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INVESTMENT DECISION IN CITRUS ORCHARDS OF PUNJAB, PAKISTAN: A SOCIOECONOMIC AND FINANCIAL PERSPECTIVE

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ABSTRACT

Agriculture is the primary source of employment, food, and money for rural communities and is vital to emerging nations' economies. Citrus ranks first among fruits in area and production in Pakistan, and Kinnow is only cultivated in Punjab province. The current study aimed to assess the production cost, factors affecting citrus yield, and financial appraisal of long-term investment in citrus orchards. A well-structured and pre-tested questionnaire using a simple random sampling technique was used for primary data for 2022-23. The study was confined mainly to Layyah, Bhakkar, Sahiwal, and Toba Tek Singh districts because of the newly emerging citrus-growing areas of Punjab. Findings indicated that citrus orchard output begins in the fourth year and continues unabated until 30 years. It hit a peak in the year 20. The net present value was $ 1507 per acre, demonstrating that citrus farming produces higher returns. The benefit-cost ratio of 1:16 indicates citrus production is a profitable enterprise. Return on investment in the citrus orchard was 20 percent, and the payback period was observed as 4th year. Regression analysis revealed that orchard size, citrus growing experience, contact with extension agents, and education level had positive and significant impacts on yield. The study concludes that investment in citrus orchards has provided favorable returns to farmers. To promote citrus production, the role of agricultural extension departments should be strengthened, and agricultural extension employees should have better training in the most recent scientific citrus discoveries and techniques. Awareness should be created among citrus growers through formal and informal education as literate farmers respond quickly to adopting innovation and interventions.

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INTRODUCTION

Agriculture is the primary source of employment, food, and money for rural communities and is vital to emerge nations' economies. It plays a vital role in the economy of Pakistan by contributing 22.9 percent to the GDP and 37.4 percent to the labor force employment. The growth rate in agriculture showed a fluctuating trend with 1.55 percent during 2022-23 (GOP, 2023). Regarding global fruit output, citrus is the most widely grown fruit crop. The total production of the world citrus industry stands at 124.5 million tons and is being cultivated on an area of 8.7 million hectares. The major citrus-producing countries are Brazil, China, the United States, Mexico, India and Spain, contributing about 2/3 of the world's citrus production (FAO, 2017). Globally, total orange and know production stand at 66.9 million tons and 32.9 million tons, respectively. In 2016, the total world citrus trade was 30.9 million tons (FAO, 2016). Brazil is the largest grower of citrus, producing 19.2 million tons. Global orange juice production is 1.6 million tons. Brazil's orange production is 16 million tons, and orange juice production is 1 million tons. Due to favorable weather conditions, China is the largest kinnow producer, having an annual production of 21.2 million tons. World grapefruit and lemon production are 6.6, and 7.7 million tons, respectively, and Argentina and Mexico are leading in lemon production (FAO, 2018). Citrus ranks first among fruits in area and production in Pakistan, and Kinnow is only cultivated in Punjab province. In Pakistan, citrus was cultivated in an area of 206 thousand hectares, with a total production of 2.3 million tons in 2016 (FAO, 2017). Globally, Pakistan ranked 36th in production and 56th in exports of citrus commodities (FAO, 2016). Pakistan exported fruit worth 641$ million in the fiscal year 2015-16. Citrus cultivars are grown in different quantities in tropical or subtropical climates. Punjab harvests over 98 percent of the crop because of its favorable conditions and ample water supply.

Among all citrus fruits, kinnow is a significant exportable good and a source of income from foreign exchange. Kinnow can be kept at 4-5 °C with 85-90 percent relative humidity for 8 to 12 weeks without chilling injury (Singh et al., 2004). During 2015-16, Kinnow's exports from Pakistan were 372.1 thousand tons, worth Rs.17.78 billion and significant markets for Pakistani exports are Mauritius, Philippines, Oman, Azerbaijan, and Afghanistan (TDAP, 2016). When compared to other developed citrus-growing nations, citrus productivity in Pakistan is low because of several factors, including poor nutritional management, a lack of disease-free planting material, unneeded premature fruit drop, abnormal fruit growth, significant yield variations, a lack of organic matter in the soil, a lack of access to good quality water, and pest and disease attack. (Lahey et al., 2004). The citrus industry is underdeveloped, growers are not informed about emerging industries, middlemen are taken

advantage of, there is a shortage of skilled labor, harvesting, transportation, packing, and storage are poorly managed, there are insufficient facilities for research and development, and there are no internationally recognized labs available (Khan, 2010).

Pakistan's citrus yield per hectare is lower than other citrus-growing countries worldwide. Pakistan's average citrus yield is 12.60 tons per hectare (GOP, 2006), and the potential yield of citrus in Pakistan is 17-20 tons per hectare (PHDEB, 2006). In 2008, Pakistan Citrus's yield was 10.6 tons per hectare, whereas in Brazil, 22 tons and USA 34 tons (FAO, 2008). Excessive pre-harvest fruit drop also depends on factors such as high temperature, water shortage, insect/pest attack, and wind speed in particular areas (Ibrahim et al., 2007). The quality and yield of citrus can be improved using the best management methods. Moderate nutrients can improve fruit biochemical quality, size, and flowering (Papadakis et al., 2005). Citrus growers cannot ignore the impact of macro- and micronutrients on plant health. They must prioritize a balanced diet of nutrients (Razi et al., 2011). At various physiological stages, nutrients that are necessary for growth are needed. Compared to micronutrients, macronutrients are needed in more significant quantities. With the balanced use of fertilizer, farmers can get better crops with more yields (Abd-Allah, 2006). Citrus yield is badly affected due to a deficiency of micronutrients. The lack of micronutrients in developing nations is receiving more attention (Graham and Welch, 2000).

Establishing the citrus orchard required considerable investment, and its return continued for around four decades. The financial analysis of investment in the citrus orchard and the factors affecting the yield will help the farmers regarding their decision to establish a citrus orchard. However, in the study area, no research provides information to the farmers regarding financial analysis and the factors affecting their yield. Therefore, this novel research will help the farmers decide to invest in the citrus orchard and the return they may receive. So, this study was conducted to assess the cost of growing citrus orchards, factors affecting citrus yield, and financial appraisal of long-term investment in citrus orchards. The study also provides policy suggestions based on the findings.

METHODOLOGY

In terms of output and land area, the province of Punjab in Pakistan is the country's leader in citrus cultivation. There are ten administrative regions and 36 districts. The current research employed a multi-stage purposive sampling strategy to choose districts, tehsils, and villages randomly. Throughout much of Punjab, you may find citrus orchards. The selected areas, however, are rapidly becoming one of the provinces of Punjab's most important agricultural hubs for citrus. The focus of the study relates to the economic analysis of citrus. To do this, essential information was gathered from citrus farmers. The four districts (Sahiwal, T.T. Singh, Bhakkar, and Layyah) were chosen to collect primary data through a well-structured questionnaire. The pre-testing of the questionnaires also took place before the actual data collection. Primary data was gathered through in-person interviews utilizing a piloted survey out in the field. Some of the citrus growers we surveyed had a poor track record of keeping financial documents relating to their orchard expenses and profits. Therefore, the farmers' memories formed the basis of the data collection. All costs associated with creating and maintaining the citrus grove were included in the statistics. We decided on a tabular format for the data to analyze the distribution of inputs, outputs, costs, and revenues among the sampled farmers.

Financial Appraisal Analysis

The potential returns from planting citrus orchards have been calculated. The present research evaluated the investment choice by computing the payback period and the capital return. The payment method is open and can be relied on when deciding whether or not to invest in a given project. This method allows projects to be sorted according to their 'payback' level. Support for earlier payment initiatives is standard, while preference for slower payment schemes is less common. The rate of return on capital invested is another factor that can be considered. To estimate the actual return on investment, this method first subtracts the tax allowance before figuring out the depreciation. In addition, the Discounted Cash Flow (DCF) analysis provides two more advanced methods i.e., Net Present Value (NPV) and Internal Rate of Return (IRR). In this study, the current interest rate was employed for convenience as the discount rate. This is supposed to be positive and will range from zero to 12.25% in future interest rates.

Net Present Value (NPV)

According to the NPV method, an asset has monetary worth if its expected return exceeds the initial investment. Projects with negative NPVs are deemed economically illegitimate, and the NPV Method selects those with positive NPVs. The NPV of an investment is the sum of its expected future cash flows after deducting all costs.

$$NPV = \sum_{t=1}^{n} \frac{Y_i}{(1+r)^t} \quad (1)$$

Where,

Yi = net cash inflows in the year 'n'

r = yearly discount rate (fixed up to the life of the project)

t = years of life period 1, 2……. n.

Internal Rate of Return (IRR)

An investment's net present value (NPV) is set to zero at the internal rate of return (IRR). Internal Rate of Return (r) value satisfies that:

$$IRR = \sum_{t=1}^{n} \frac{Y_i}{(1+r)^t} = 0 \quad (2)$$

This method uses an internal rate of return (IRR) greater than the current market interest rate as a criterion for making investment decisions.

Cost and Revenue Analysis

The term "fixed costs" (FC) is used to refer to those expenses that remain constant during manufacturing, while "variable costs" (VC). Costs associated with setting up a citrus grove before fruiting begins are factored into the FC. Land preparation, planting, maintenance, and equipment expenses are substantial. Costs associated with crop management include ploughing, planting, building, and leveling fruit trees. Additional components of fixed expenses include government levies, land lease payments, and profit margins. In addition to purchasing and maintaining agricultural equipment and paying wages to year-round employees, the various expenses incurred daily are also included in FC.

On the other hand, the expenses associated with grading, ploughing, planking, FYM, planting supplies, fertilizer, insecticides, and pesticides are all elements of variable cost. In addition, VC includes the costs associated with hiring temporary workers for inter-cultivation, spraying, irrigation, handling, management procedures, and transportation of the product. The capital invested during a crop's production cycle is known as its "production budget," It varies from one crop to the next.

To do a benefit-cost analysis, one must compare the discounted cash flows into and out of a project (costs and benefits). The following formula was used to determine the BCR:

$$BCR = \frac{\sum_{t=1}^{n} \frac{B_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+r)^t}} \quad (3)$$

Where C_t is the costs, and B_t, is the benefits.

Pay Back Period (PBP)

The time it takes a project to recoup its initial investment is called its payback period. It is the period during which the investment generates a net cash flow equivalent to the initial investment. The present research evaluated the PBP by deducting the outlay for initial investment from the net cash flows until the initial outlay is repaid in full.

Equivalent Annual Annuity (EAA)

The estimated useful life of citrus orchards was calculated using EAA methodology. The EAA for a given time period of 'n' years is the discounted amount of the constant annual cash flow that would be received if the discount rate ('r') were applied to the entire amount ('p'). The complete economic history of citrus was modeled as an annual cash flow forecast. Orchard economic life cycles are defined by the year with the largest cash flow, followed by years with declining cash flow (Meikle, 1991). In order to get an approximation, a formula was used:

$$EAA = \frac{\text{Present Value}}{\sum (\text{Discount Factors})} \quad (4)$$

Cost of Production

Different cost components were as under and variables are given in Table 1.

TC=

V1P+V2Lp+V3Wd+V4FYM+V5Fr+V6Mn+V7H+V8Pr+V9Pe+V10Ir +V11Lb+V12Ht (5)

Table 1. Description of variables.

P= Plantation	V1= Plantation cost
Lp= Land Preparation	V2= Land preparation cost
Wd= Weedicide	V3= Market price of Weedicide
FYM= Farm Yard Manure	V4= Market price of FYM
Fr= Fertilizer (NPK)	V5= Market price of Fertilizer
Mn= Micronutrient	V6 = Market price of Micronutrient
H= Hoeing	V7= Hoeing cost
Pr= Pruning/Trimming	V8= Pruning/Trimming cost
Pe=Pesticide/Fungicide	V9= Price of Chemical use
Ir= Irrigation cost (Tube well + Canal)	V10= Price of tube well & Canal
Lb= Labor	V11= Wage rate
Ht= Harvesting	V12= Harvesting Cost

Factors Affecting Citrus Yield

The Cobb-Douglas production function model, which assesses the actual contribution of every factor affecting yield positively or negatively, was used to analyze the impact of factors on citrus yield (Hassan et al., 2012). The Cobb-Douglas production type method was also used by Khushk et al. (2008) to estimate the relationship between input and output in citrus processing.

Regression analysis

The factors that impact citrus production were evaluated by multiple regression analysis. This technique is often used to determine which independent variables correlate with the dependent variable and the shapes of these interactions. In addition, measuring is affordable and uncomplicated to employ as a substitute for costlier or time-consuming tasks. The benefit is that the reaction levels are correctly specified according to a few controllable conditions.

The Cobb-Douglas Production Function (CDPF) was estimated using the Ordinary Least Square (OLS) method. This function may make use of a wide variety of manufacturing elements. It may also be used to deal with econometric estimating issues, including multicollinearity, heteroscedasticity, and autocorrelation, as well as the fact that production size might vary from rising to decreasing to remaining constant. Ability is represented in addition to the benefits of adaptability, parsimony, and explicit uniformity (Bhanumurthy, 2002; Zellner et al., 1996). Regression analysis was utilized by Hassan et al. (2012) and Khushk et al. (2008) to determine the factors that influence citrus output.

This work utilized a log-linear multiple regression model to analyze how different farm-level and macroeconomic variables affect citrus harvest production. This is the study's underlying model:

$$\ln y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + \in \quad (6)$$

Where,

ln y: Citrus per acre yield (Kg)

x_1: Farming experience of citrus cultivation (years)

x_2: Education (years)

x_3: Acreage under citrus (acres)

x_4: Age of citrus plants (years)

x_5: Distance from fruit and vegetable market (km)

x_6: Dummy Extension services (if yes =1 otherwise = 0)

$\in$: Error term.

b_0: Constant

b_1, b_2,....., b_6 are parameters of the model.

RESULTS AND DISCUSSION

Descriptive Statistics

Generally, citrus production recorded a handsome increase from 2011 to 2018 (Table 2). There is an increasing trend in overall citrus production in these districts, from 315.4 thousand tons in 2011-12 to 400.3 thousand tons in 2017-18. The area in these districts almost remained stagnant during this period. Citrus cultivation is being initiated in these areas of Punjab as production in the old areas is decreasing due to the prevalence of diseases and low productivity (Fateh *et al.,* 2017).

Socio-Economic Characteristics and Farm Particulars of Citrus Growers

It was noted that the farmers' average age was 44 years, while up to 25 years of age, there were 8 percent farmers, 31 percent were aged between 26-40 years, and 55 percent were between 41-60 years (see Table 3). The general education of the farmers was seven years of schooling. Fourteen percent were illiterate, 24 percent had up to 5 years of schooling, 44 percent matriculated, and 18 percent were above matric. On average, 25 years of farming experience were observed among the sampled farmers. However, 19 percent had farming experience of up to

10 years, and 23 percent had 11 to 20 years of farming experience. There were 28 percent of farmers had 21 to 30 years, and 30 percent had over 30 years of farming experience. However, the citrus growing experience had a different picture, and it was observed that almost half of the farmers had up to 10 years of citrus growing experience. Out of the remaining half, 39 percent had 11 to 20 years of experience, 10 percent had 21 to 30 years, and 4 percent had above 30 years of citrus growing experience. The farmers were categorized as per their operational land holdings, i.e., up to 5 acres, 5.1 to 12.5 acres, and above 12.5 acres, and considered as small, medium, and large farmers. It was observed that 16 percent were small, 40 percent medium, and 44 percent large farmers, respectively. The average land holding in the study area of the sampled farmers was estimated to be 16 acres. Similarly, the situation was slightly different in the case of citrus orchard size out of total operational landholding. Thirty-eight percent were small, 39 percent medium, and 23 percent large farmers. The average size of the citrus orchard among the target farmers in the study area was 10 acres.

There were different farm characteristics of the citrus farmers, and it was observed that a variety of soil types was found in the study area. Soil type is essential for citrus cultivation and productivity as all soil types are not suitable for citrus. The clay soil was found on the farms of 6.7 percent of farmers, 37 percent had loamy soil, 19 percent had sandy soil, 17.5 percent had clay loam, and 19 percent had sandy loam soil on their farms. The farmers inquired about their soil quality, where 71 percent thought their soil was suitable for citrus production, 26 percent were satisfied with the citrus orchard, and 2 percent considered it poor. Similarly, salinity and waterlogging were not found to be high in the study area (Table 4).

Table 2. Comparison of area and production of citrus in project districts during different time period.

Districts	2011-12		2015-16		2017-18	
	Area(ha)	Production(T)	Area(ha)	Production (T)	Area(ha)	Production(T)
T.T. Singh	11412(6)	160758(7)	11819(6.5)	205991(9.8)	12015(6.6)	249315(10.9)
Sahiwal	8253(4)	92413(4)	7623(4)	95834(4.5)	7594 (4.1)	89246 (4)
Layyah	4473(2)	39799(2)	4478(2.5)	42208(2)	4480 (2.4)	43311(1.9)
Bhakkar	2309(1)	22461(1)	1815(0.9)	18089 (0.8)	1798 (0.9)	18472(0.8)
Total	26447(13)	315431(14)	25735(13.9)	362122(17.1)	25887(14)	400344(17.6)

Source: Fruit, Vegetables and Condiments Statistics of Pakistan 2019. Figures in parenthesis show the percentage.

Table 3. Summary characteristics of descriptive tools (continuous variables).

Variables	Description/Group	Frequency	%age	Mean
Age (Years)	Up to 25	33	8	22.93
	26 to 40	122	31	34.72
	41-60	219	55	50.23
	Above 60	26	6	64.69
	Overall	400	100	44.19
Education Level	Illiterate	58	14	0
	Up to Primary	98	24	4.89
	Up to Matric	173	44	9.09
	Above Matric	71	18	12.83
	Overall	400	100	7.44
Farming Experience (Years)	Up to 10 years	77	19	6.97
	11 to 20	91	23	17.18
	21 to 30	112	28	24.84
	Above 30	120	30	37.13
	Overall	400	100	25.01
Citrus growing experience (Years)	Up to 10 years	186	47	7.02
	11 to 20	156	39	15.7
	21 to 30	42	10	23.73
	Above 30	16	4	30
	Overall	400	100	12.43
Farm Land Holding (Acres)	Small (up to 5 acres)	65	16	3.06
	Medium (5.1 to 12.5)	159	40	8.43
	Large (above 12.5)	176	44	28.32
	Overall	400	100	16.62
Orchard Size (Acres)	Small (up to 5 acres)	154	38	2.56
	Medium (5.1 to 12.5)	156	39	7.65
	Large (above 12.5)	90	23	24.46
	Overall	400	100	10.33

Source: Field Survey, 2022.

It was observed that most farmers were using canals and groundwater simultaneously, i.e., 59 percent. Fewer citrus growers, i.e., 15 percent, use only surface water, while 26 percent irrigate their orchards with groundwater. The issue of groundwater quality is not severe in the study area as 95 percent of farmers have fit to marginal fit tube well water. It was observed that water-saving technologies or high-efficiency irrigation systems are not prevalent among the sampled farmers. Most of the farmers (89 percent) used traditional flooding irrigation. Almost all the farmers had access to farm mechanization and cultivation of their land through tractors. It was observed that 30 percent of farmers had access to carpet roads, while 59 percent had access to the metal road. Around 90 percent of farmers had their own land, while 10 percent were doing business using rented land (see Table 4).

Table 4. Summary characteristics of descriptive tools (categorical variables).

Variable	Item (Dummy)	Frequency	%age
Soil Type	Clay	27	6.75
	Loamy	148	37
	Sandy	76	19
	Clay Loam	70	17.5
	Sandy Loam	76	19
	Other	3	0.75
	Overall	400	100
Soil quality	Good	287	71.75
	Satisfactory	104	26
	Poor	9	2.25
	Overall	400	100
Salinity	High (75%Area)	1	0.25
	Medium (25 %< 75%)	84	21
	Low (Below 25%)	315	78.75
	Overall	400	100
Water Logging	High (75%Area)	0	-
	Medium (25 %< 75%)	21	5.25
	Low (Below 25%)	379	94.75
	Overall	400	100
Source of Irrigation	Tube well	104	26
	Canal	61	15.25
	Canal + Tube well	235	59
	Overall	400	100
Quality of Ground Water	Fit	229	57.25
	Marginal Fit	153	38.25
	Unfit	18	4.5
	Overall	400	100
Method of Irrigation	Flood	356	89
	Drip	0	-
	Furrow	44	11
	Overall	400	100
Source of Power	Tractor	374	93.5
	Animal	4	1
	Tractor + Animal	22	5.5
	Overall	400	100
Main Road Condition	Kacha	21	5.25
	Gravel	30	7.5
	Metal	227	56.75
	Carpet	122	30.5
	Overall	400	100
Land ownership	Own	354	88.5
	Rented	42	10.5
	Other	4	1
	Overall	400	100

Source: Field Survey, 2022.

Financial Appraisal Analysis of Citrus Orchards

Establishment and Maintenance Cost

The prevailing prices of inputs and wages of labor were used to compute the establishment and maintenance cost of citrus orchard per acre. Table 5 portrays the details of the various costs of establishment and maintenance. There are three years required for the establishment of citrus. The land rent, land preparation cost, and planting material are the investment costs of citrus orchard establishment. However, labor engaged in different operations, the material price, and fixed costs throughout the maturation phase are the maintenance costs of citrus orchard establishment. In the first year, expenses were taken into account, and maintenance costs were covered for the second year up to the fruit-bearing point. The cost of land preparation or ploughing was Rs. 5068 for the first year and constantly decreased until the 10th year but after that 11th to the 30th year was Rs. 3997. The reason behind this was that as the orchard gets more and more maturity, it has more weeds that require intensive ploughing. Similarly, this cost was also for the next two decades, i.e., years 21-30 (Rs. 5100 and year 31-40 (Rs. 5980), respectively (Table 5).

Farm Yard Manure (FYM) is indispensable to preserving citrus orchards' fertility and nutrient level. The sampled growers used FYM with a gap of one to two years to improve the orchard's productivity. During field visits and Focus Group Discussions (FGDs), it was noted that citrus orchards significantly attack weeds and unbeneficial plants. To avoid these attacks, farmers practiced hoeing. The hoeing cost for the 2nd year was Rs. 940, which remained fixed until the 7th year. However, in (8-12 years) of the citrus orchard, it was Rs. 1850. It increased from Rs. 1850 to Rs. 2550 from 13-40. The fertilizer applied by the sampled growers in the citrus orchard was NPK. NPK cost from the 13th to 20th year and until 30 years was Rs. 15250. However, for the last decade (31-40 years), fertilizer cost has risen to Rs. 17770 per acre (Table 4).

The sampled farmers were applying micronutrients to sustain the fertility of the soil. The expenditure on these minerals for the 1st year was Rs. 1630 and for 21-40 years Rs. 3885, respectively. The sampled citrus orchards were the victims of gigantic insect and pest attacks. Farmers apply pesticide sprays throughout the year at frequent intervals to control these attacks. These expenses were calculated as Rs. 7880, 7500, and 7250 for the age bracket of a citrus orchard of 13-20, 21-30, and 31-40 years, maintenance. The decline in the pesticide cost was due to a diminishing return with the increasing age of the orchard, and the growers focused less on the maintenance cost. Pruning operation is done to maintain the canopy of the citrus tree. There was no expenditure until the 4th year of the establishment of the citrus orchard as plants were small during this period. The pruning cost from 6-12 years was Rs. 4618 per year. However, there was an increase in pruning costs from 13-20 years (Rs. 5250), 21-30 years (Rs. 5500), and 31-40 years (Rs. 5850). The citrus orchard needs frequent irrigation. The mean expenditure on tube well irrigation from the first year until the boom period was Rs. 5314. On the other hand, water charges (abyana) per year for canal irrigation were Rs. 400 per annum (Table 5).

Picking and packaging of citrus fruit involve labor on an almost daily basis during the seasons of citrus fruiting. The citrus orchard starts fruiting in the fourth year of establishment. From 4-20 years, there is an increase in the cost of labor engaged in picking and packing as orchards become more and more mature, yielding more fruit requiring higher labor. The maximum expense of picking and packing was during the boom period (Rs. 58,950), and after that, it declined continuously as the yield per acre diminished. Most of the growers were using wood cartons of weight 10 kilograms for packaging citrus fruit. The pieces of newspapers and straw were also used in the wood boxes to avoid fruit loss during transportation. Most of the farmers were selling the citrus fruit in food and vegetable markets located away from the production centers. The transportation cost starts from the fourth year (Rs. 11,200), increases every year, reaches a maximum (Rs. 31,800), and then again declines up to 31-40 years (Rs. 14,000). The land rent of the citrus orchard per acre was Rs. 30000 during the first year of establishment, and it remained the same throughout 30 years. The total cost of production of various establishment and maintenance operations during the first year was calculated at Rs. 61,5994, which increases till the 20th year (Rs. 193,405) and then starts to decline (Rs. 133,958) to the end of the citrus orchard life (Table 5).

Table 5. Investment and maintenance cost of citrus orchard.

Particulars	Year										
	1	2	3	4	5	6	7	8-12	13-20	21-30	31-40
Plantation	11987										
Land Preparation /Ploughing	5068	3523	2978	2978	2978	2978	2978	2978	3997	5100	5980
FYM	3139	2834	2939	2939	2958	3206	3206				
Hoeing		940	940	940	940	940	940	1850	2550	4235	5230
Fertilizer (NPK)	4995	8500	8500	9800	10940	10940	10940	12500	15250	15250	17770
Micronutrients (Zinc. Etc.)	1630	1885	2395	3307	3307	3307	3307	3307	3307	3885	3885
Pesticide/Fungicide		4332	4826	6550	6880	6880	6880	7200	7880	7500	7250
Pruning				1169	4682	4618	4618	4618	5250	5500	5850
Irrigation	4775	4918	5263	5749	5749	5749	5749	5749	4918	4918	4918
Labor Picking				13500	16500	21250	28000	29750	33450	19600	18750
Labor Packaging				9800	14250	22250	24500	28000	25500	16800	14000
Transportation				11200	19600	22400	25200	28000	31800	15000	14000
Packaging Material				15680	24780	31360	35280	35280	39860	23520	19600
Water Charges (Abyana)	400	400	400	400	400	400	400	400	400	400	400
Rent per acre	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000
Total Cost	61994	57332	58241	114012	143964	166278	181998	189632	204162	151708	147633

Financial Feasibility of Investment in Citrus Orchard

To evaluate the viability of investing in the citrus sector, the current study examined many financial indicators, including Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR), Payback Period (PBP), and Equivalent Annual Annuity (EAA).

Net Present Value (NPV)

Over the economic lifetime of the citrus orchard, the present value of cash inflows (revenue/returns) is subtracted from the present value of cash outflows (costs/expenditures) to arrive at the Net Present Value (NPV). Results showed that the tested citrus had an NPV of Rs. 182,912 per acre at a discount rate of 12.25 percent (Table 7). Since citrus trees don't begin blossoming for another four years and maintenance costs must be spent annually with no return from intercropping, research conducted by Sharif et al., (2009) in district Sargodha showed a negative cash flow up to the fifth year. After the fifth year, the cash flow is positive. Between the sixth and thirtieth years, cash flow never drops. From age 50 and beyond, income drops steadily. When figuring up NPV, cash flows were discounted at an inflation-adjusted rate. Net Present Value of 194193 Rupees was calculated. However, Sari and Putri (2020) estimated an NPV of IDR 51,809,117. NPV of 71,599,830 was estimated by Fauzi et al. (2021).

Internal Rate of Return (IRR)

Investing in a citrus grove can be profitable or unprofitable, depending on the Internal Rate of Return (IRR). An internal rate of return of 20% was determined for this study, suggesting that planting a citrus grove in the region under consideration would yield a positive financial return (Table 8). An IRR of was estimated at 34% by Sharif et al. (2009) and 37% by Sari and Putri (2020). An IRR of 20.23 percent was estimated by Fauzi et al. (2021).

Benefit Cost Ratio (BCR)

Investment returns per rupee in the citrus grove were calculated using the benefit-cost ratio (BCR). Long-term investment in the citrus business is viable. The BCR was 1.16 at a discount rate of 12.25 percent (See Table 8). As a result, the farmer should be encouraged to expand into this lucrative business to make more than the cost of production. According to research conducted by Porwa (2012) in the Jhalawar area of Rajasthan, the benefit-cost ratio and net present value of a citrus orchard are, respectively, 2.38 and $2.75 million. Moreover, Sari and Putri (2020) estimated a BCR of 1.92. In addition, the BCR was 1.47 (Fauzi et al., 2021).

Pay Back Period (PBP)

The citrus business's Pay Back Period (PBP) is when it has made a profit after incurring expenses. The present analysis found that the PBP needed to be six years to recoup the original cost. However, this metric does not account for producers' net cash flows in years eight and beyond, which might be especially important in the case of a long-term industry like citrus. According to the data, farmers should expect a profit from their citrus groves beginning in the sixth year (Tables 7 & 8). PBP was 5 years according to the findings of Fauzi et al. (2021).

Equivalent Annual Annuity (EAA)

The issue of replacements frequently arises with agricultural goods, especially in orchards. Growers, company owners, and entrepreneurs who plan to increase their spending in the citrus industry should familiarize themselves with the orchard's daily operations. Orchards might be unprofitable for farmers, but they still have options. Will a replacement orchard be planted, or will the existing one be razed? Second, are they obligated to pay for other businesses' coverage? To put a number on this orchard's economic lifespan, we may estimate its breakeven cash flow using an EAA (Meikle, 1991).

Table 6 depicted the cash flow analysis of citrus orchards per acre, which included cash outflow, cash inflow, net cash flow, and discounted net cash flow of forty years.

The data provided by EAA is quite helpful. EAA gives valuable data to aid decisions about future investments in this area (Table 7). A negative EAA was seen for the first five years, but after that, it began to rise and eventually reached its highest point by the twelfth year. After this period, there was a general decline in citrus output, producing less EAA. Even if the cash flow is positive until year 40, the output quality will be low, and the maintenance cost will be high (See Tables 6 and 7).

Table 6. Cash flow analysis of citrus orchards (per acre).

Year	Cash Outflow	Cash Inflow	Net Cash Flow	Discounted Net Cash Flow
1	61994	0	-61994	-55228
2	57332	0	-57332	-45501
3	58241	0	-58241	-41178
4	114012	90078	-23934	-15075
5	143964	119000	-24964	-14008
6	166278	189000	22722	11358
7	181998	213450	31452	14006
8	189632	254800	65168	25854
9	189632	254800	65168	23033
10	189632	291200	101568	31981
11	189632	311780	122148	34263
12	189632	311780	122148	30524
13	204162	311780	107618	23958
14	204162	311780	107618	21344
15	204162	311780	107618	19014
16	204162	311780	107618	16939

17	204162	311780	107618	15090
18	204162	311780	107618	13444
19	204162	311780	107618	11976
20	204162	311780	107618	10669
21	151708	228500	76792	6782
22	151708	228500	76792	6042
23	151708	228500	76792	5383
24	151708	228500	76792	4795
25	151708	228500	76792	4272
26	151708	228500	76792	3806
27	151708	228500	76792	3390
28	151708	228500	76792	3020
29	151708	228500	76792	2690
30	151708	228500	76792	2397
31	147633	192750	45117	1254
32	147633	192750	45117	1117
33	147633	192750	45117	995
34	147633	192750	45117	887
35	147633	192750	45117	790
36	147633	192750	45117	704
37	147633	192750	45117	627
38	147633	192750	45117	558
39	147633	192750	45117	497
40	147633	192750	45117	443
Total				182912

Source: Field Survey, 2022.

Table 7. Optimal economic life of citrus orchard.

Year	Net Cash Flow	NPV	Discount Factor	EAA
1	-61994	-55228	0.891	-61984.9
2	-57332	-45501	0.794	-57306.5
3	-58241	-41178	0.707	-58243.9
4	-23934	-15075	0.630	-23929.3
5	-24964	-14008	0.561	-24970.1
6	22722	11358	0.500	22717.39
7	31452	14006	0.445	31476.31
8	65168	25854	0.397	65125.8
9	65168	23033	0.353	65250.3
10	101568	31981	0.315	101527.3
11	122148	34263	0.281	121935.5
12	122148	30524	0.250	122,098.5
13	107618	23958	0.223	107437.9
14	107618	21344	0.198	107798
15	107618	19014	0.177	107427.7
16	107618	16939	0.157	107895.6
17	107618	15090	0.140	107792.6
18	107618	13444	0.125	107552.5
19	107618	11976	0.111	107900
20	107618	10669	0.099	107776.2

21	76792	6782	0.088	77076.14
22	76792	6042	0.079	76487.28
23	76792	5383	0.070	76900.98
24	76792	4795	0.062	77348.5
25	76792	4272	0.056	76290.28
26	76792	3806	0.050	76120.37
27	76792	3390	0.044	77060.51
28	76792	3020	0.039	77452.17
29	76792	2690	0.035	76885.39
30	76792	2397	0.031	77332.81
31	45117	1254	0.028	44813.14
32	45117	1117	0.025	44713.33
33	45117	995	0.022	45265.57
34	45117	887	0.020	44358.24
35	45117	790	0.018	43908.18
36	45117	704	0.016	44005.97
37	45117	627	0.014	44804.05
38	45117	558	0.012	46566.94
39	45117	497	0.011	45256.39
40	45117	443	0.010	44349.24

Source: Field Survey, 2022.

Table 8. Financial feasibility analysis.

Particulars	Unit	Vale
Net Present Value (@ 12.25 % discount rate)	Rs. /acre	182912
Internal Rate of Return (IRR)	Percent	20
Benefit Cost Ratio (@ 12.25 % discount rate)	---	1.16
Pay Back Period (PBP)	Years	6
Equivalent Annual Annuity (EAA)	Years	20

Source: Field Survey, 2022.

Factors Affecting Yield of Citrus

Citrus production is sensitive to several agronomic and social variables. A log-linear regression model was utilized in the present investigation to quantify the impact of several factors on citrus harvest output. Investment in citrus orchards is a long-term venture that requires the manager's knowledge and experience. Those with more experience than their peers in establishing and managing citrus trees have higher yields. According to the study, per-acre production in citrus orchards rose as farmers gained expertise. This variable is consistent with the findings of Abbas et al. (2017). Research also showed that literate farmers had a higher year of schooling than their less educated counterparts. As a result, the citrus crops of the better-educated farmers produced higher yields and profits. Citrus crop success was positively related to educational attainment. Farmers with more extensive citrus orchard land use their inputs effectively and are up to date on production and marketing trends. A well-educated farmer can effectively do all tasks associated with their occupation. According to mainstream economic theory, there is a positive correlation between educational attainment and agricultural output (Ghafoor et al., 2010). Educated citrus producers are more likely to employ inputs successfully and manage their fields, leading to increased yields (Tanzeel and Mustafa, 2011). Farmers who are educated and have received training in harvesting techniques are better able to make informed decisions that save waste and guarantee product quality (Anwar et al., 2021). Citrus tree ages appear exaggerated during discussions with growers and during trips to their plantations—fruit production increases. The regression model yielded similar findings, displaying a positive and significant association between the age of the citrus tree and the dependent variable. As a result, it is suggested that the farmer take the necessary precautions to lengthen the lifespan of citrus trees to achieve more excellent and stable financial returns. Maintaining citrus groves' current population is essential if higher profits are to be realized in the long run. The variable citrus area has a positive but insignificant impact on the dependent variables.

Due to its perishable nature citrus has a shorter shelf life and suffers in quality and economic value when transported long distances from the orchard to the marketplace. Thus, the economic returns fell as the gap between the citrus orchard and FVM widened. The findings indicated that due to the large number of farmers who sold their orchards to contractors, this variable has a negative and statistically significant effect. Establishing processing industries close to production hubs of fruits may help increase value addition. It's being transported in a refrigerated truck to extend its storage life. The government should set up processing operations close to marketplaces for maximum value addition (Ali et al., 2021). Regarding supplying relevant and timely information to farmers, the agriculture department's extension division plays a crucial role. However, in the current investigation,

the dummy extension department's coefficient was positive and statistically significant. Providing citrus training regarding production and marketing and increasing the technical knowledge accelerate the yield (Sulehri et al., 2021).

Table 9. Regression results of Cobb-Douglas production function.

Variables	Beta	t value	Sig.
Constant	5.44	21.65	0.007
Citrus farming experience (years)	3.22	3.019	0.004
Education (years)	0.797	0.646	0.057
Citrus area (acres)	0.138	0.750	0.455
Age of trees (years)	0.576	4.343	0.445
Distance from fruit and vegetable market (km)	-0.039	-0.073	0.235
Dummy Extension (if yes =1; otherwise = 0)	1.85	3.646	0.000
R2	0.52		
F-Value	20.31		

Source: Field Survey, 2022.

Discussion

Citrus fruit is prominent in its production, followed by mango, dates, and guava. Citrus fruit includes mandarins (Kinnow), oranges, grapefruit, lemons, and limes, of which mandarin (Kinnow) is vital to Pakistan. The study area included districts Bhakkar, Layyah, TT Singh, and Sahiwal. Considering a favorable return and general awareness about citrus cultivation among local farmers, citrus cultivation is being initiated in these areas of Punjab as productivity in the old citrus zones (Sargodha Division) is decreasing due to low yield and diseases (Fateh et al., 2017). The percentage share of these project districts in terms of area and production is low. There is a need to expand the area and enhance the production of citrus in these districts. To fulfill this objective, the present study in these districts was started to overcome the potential issues and identify the economic viability of citrus. The data collected comprised all expenditures on establishing and maintaining the citrus orchard. Resource structure, demographics, production cost, and profits/returns were calculated. Many studies (Ozkans et al., 2004; Pellokila et al., 2004; Aular et al., 2017; Khan et al., 2016; Sabir et al., 2010) have conducted profitability analyses of growing citrus orchards.

This study conducted a profitability analysis of citrus by using Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR), payback period (PBP) and Equivalent Annual Annuity (EAA) approaches. The results elaborated that net present value per acre was highly profitable. It was Rs.175607, which indicated that growing citrus gave a higher return. The benefit-cost ratio was reasonably high at 1.61, which is larger than the one indicating that investing more in a citrus orchard is lucrative. They concluded that investing in the citrus orchard would bring considerable returns to the farmers on the one hand and for the country in the form of more exports.

The agroecological conditions of Punjab are best suited for the production of citrus. Citrus cultivation in these new emerging districts proved a boon for the farmers because of higher economic returns than traditional crops. Due to adopting improved citrus orchard practices, households' average income from citrus produce sales increased from $ 1174.3 to $ 2353.0, meaning production increased from 5370 to 11993 kg HH-1. Training in orchard management substantially increased the adoption rate, resulting in increased production and yield. Enormous potential exists to improve the livelihoods of citrus growers by providing growers with existing orchard management techniques through appropriate research and extension interventions. Thus, it is recommended to apprise citrus growers about the latest technology for rearing citrus at the community level and to raise the level of poor farmers (Dorji et al., 2016).

Many studies assessed the factors on citrus yield by applying the Cobb-Douglas Production Function (Iqbal et al., 2009; Jari and Fraser, 2009). Results of the analysis indicated the following details for the low productivity of citrus orchards; 30 percent due to disease attack, 25 percent lack of availability of irrigation facilities, 24 percent poor and traditional agricultural extension services, 1.6 percent lack of adoption of improved and certified varieties, high transportation cost 22 percent and poor marketing structure 16 percent. The main challenges experienced by citrus growers, according to Ashraf et al. (2018), were a lack of technical expertise, the unwillingness of agricultural extension field employees to cooperate, and the lack of availability of agricultural extension field workers. Additionally, he stated that the main challenges faced by respondents were the high cost of inputs, adulteration in chemicals and fertilizers, a lack of technical expertise, the inability to obtain fertilizer at the appropriate time, and a lack of funding. The main challenges experienced by respondents, according to Bhat et al. (2015), were a lack of technical expertise, the unwillingness of agricultural extension field employees to cooperate, and the unavailability of agricultural extension field workers.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to evaluate the profitability of cultivating citrus orchards. Studying the socioeconomic traits of citrus farmers, the cost of maintaining citrus groves, and the use of various financial indicators, such as Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR), and Payback Period (PBP) and Equivalent Annual Annuity (EAA) to assess the feasibility of investment in citrus business and through the use of multiple regression analysis, the factors that influence citrus yield were examined. The study concludes that investment in citrus orchards has provided favorable returns, farmers should be encouraged to grow citrus, and extension agent staff and research institutes should need to disseminate such lucrative information to farmers. The return on investment for the long-term citrus orchard is high, and output prices may change drastically to reduce profits; there must be stabilization of citrus prices by enhancing the current marketing system and improving export policy. Good Agricultural Practices (GAP) certification at the farm level and cold chain facilities must be developed. The farmers must be aware of SPS measures and ISO standards so that exports may be boosted of citrus crops.

Wholesale markets are required in the areas where products are manufactured. Lack of information among citrus producers is a problem regarding the citrus industry's ability to thrive financially. This demonstrates that research and extension organizations are not doing their duties effectively, and more people need to be informed on how to replace citrus orchards that are getting on in years. Because of the high rate of return on long-term investments in citrus orchards, the price of inputs (such as pesticides, weedicides, and fertilizer) and the price of output (such as citrus fruit) are not forecasted to have a significant influence on the incentives for new plantings. The existing marketing system and the export strategy need to be enhanced to maintain consistent pricing for citrus.

In Pakistan, there is an extreme need for research facilities about citrus fruits of the best possible standard. It is essential that only

specific nurseries in the citrus nursery sector receive certification, and this process should be carried out with caution. Farmers should avoid buying plants from unlicensed sources and stick to those sold by certified nurseries. The production of high-yielding cultivars in Pakistan and the reduction of post-harvest losses, both of which should be prioritized in research and development activities, have the potential to be of tremendous benefit to Pakistan's kinnow exports (R&D). Exporters and individuals in the value chain who are involved in exporting should get training since the requirements of importers, certification organizations, and other constraints need it. The first limitation of this research is that it is conducted in a limited area. So, future research may be conducted in a broader area, and cross-country analysis may be conducted. Moreover, this research uses only primary data. Future research may use the cross-sectional data for analysis purposes.

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