extension Worker	Media	Input Dealer	Fellow Farmers	
Ghaze Abad	24(20)	6(5)	15(12.5)	2(1.7)	2(1.7)	5(4.2)	30(25)
Shab Diyani	20(16.7)	4(3.3)	10(8.3)	0(0.0)	4(3.3)	6(5)	24(20)
Lowarty	18(15)	6(5)	9(7.5)	4(3.3)	2(1.7)	3(2.5)	24(20)
Anbar Khana	15(12.5)	6(5)	4(3.3)	1(0.8)	1(0.8)	9(7.5)	21(17.5)
Barekab	17(14.2)	4(3.3)	11(9.2)	2(1.7)	2(1.7)	2(1.7)	21(17.5)
Total	94(78)	26(22)	49(40.8)	9(7.5)	11(9.2)	25(20.8)	120(100)

Source: field Survey, 2023 at District Bati Kot, Nangarhar-Afghanistan

Distribution of Citrus Growers regarding the Practice of Intercropping in their Citrus Orchard

Intercropping is the practice of growing two or more crops together in the same field is a popular method for improving soil health and increasing crop diversity in citrus orchards. By planting complementary crops such as legumes, cereals or vegetables between the citrus trees, farmers can reduce soil erosion, improve soil fertility, and enhance overall soil health. Furthermore, intercropping can provide an additional source of income for citrus growers, as the interplanted crops can be sold in the market alongside the citrus harvest. Proper spacing, timing of planting and selection of suitable crops are the essential factors of considerations for practicing of intercropping in citrus orchards. Table 6 shows that the majority of the citrus growers (73%) have practiced intercropping in their citrus orchards. These findings are consistent with (Poudel *et al.*, 2022) who found an overwhelming majority (74.5%) respondents practiced intercropping in his study area. This practice of intercropping shows the interest and skills of the citrus growers along with their concerns in citrus production towards stepping the self- sufficiency in citrus production to Afghanistan. Moreover, it was more encouraging that overwhelming majority is involved in the practice of intercropping by giving better future to the families in the study area of Afghanistan as per data revealed in Table 6.

Table 6 distribution of Citrus Growers involved in the Practice of Intercropping in their Citrus Orchard

Villages	Practice of Intercropping in Citrus Orchard		Total
	Yes	No	
Ghaze Abad	25(20.8)	5(4.2)	30
Shab Diyani	18(15)	6(5)	24
Lowarty	16(13.3)	8(6.7)	24
Anbar Khana	15(12.5)	6(5)	21
Barekab	14(11.7)	7(5.8)	21
Total	88(73.3)	32(26.7)	120

Source: field Survey, 2023 at District Bati Kot, Nangarhar-Afghanistan

Key Issues and Constraints of Citrus Growers in Citrus Farming

Growers have many different challenges during growing of citrus orchard as per usual routine in all agricultural practices. Citrus production is always suffer as a result of these issues and difficulties. Problems having an impact of direct correlation to the production of citrus fruits will have adverse effect on citrus production if the problem ratio is more. Citrus fruits will be produced in large quantities by minimizing the problems related to citrus production. Data in Table 7 illustrates that maximum (49.2%) citrus growers were facing the non-availability of extension field staff issue for technical and scientific guidance where 19% revealed about their non-cooperative attitude of extension department staff as the main issue. About 32% citrus growers faced the non-focus of media on citrus cultivation. Our results are at par with Saddam (2021) who revealed in his results of tomato issues that main issue confronting tomato growers in District Peshawar–Khyber Pakhtunkhwa, Pakistan was non- availability of extension

staff as pointed out by 47.1% tomato growers. This is serious issue of field in any crop or fruits always complained by majorities, which needs to be addressed on urgent basis for bridging the gap of farming communities and extension workers to improve the socio- economic status of them through building the trust among the two pillars of agriculture by bringing self-sufficiency in citrus production.

Table 7 Key Issues and Constraints of Citrus Growers in regarding Citrus Farming

Villages	Key Issues of Information regarding citrus farming			Total
	Non-Cooperative Staff of Extension Department	Non-Availability of Extension Staff	No Focus on Citrus Farming in Electronic Media	
Ghaze Abad	8(6.7)	10(8.3)	12(10)	30
Shab Diyani	4(3.3)	14(11.7)	6(5)	24
Lowarty	3(2.5)	13(10.8)	8(6.7)	24
Anbar Khana	4(3.3)	12(10)	5(4.2)	21
Barekab	4(3.3)	10(8.3)	7(5.8)	21
Total	23(19.2)	59(49.2)	38(31.7)	120

Source: Field Survey, 2023 at District Bati Kot, Nangarhar-Afghanistan

Types of Marketing for Citrus Fruits

The factors that directly affect a farmers' profitability and their ability to generate revenue from a particular crop and fruit is the marketing of the product. As per the past study of Rehman *et al.* (2012) revealed that agricultural marketing is in broadest sense comprises all of the processes involved in moving goods and raw materials from the growers' fields to the final customer or consumer. There are numerous channels along with middlemen among farmers and customers. These middlemen always provide low return to the actual farmer during the selling of the agricultural products. Table 8 demonstrates that the majority (76%) citrus growers in the study area sell their products through middlemen. The middleman is a significant consumer of farmers' income because many citrus growers are unaware about the fruit markets and successful marketing strategies. This exploitation has been in vogue since long and an actual farmer of any produce is suffering which directly affecting the socio economic and self-sufficiency of the farmers in particular while country in general. Special attention is the need of the day to look for this chronic complexity which is faced by overwhelming farming communities in maximum cases in agriculture production during marketing of the product. The data of Citrus marketing problems is shown in Table 8.

Table 8 Marketing Types of the Citrus Growers for Citrus Fruits

Villages	Problems of Citrus Marketing		Total
	Direct Marketing	Through middle man	
Ghaze Abad	10(8.3)	20(16.7)	30
Shab Diyani	4(3.3)	20(16.7)	24
Lowarty	6(5.0)	18(15.0)	24
Anbar Khana	3(2.5)	18(15.0)	21
Barekab	6(5.0)	15(12.5)	21
Total	29(24.2)	91(75.8)	120

Source: Field Survey, 2023 at District Bati Kot, Nangarhar-Afghanistan

Citrus Growers' Perception about Extension Workers' Skills in Picking of Citrus Fruits

Important process in citrus fruits is picking which needs proper knowledge and attention for ensuring the best quality of fruits to be harvested. The proper and best time of citrus fruits' picking of oranges, lemons, limes, and grapefruits is when they are fully ready and have reached to ripe and their optimal flavor and texture. The heavy for

their size with firm texture and free from stains or soft spots as well as brightly colored with sweet, citrusy aroma is the most important criteria for selecting the citrus fruit. The ripening of citrus fruits will continue after they are picked which needs to be stored at room temperature until they are fully ripe. Analysis in Table 9 shows the citrus growers' point of view on ranking skills of extension workers in picking of citrus fruits on the basis of their mean and standard deviation. Skills of forecasting the maturity and yield was ranked on top with highest mean value of 3.47 and standard deviation 1.099 while, collecting and processing of citrus fruits was ranked at the last with lowest mean value of 1.942 and standard deviation 0.853. This reveals that forecasting about maturity and yield of citrus fruit is the fundamental skills of extension workers which were always appreciated by the citrus growers for improve their living standards and self- sufficiency in the study region.

Table 9 Citrus Growers' Perception about Extension Workers' Skills in Picking of Citrus Fruits

Skills regarding Picking of Citrus	1	2	3	4	5	Mean	S.D	Ranks
Forecasting the maturity and yield	7(5.8)	16(13.3)	31(25.8)	46(38.3)	20(16.7)	3.47	1.099	I
Judging proper time for picking	15(12.5)	21(17.5)	43(35.8)	26(21.7)	15(12.5)	3.042	1.184	II
Picking techniques and tools	27(22.5)	37(30.8)	31(25.8)	22(18.3)	3(2.5)	2.475	1.107	III
Collecting and processing of citrus	41(34.2)	50(41.7)	25(20.8)	3(2.5)	1(0.8)	1.942	0.853	IV

Scale: 1= Very Low 2= Low 3= Medium 4= High 5= Very High S.D=Standard Deviation

Citrus Growers' Perception about Extension Worker Skills in Post Picking Processes of Citrus Fruits

Shelf life and postharvest quality of the citrus fruit will depend on some handling practices of postharvest along with their treatments supported after harvest. The findings of Arah *et al.* (2016), handling procedures such as harvesting, pre-cooling, cleaning and disinfecting, sorting and grading, packaging, storage, and shipping were important for sustaining quality and extending shelf life of fruits. The knowledge of post-harvest losses was ranked on top with highest mean 2.767 and standard deviation 1.106 and understanding post-harvest losses during marketing was ranked last with lowest mean value of 2.400 and standard deviation of 1.064. This is obvious from data that the understanding of post-harvest losses during marketing was of little importance for citrus growers as they can manage by their selves, which they do not bother to think about the skills of extension workers' skills in this scenario, while postharvest losses knowledge was of supreme importance for citrus growers which they were expecting from extension workers. Fortunately this knowledge was up to marks and they ranked at top regarding this particular parameter of postharvest losses. The data regarding post picking skills of extension workers as perceived by citrus growers is shown in Table 10.

Table 10 Citrus Growers' Perception about Extension Workers' Skills in Post Picking Processes of Citrus fruits

Skills regarding post picking processes of citrus	1	2	3	4	5	Mean	S.D	Ranks
Knowledge of post-harvest losses	20(16.7)	24(20)	46(38.3)	24(20)	6(5)	2.767	1.106	I
Understanding quality and control measures	21(17.5)	29(24.2)	40(33.3)	22(18.3)	8(6.7)	2.725	1.152	II
Understanding various types of storage	33(27.5)	28(23.3)	34(28.3)	20(16.7)	5(4.2)	2.467	1.181	III
Understanding post-harvest losses during marketing	26(21.7)	43(35.8)	32(26.7)	15(12.5)	4(3.3)	2.400	1.064	IV

Scale: 1= Very Low 2= Low 3= Medium 4= High 5= Very High S.D=Standard Deviation

Association between Average Citrus Yield & Extension Workers’ skills in Picking of Citrus

Chi-square test was used to find out association between average yields of citrus with skills of extension workers in picking of citrus in the study area. Findings in Table 11 showed the highly significant association (p=0.001) between average yield of citrus with skills of extension workers in picking. The results indicated those farmers who ranked extension workers skills in picking as, medium, high & very high obtained high yield as compared to others growers in the study area.

Table 11 Association between Average Yield of Citrus and Skills of Extension Workers in Picking of Citrus

Average yield of citrus (Kg/Acre)	Skills of Extension Worker in Picking					Total
	Very Low	Low	Medium	High	Very High	
Up to 3000	13(10.8)	7(5.8)	6(5)	3(2.5)	1(0.8)	30
3001 to 6000	12(10)	15(12.5)	18(15)	7(5.8)	3(2.5)	55
6001 to 8000	4(3.3)	3(2.5)	6(5)	5(4.2)	3(2.5)	21
Above 8000	0(0)	1(0.8)	3(2.5)	4(3.3)	6(5)	14
Total	29(24.2)	26(21.7)	33(27.5)	19(15.8)	13(10.8)	120
	$\chi^2 = 32.150$ P-value= 0.001***					

Calculated by Author

Note: *** indicates significant at 1 percent level of probability.

Association between Average Yield of Citrus and Literacy Status

The association between literacy status and average yield of citrus in the study area is presented in Table 12. A chi-square test was employed to determine this relationship which revealed a highly significant association (p=0.000) between literacy status and average yield of citrus. Consequently, the research findings suggest that literacy status play a crucial role in citrus production.

Table 12 Association between Literacy Status and Average Yield of Citrus

Literacy status	Average Yield of Citrus (Kg/Acre)				Total
	Up to 3000	3001 to 6000	6001 to 8000	Above 8000	
Illiterate	29(24.2)	36(30)	1(0.8)	0(0)	66
Primary	1(0.8)	14(11.7)	9(7.5)	0(0)	24
Middle	0(0)	5(4.2)	8(6.7)	2(1.7)	15
Matric	0(0)	0(0)	3(2.5)	7(5.8)	10
Intermediate and Above	0(0)	0(0)	0(0)	5(4.2)	5
Total	30(25)	55(45.8)	21(17.5)	14(11.7)	120
	$\chi^2 = 131.47$ P-value=0.000***				

Calculated by Author

Note: *** indicates significant at 1 percent level of probability

Association between Age of the Citrus Growers and the Average Yield of Citrus

The association between age and average yield of citrus in the study area is presented in Table 13. A chi-square test was employed to determine this relationship. The study results revealed a highly significant association (p=0.000) between the age and average yield of the citrus. Therefore, the research findings indicated that education plays a significant role in the production of citrus and as education level increases the yield of citrus also increases and vice versa.

Table 13 Association between Age of the respondents and Average Yield of citrus

Average yield of citrus (Kg/Acre)	Age of the respondents (in years)					Total
	Below 20	21 to 31	31 to 40	40 to 50	Above 50	
Up to 3000	5(4.2)	17(14.2)	8(6.7)	0(0)	0(0)	30
3001 to 6000	1(0.8)	5(4.2)	19(15.8)	25(20.8)	5(4.2)	55
6001 to 8000	0(0)	0(0)	2(1.7)	12(10)	7(5.8)	21
Above 8000	0(0)	0(0)	1(0.8)	1(0.8)	12(10)	14
Total	6(5)	22(18.3)	30(25)	38(31.7)	24(20)	120
	$\chi^2 = 111.023$					
	P=0.000***					

Calculated by Author

Note: *** indicates significant at 1 percent level of probability

CONCLUSIONS AND RECOMMENDATIONS

It is concluded that more than half of the citrus growers were illiterate who belonged to middle age of 31-50 years. Majority citrus growers were found in joint families of 12 members. Most citrus growers have cultivated 134 trees per Acre and maximum were cultivating 7007 variety and practiced intercropping as advised by the agriculture extension department. Non-availability and non-cooperative attitude of extension field staff was the key issue in the study area. Majority citrus growers were exploited by selling their products through the middle man. Extension workers' skills in different aspects of citrus production as perceived by citrus growers was forecasting maturity and yield in picking, while knowledge of post-harvest losses in post picking was top ranking skills, while collecting and processing of citrus fruits and understanding post-harvest losses during marketing was ranked at last with the lowest mean values and standard deviations. Highly significant association existed between average yields with extension workers skills in picking of citrus fruits, age and literacy status leading to self-sufficiency of Afghanistan.

It is recommended that:

- Agriculture Extension Department may distribute free of cost citrus varieties to encourage citrus orchards.
- Agriculture extension department may ensure the availability of their staff in the field and train them in their attitude with the farming communities which are the real stake holders.
- Citrus is a highly cash crop, so youth should be trained for provision of job facilities in citrus production to control them to spent their life fruitfully and efficiently and control them from illegal immigration. More formal trainings regarding different aspects of citrus cultivation and production may be arranged by Extension Department for motivation of more farmers towards citrus farming on large scale and sustainable basis
- Researches should be encouraged for varieties' suitability for particular area of the region for their higher production.
- Drip irrigation system may be introduced in citrus growing areas of the province to increase and encourage citrus production in the province on sustainable bases to bring self-sufficiency in citrus production.
- Industries should be encouraged for preparation of various beverages, canned juices, juice concentrates, squash, juice powder, crush, jam, pickles and carbonated beverages to preserve and save citrus fruits for increasing the economy of the country.
- The identified issues in citrus cultivation and production needs to be resolved on urgent basis by upgrading the skills of extension workers in the weak areas as highlighted in the study trough provision of in-service training and refresher courses.

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