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Research Article

Economics and Marketing of Sugarcane Production in District Mandi Bahaudin

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Abstract

A cash crop, sugarcane (*Saccharum officinarum L.*), is regarded as a crucial raw ingredient for agricultural-based enterprises. Due to their significant contribution to GDP, the sugar industries are of utmost economic significance. In addition to offering financial incentives to the growers, it also produces byproducts that may be utilized as raw materials in other businesses to make a variety of goods. As a result, sugarcane growing has a lot of potential to boost the local economy because its operations have the potential to boost income and draw in local labor. The goal of the current study is to document knowledge about sugarcane crop marketing channels and the economic advantages of sugarcane farming in the area of Mandibahaudin, Punjab, Pakistan. Malakwal, Phalia, Qadirabad, and Gojra were the study's locations. A visit to the study area was made in order to collect the data. To gather primary data, 120 people randomly chosen from these communities were questioned using a pre–validated questionnaire. Techniques for random sampling produce accurate data. Secondary information is gathered from other sources. However, the findings support the understanding of the sugarcane crop's marketing channels as well as the financial advantages of sugarcane farming and its byproducts in the district of Mandibahaudin. Both a descriptive analysis and multiple regression analysis were performed.

Keywords: Sugarcane, Marketing, Profitability, Production, Mandi Bahaudin

Introduction

In Pakistan, sugarcane is a significant revenue crop that significantly raises the socioeconomic standing of growers. The country's economy has developed as a result of the sugar industry's explosive rise. Sugarcane is the government's principal source of income because it generates billions of rupees in levies and taxes. Sugarcane may now be processed to create a variety of industrial chemical compounds, including alcohol, chipboard, and dozens of others, as a result of recent technological advancements. Pakistan is ranked fifth in the world for producing sugarcane, seventh for producing sugar, and eighth for consuming sugar. Sadly, the country is only at a relatively low level of 4 tonnes per hectare, according to Boamah (2014). Currently, Pakistan's sugarcane industry uses 5% of the country's total planted area and generates 17% of the nation's gross agricultural income from all crops. The Sindh, Punjab, and NWFP provinces of Pakistan frequently grow sugarcane as a crop. Pakistan is one of the developing nations in South Asia and is ranked as the sixth most populated nation in the world (Sun et al., 2020). 63% of Pakistan's population resides in rural areas and earns a portion of their income from agriculture. The economy of Pakistan is based on agricultural products because 18.9% of its GDP is devoted to agriculture (Hayat et al., 2019). The majority of the cultivated area in Punjab provides 69% of Pakistan's agricultural output by providing a significant portion of various crops like cotton, wheat, rice, maize, and sugarcane. Approximately 657,000 hectares, or roughly 60% of Pakistan's entire sugarcane land, are thought to be used for cultivation. Punjab's central and eastern regions are important producers of sugarcane (Irfan et al., 2022).

This study is only focused on the Mandi Bahauddin (M.B.Din) district. Mandi Bahauddin is a plain region situated in the center of Pakistan with excellent agricultural conditions. Due to its proximity to the Chenab and Jhelum, two of the country's largest rivers, it has a wealth of irrigation capabilities. Mandi Bahauddin, which translates to "Market of Bahauddin," was given to this area after a grain market was established there in the early 20th century. The district was chosen for the study for a number of reasons, including its favorable terrain and the area's large population of small farmers. Most of these farmers have fewer than 13 acres of land under their control. Mandibahaudin, one of Punjab's 34 districts, contributes most to agriculture (Tahir et al., 2016). There are 3 tehsils in the district, each with a population of 1.41 million. The three main crops grown on around 222,600 hectares are rice, wheat, and sugarcane. In addition, the district also grows small amounts of Jawar, Bajra, Tobacco, Mash, Moong Masoor, Gramme, Maize, and Oil Seeds including Rape and Mustard. Mandibahaudin sugar cane is grown on 85000 acres out of the total farmed area, producing 550 tonnes per acre year (Tahir & Mughal 2012).

About 15 to 20 percent of the region's total sugarcane crop over the past three years has been sold to sugar mills for crushing (GOP, 2013). The region's sugarcane farmers significantly rely on these mills to provide a just price, prompt delivery to allow them to leave their fields, precise weighing of their crops, and prompt payment of their debts. To achieve better sugar recovery, mills often start crushing sugarcane late, delaying the following crop (such as wheat) and leading to lower yields for farmers. It has recently become common practice for mills to appoint commission agents to bargain on their behalf when buying sugarcane from farmers. Compared to many other commodities, marketing sugarcane is a far more serious problem because farmers frequently have no choice than to sell the majority of their output to the mills.

Researchers and policymakers agree that efficiency plays a key role in increasing agricultural productivity. The improvement of crop yields, especially for small-scale farmers, should be the focus of the agricultural development strategy. A decrease in rural poverty and an improvement in social welfare is associated with an increase in agricultural output. It is important to focus on output gains brought on by the effective application of present technology because the technological improvements brought on by the green revolution seem to have peaked in the developing world (Squires & Tabor 1991).

Economic experts propose that lowering input costs, creating high-yield technology, or enhancing management techniques can all cut manufacturing costs. Electricity, gas, petroleum goods, and agricultural products have all seen price increases in Pakistan during the past few years, and these increases are expected to continue in the coming years. In the past, input prices have risen more quickly than output prices in the agricultural sector. There may not be much chance of lowering input costs based on reality. Similar to this, it takes years for new agricultural methods or high-yielding varieties to be developed and disseminated among farmers.

Afghan (2023) sugarcane, which is primarily farmed in tropical and subtropical regions of the world, is used to make over 85% of the sugar that is consumed globally. In Pakistan and globally, sugarcane has increased in area, output, and yield compared to other crops. It is the second-largest crop in terms of economic significance after cotton. Due to its high value, it is an important cash crop for Pakistan's sugar businesses. It raises the value of all agricultural output by 2.9% and the GDP by about 0.6%. It provides power and energy and brings in a sizable sum of money for the government. The climate in Pakistan is perfect for growing sugarcane in the regions of Punjab and Sindh. Numerous climatic factors, including sunlight, temperature, germination, tillering, growth, humidity, dew, frost, hailstorms, windstorms, sunburn, and drought, have a significant impact on the production of sugarcane. Pakistan, which ranks fifth in terms of cane acreage, sixth in terms of cane sugar production, and ninth in terms of overall sugar production, is a significant cane-growing country. The economic significance, climate, and prospective yield of sugarcane in Pakistan are all covered in this chapter. Haque (2006) analyzed that the agriculture industry is extremely important to the economy of developing nations. This analysis analyses a number of studies that evaluated the productivity of farmers in different nations and offers insightful information to all parties involved in policymaking.

Tahir and Mughal (2012) conducted research to determine the regular provision of excess power by the private sector, such as mills, to lessen local area demand in a nation. Data was collected during the trial, which was

conducted at various sugar mills in the Mandibahaudin district. According to the findings, up to six months' worth of extra electricity might be added to the public system. Additionally, the supply of sugarcane during the crushing season reached up to four months, and the cost of production was advantageous economically.

Iqbal (2014) is analyzed that sugarcane is a well-liked crop that is farmed throughout the world. On 1.17 million hectares of land, it is grown in Pakistan, where 66.5 million tonnes of sugarcane were produced in 2012–13. However, Pakistan grows less sugarcane per acre than nations like Brazil, Egypt, and the United States. Each person in Pakistan consumed 24 kilograms of sugar in 2012–2013 despite producing 5 million tonnes of it. This exceeds what is found in China, Bangladesh, and India. Pakistan ranks as the world's eighth-largest consumer of sugar, the world's ninth-largest producer of sugar, and the world's sixth-largest producer of sugar from sugarcane. There is a lot of molasses produced in Pakistan that can be exported. Unfortunately, because farming expenses, such as purchasing fertilizer and pumping water from wells, are rising, farmers are not generating much money from cultivating sugarcane. Farmers only make roughly Rs. 39,000 per acre after 12–14 months. More information regarding improving and sustainably growing sugarcane is required in order to support farmers. New varieties of sugarcane that are pest-resistant and yield more sugarcane should also be available.

The objective of the study is to determine the production cost and net returns of the sugarcane crop and to overview the supply chain of sugar cane in district Mandibahaudin. Based on the results of the study, recommendations will be given for effective policy intervention.

Methodology

The researcher uses the methodology to help in data collection, analysis, and interpretation. In order to solve the issues, they run across, researchers employ a research design as a guide (Nachmias & Nachmias 1992). In this chapter, we'll talk about the methods and tools utilized in data collecting and analysis. The study aimed to evaluate the economic viability of sugarcane cultivation and marketing-related concerns in the Mandi Bah Uddin district. A strategic method was used to accomplish the study's goals in light of the area, kind, and quantity of respondents.

The Study Area

The study was done in the Pakistani province of Punjab. With a land size of 205,344 square kilometers, the province is Pakistan's second-largest after Balochistan. It occupies about 25.8% of the country of Pakistan's total land area. With an estimated 110 million residents, Punjab is the most populous province in Pakistan, home to over 60% of the nation's citizens. It is the only province that touches the federal capital in addition to touching every other province in the nation. Punjab is largely made up of fertile alluvial plains and the four major rivers, the Ravi, Jhelum, Sutlej, and Chenab as the Indus River and its four major tributaries pass the province from north to south. The province's environment, which is among the most irrigated on earth, is covered in canals. Extremes are also remarkable, ranging from the chilly northern hills to the sweltering and desolate south. The north has cold hills that contrast with the sweltering, desolate south in addition to the harsh weather conditions. Punjab's region typically ranges from -2 to 45 degrees Celsius, while it can be as hot as 50 degrees Celsius in the summer and as cold as -10 degrees Celsius in the winter. Annual rainfall averages 960 mm in the sub-mountain region and 460 mm in the plains.

Since this study was conducted in Mandi Bah Uddin, it is the most significant district in Punjab in terms of sugarcane production potential. There are two tehsils in the Mandi Bah Uddin district: Mandi Bah Uddin and Phalia. Mandi Bah Uddin district has 1.5 million residents as of the 2017 Census (GOP, 2017). The soil in this region is rich. The climate in this district is chilly in the winter and scorching in the summer. May and June are the hottest months, with highs of 44 °C. In January, the minimum temperature is 2°C. The annual average rainfall is 200mm. The study area's primary economic sources of income are farming and raising livestock. In this region, a variety of crops are cultivated, including rice, wheat, sugarcane, cauliflower, peas, and maize.

Data and Sampling

Information had to be obtained for the study from a variety of primary and secondary sources. The core data

was gathered through surveys. Interviews with randomly chosen sugarcane growers were undertaken. In Nov and Dec 2022, we collected the data from 2 tehsils. We collected data from 120 farmers through personal contact using the random sampling technique from the study area. Distribution of the sample is shown in Table 1.

Table 1. Distribution of the sample.

District	Tehsil	Villages	No. of Farmers
Mandi Bah Uddin	Mandi Bah Uddin	Rukkan, Magat, Mong, Bahoo, Manga, Ruk, Sarlay	60
Mandi Bah Uddin	Phalia	Dhal, Maken, Ladher, Madhary Pir Bollah, Chak Meerak	60
Total		12	120

Questionnaire Development

To gather information, a one-on-one interview with sugarcane farmers was done. This was achieved by creating a questionnaire and using respondents' answers to gather data. The questionnaire was written in English, but questions were also asked in regional tongues including Punjabi and Urdu. Seven sections made up this questionnaire:

Basic Information: In this section, questions were posed to farmers regarding their backgrounds, education, agricultural experience, and farm location.

Farm Size: The questions in this part pertain to a farmer's farm's features, such as whether the land is owned, rented, used for farming, and how much of it is used for sugarcane production.

Sugarcane seed canes: Farmers inquired about the sort of sugarcane seed used and the source of the seed.

Institutional Determinants: Farmers were asked about their ability to acquire agricultural services, including financing and extension, throughout this part.

Cost of Production: Information on labor expenses, harvesting costs, storage costs, macro- and micro-input costs, and land rent was among the different types of data acquired.

Yield: This section looked at the yield of various sugarcane types.

Marketing Pattern and Problems: I questioned farmers about the production of sugarcane, the organizations to whom it was sold, prices, the means of sale and payment, the sources of price information, and the marketing difficulties they encountered.

Data Coding and Editing and Field Experience

An organized questionnaire was used for data gathering. In order to prevent any inaccuracies, the data was carefully examined. Utilizes a serial number to identify each questionnaire. Microsoft Excel and the Statistical Package for Social Science (SPSS) program were used to analyze the survey's data.

The researcher faced a variety of challenges while collecting the data. Some of them are as follows:

The fact that respondents could not comprehend the purpose of the research was a significant issue. They were hesitant to respond since they were inquisitive about the questions.

They thought the researcher was an official from the government who had come to administer benefits or apply taxes. The researcher acquired the respondents' trust by describing the study's objectives and assuring them that the data was being gathered for scholarly purposes.

Due to their busy schedules, the researcher had little time to interview the farmers. Government regulations based on such research might benefit farmers if they gave accurate information about their experiences producing crops. Farmers were not keeping proper records of inputs, seeds, seed canes, pesticides, and expenses was another issue seen during data collecting. With the assistance of other farmers, the information was gleaned from their memories and recalls.

Statistical Techniques for Data Analysis

The averages, percentages, and means for the sugarcane area, cost of production, yields, profits, and losses are only a few of the variables that are calculated.

The average is calculated using the formula below:

$AM = \Sigma X / N$

Where,

"AM" represents Arithmetic Mean,

"ΣX" represents the total number of variables,

"N" represents the number of observations.

For making considerations and comparisons, percentages is calculated by using following formula:

$P = F / N*100$

Where,

"F" represents the frequency of data,

"N" represents total number of observations.

Economic Analysis and Cost Estimation

Due to their interdependence and connectivity, farmer's enterprises had a very challenging issue when determining their production costs. Therefore, it is difficult to estimate each farmer's cost of production. The farmer's enterprises combined a number of products with varying quantities and intensities.

The cost of several farm inputs was calculated using the following methods in order to determine the economics of potatoes and yield variance. Profit is calculated using the formula below:

$\Pi = PY - TC$ Where,

"Π" represents the profit

"P" represents the output price per mound "Y"represents the output

"TC" represents the total cost

The Total cost is calculated by using the following formula:

$TC = p1Lb + p2Lp + p3Sc + p4FYM + p5Wr + p6Fr + p7Pp + HT + LR$

Where,

Lb	=	Labor	p1=Wage rate
Lp	=	Land Preparation	p2=Hiring Machinery Rate
Sc	=	Seed rate(Kg/acre)	p3=Price of seed per Kg, price of seed canes
FYM	=	Farm Yard Manure	p4=Market price of FYM
Wr	=	Irrigation Cost (Tubewell+Canal)	p5=Price of tube well, Irrigation per acre
Fr	=	Fertilizer	p6=Market price of Fertilizer
Pp	=	Plant Protection	p7=Price of a Chemical Used
HT	=	Harvesting and Threshing/Acre	LR= Land rent

The Net farm income is calculated by using following formula.

Net Income=Gross Income - Total Cost

Average yields and output prices will be multiplied to compute gross income.

Description of Variables

Family Size: In order to calculate household income and expenditure, family size and workforce must be

considered. It is calculated based on the percentage of people who work on the field full-time or part-time, as well as their ages.

Household Income: The household income includes the data for the source of income collected, i.e., farming, government jobs, private jobs, own businesses, government retirement, etc.

Number of Children: Data including the number of children and number of adults collected from each household.

Farm Size: This data includes the total number of own acres, rented in and rented out, shared in and shared out, cultivated and uncultivated acres collected.

Labor Input: Three categories of labor in the field can be made: family labor, permanently hired labor and casual labor. Family labor provides its services for free. The potential cost of using family labor was the same as the hourly wage for paid labor. The tasks performed by causal labor included irrigating, spraying, fertilizing, and harvesting. Permanent employees work for the company for a predetermined length of time, such as six or twelve months.

Preparation of Land: It is crucial to properly prepare the land in order to cultivate sugarcane with excellent yields. We used rental machinery rates to determine how much ploughing, rotavator, planking, and leveling would cost.

Seed Cost: Farmers primarily produced sugar cane seeds in their own homes. The quantity and cost of the seed are taken into account before sowing.

Farm Yard Manure (FYM): The FYM boosted the soil's fertility and productivity. The opportunity cost of selling FYM was used because the majority of farmers consumed their own domestically produced FYM. The FYM cost was determined using the purchase price at the village rate.

Irrigation: The farmer uses water from canals and tube wells for irrigation. Farmers pay rabi and kharif abiyana for canal water to the government on time. Water from tube wells is priced differently in each hamlet. The cost of tube wells is set thus, farmers must purchase water from one another.

Plant Protection: Weedicide costs were estimated based on chemical prices and spraying hiring rates.

Harvesting: Manual labour is used to harvest sugar cane in the Mandi Burhanuddin district. Contract labour is used to harvest sugarcane. Costs for harvesting it are determined by acres.

Economic Analysis

The economic analysis was done by using the following formula:

Gross Margin

Gross margin was estimated to make comparisons. The formula used to calculate the gross margins is given below:

GM = TR - VC

Where, “GM” represents Gross Margin “TR” represents Total Revenue “VC” represents Variable Cost.

Net Returns

Net Returns were calculated by using the formula stated below:

NR = TR –TC

Where, “NR” represents Net Returns “TR” represents Total Revenue “TC” represents Total Cost.

Benefit Cost Ratio (BCR)

If the BCR>1, then the project is viable and worthy. Benefit Cost Ratio (BCR) is calculated by using this formula:

BCR= TR/ TC

Where, “BCR” represents Benefit Cost Ratio “TR” represents Total Revenue “TC” represents Total Cost.

Multiple Regression Analysis

The relation between one dependent variable and many independent variables is called multiple regression.

The yield of the potato crop depends upon many factors such as farmer age, farming experience, farm size, land preparation, seed, fertilizer, spray, irrigation, harvesting, etc.

Ln Yield = β_0 + β_1 Ln (Age) + β_2 Ln (Education) + β_3 Ln (Farming Experience) + β_4 Ln (Land Preparation Cost) + β_5 Ln (Seed Cost) + β_6 Ln (Fertilizer Cost) + β_7 Ln (Spraying Cost) + β_8 Ln (Irrigation Cost) + β_9 Ln (Harvesting Cost) + β_{10} Ln (Income) + μ

Results and Discussions

Economic Analysis of Cost of Production of Sugarcane Crop

This section is further separated into four sections based on how the farmers cultivate sugarcane, including less than 10-acre cultivation, 10-to-25-acre cultivation, over 25-acre cultivation, and the overall cost of sugarcane production. The cost of production for sugarcane growers with fewer than 10 acres under cultivation is shown in the first section. There are 48 farmers who cultivate sugarcane on fewer than 10 acres. The cost of production for sugarcane farmers who cultivate their crops on 10 to 25 acres is shown in the second section. There are 85 farmers that cultivate sugarcane on plots between 10 and 25 acres. The cost of production for sugarcane growers with over 25 acres under cultivation is shown in the third section. There are 17 farmers who cultivate sugarcane on more than 25 acres. The total cost of producing sugar cane is described in the fourth section.

Cost of Production of Sugarcane Growers (Less THAN 10-Acre)

Table 2 explains the expenses of production for sugarcane growers with fewer than 10 acres under cultivation. The following are some examples of costs:

Land Preparation Cost: Basic elements of land preparation include labor, a rotavator, thorough ploughing, and planking. The typical rate of ridges, cultivators, rotavators, and ploughs is Z.

Table 2. Land preparation cost.

Implements	Diesel Consumption (liter)	Total cost
Disc harrow	8	1600
Rotavator	10	2000
Laser land leveler	5	1000
Cultivator	12	2400
Ridger	4	800

Seed Rate: The average seed rate utilized cost 28800 on average and was between 100 and 120 mounds per acre.

Fertilization: Fertilizers include things like potash and urea DAP. A total of 38172 dollars were spent on fertilizer production costs per acre.

Irrigation: The average cost of tube well irrigation was Rs. 24,000 overall.

Harvesting: Sugarcane harvesting costs Rs 30 per mound per acre.

Land Rent: The market standard rate of land rent, which was Rs. 5000 per acre, was used.

Table 3 reflects responses from farmers who have cultivated sugarcane for fewer than 10 acres, displays the gross margin, total revenue, total costs, and profit of sugarcane growers. Sugarcane yields 85.35 maunds on average per acre, with a price of Rs. 300.00 per maund. Net income, total cost, and net profit, as calculated, are Rs. 213375.00, 163242.4, and 20132.60, respectively.

Table 3. Cost of production of less than 10 acres of sugarcane cultivation.

Sr.	Operations/Input	Unit	Number of acre	Cost of 1 acre	Cost of 110 Acre
A	Fixed Costs/Acre Land Rent = Rs. 50000 Canal Water = Rs. 350				
1	Land Rent	Acre	1.00	50000	5500000
2	Canal Water	Acre	1.00	350	38500
B. Land Preparation		No. of trips	No. of acre	Cost of 1 Acre	Cost of 110 Acre
1	Rotavator	2	1.00	2000.00	220000
2	Laser land leveler	1	1.00	1000.00	110000
4	Cultivator	4	1.00	2400.00	264000
5	Ridger	1	1.00	800.00	88000
C. Sowing Cost		Cost of 1 Acre		Cost of 110 Acre	
1	Seed Cost of 120 mounds	28800		3168000	
D. Fertilizer Cost		Bags Used	Cost of 1 Acre	Cost of 110 acre	
1	DAP	2	21600	2376000	
2	Urea	4	7072	777920	
3	Potash	1	9500	1045000	
E	Total Labor Charges of sowing (110 acre)				990000.00
F	Total Harvesting Cost of harvesting (110 acre)				2640000.0
1	Transportation	1 Acre cost 12000		110 Acre cost 1320000	
Total Costs of 110 acre (A+B+C+D+E+F)					18883920
Production (Mounds) Rate of 1 mound Rs. 300		1 Acre (Mounds) 800		110 Acre (Mounds) 88000	
Profit of 110 Acre		TR–T C			7516089

Cost of Production for Sugarcane (with 10- to 25-acre)

Table 4 explains the expenses of production for sugarcane producers that cultivate their crops on 10 to 25 acres. The following are some examples of costs:

Land Preparation Cost: Basic elements of land preparation include labor, a rotavator, thorough ploughing, and planking. The average cost of a rotavator, a plough, a plank, a cultivator, and a ridge is, respectively, 2480, 2520, 1886, 4730, and 1800 Rs per acre. In the chosen study location, the average cost of all land preparation is Rs. 13516.00 per acre.

Seed Rate: The typical seed rate per acre is 13.28 kg, and the typical cost per maund is Rs. 3637.81. Per acre, average total price of seed is Rs. 49810.12.

Fertilization: The various types of fertilizer include urea, DAP, and potash. Fertilizer costs, on average, are Rs. 7261.12, Rs. 2769250, and Rs. 12241.13 per acre. In the chosen study location, the average total cost per acre is Rs. 48954.16.

Irrigation: The average price per acre is Rs. 5000.00.

Harvesting: Sugarcane harvesting costs Rs. 8000.00 per acre.

Land Rent: Land rent was calculated using the market standard rate, which is Rs. 19080.70.

Table 4. Cost of production between 10 to 25 acres of sugar cane cultivation.

Sr.	Operations/Input	Unit	Physical Unit	Rate/ Unit (Rs.)	Cost/Acre (Rs.)
A	Fixed Costs				19080.7
1	Land Rent	Acre	1.00	18963.20	18963.20
2	Canal Water	Acre	1.00	117.50	117.5
B	Land Preparation Cost				13516.00
1	Rotavator	Nos.	1.55	1600.00	2480
2	Ploughing	Nos.	1.80	1400.00	2520
3	Planking	Nos.	3.31	600.00	1986
4	Cultivator	Nos.	4.30	1100.00	4730
5	Ridger	Nos.	1.00	1800.00	1800
C	Seed Cost				49810.12
1	seed Cost	Sugarcane bundle (maunds)	13.28	3637.81	48310.12
2	Seed Treatment	Sugarcane bundle (maunds)	1.00	1500.00	1500.00
D	Fertilizer Cost				48954.86
1	Urea	Bags	4.02	1806.25	7261.12
2	DAP	Bags	2.65	10450.00	27692.50
3	Potash	Bags	1.40	8743.67	12241.13
4	Micronutrients	Bags	2.00	880.00	1760.00
E	Total Labor Charges				5000.00
F	Total Harvesting Cost				8000.00
G	Packing Material Cost				14592.00
1	Packing	Sugarcane bundle (maunds)	91.20	160.00	14592.00
H	Marketing Costs				5016.00
1	Loading & unloading	Sugarcane bundle (maunds)	91.20	20.00	1824.00
2	Transportation	Sugarcane bundle (maunds)	91.20	30.00	2736.00
3	Commission	Sugarcane bundle (maunds)	91.20	5.00	456.00
Total Costs(A+B+C+D+E+F+G+H)					163669.68
Physical Productivity		Sugarcane bundle (maunds)	91.20	2500	228000
Profit		TR–T C			64330.32

The gross margin, total revenue, total cost and profit of sugarcane growers are shown in Table 4.28, which responded farmers have done 10 to 25 acre cultivation of sugarcane. The average yield of sugarcane is 91.20 maunds per acre and the price per maunds is Rs. 300.00. The calculated Net income, total cost, and net profit are Rs 228000,163669.68 and 64330.32 respectively.

Cost of Production of Sugarcane (above 25 acre)

The costs of production of sugarcane farmers which have more than 25 Acers cultivation of sugarcane is explained in the Table 5. Some costs are illustrated below:

Land Preparation Cost: The land preparation has a basic component including rotavator, deep ploughing, planking and labor. The average rate of rotavator, ploughing, planking, cultivator and ridger are 2400.00, 2450.00, 1926.00, 4785.00 and 1800.00 Rs per acre respectively. The average total land preparation cost is Rs13361.00 per acre in the selected study area.

Table 5. Cost of production above 25 acres of sugarcane cultivation.

Sr.	Operations/Input	Unit	Physical Unit	Rate/ Unit (Rs.)	Cost/Acre (Rs.)
A	Fixed Costs				19080.70
1	Land Rent	Acre	1.00	18963.20	18963.20
2	Canal Water	Acre	1.00	117.50	117.50
B	Land Preparation Cost				13361.00
1	Rotavator	Nos.	1.50	1600.00	2400.00
2	Ploughing	Nos.	1.75	1400.00	2450.00
3	Planking	Nos.	3.21	600.00	1926.00
4	Cultivator	Nos.	4.35	1100.00	4785.00
5	Ridger	Nos.	1.00	1800.00	1800.00
C	Seed Cost				47899.39
1	Seed Cost	Sugarcane bundle (maunds)	12.96	3580.20	46399.39
2	Seed Treatment	Sugarcane bundle (maunds)	1.00	1500.00	1500.00
D	Fertilizer Cost				46522.08
1	Urea	Bags	3.92	1806.25	7080.50
2	DAP	Bags	2.56	10450.00	26752.00
3	Potash	Bags	1.25	8743.67	10929.59
4	Micronutrients	Bags	2.00	880.00	1760
E	Total Labor Charges				4600.00
F	Total Harvesting Cost				7800.00
G	Packing Material Cost				15584.00
1	Packing	Sugarcane bundle (maunds)	97.40	160.00	15584.00
H	Marketing Costs				5357.00
1	Loading & unloading	Sugarcane bundle (maunds)	97.40	20.00	1948.00
2	Transportation	Sugarcane bundle (maunds)	97.40	30.00	2922.00
3	Commission	Sugarcane bundle (maunds)	97.40	5.00	487.00
Total Costs(A+B+C+D+E+F+G+H)					162204.17
Physical Productivity		Sugarcane bundle (maunds)	97.40	2500	249500.00
Profit		TR–TC			87295.83

Seed Rate: The average seed rate used is 12.96 kg per acre and the average cost of maunds is Rs.3580.20. The average total cost of seed is Rs.47899.39 per acre.

Fertilization: Fertilizers include Urea, DAP, potash, etc. The average rate of fertilizers is Rs. 7080.50, Rs 26752.00, and Rs 10929.59 and per acre. The average total cost per acre is Rs. 46522.08 in the selected study area.

Irrigation: The total average cost is Rs.4600.00 per acre.

Harvesting: The harvesting cost per acre of sugar cane is Rs7800.00

Land Rent: The market prevailing rate of land rent used is Rs19080.70

Table 5 reflects responses from farmers who have cultivated sugarcane for more than 25 years, displays the gross margin, total revenue, total costs, and profit of sugarcane growers. The cost of a maund of sugarcane is Rs. 2500.00, while the average production is 97.40 maunds per acre. Net income, total cost, and net profit, as calculated, are Rs. 249500.00, Rs. 162204.17, and Rs. 87295.83, respectively.

The aforementioned graphs and table discussions make it clear that the area of irrigation has a positive impact on profit margin because when a farmer works over a bigger area, productivity grows, and expenses per acre decrease.

Regression Analysis

The sugarcane yield is used as the dependent variable. Age, education, farming experience, income, land preparation costs, fertilizer costs, seed costs, spray costs, irrigation costs, and other factors are taken into consideration. Costs associated with irrigation and harvesting are regarded as independent variables. By adding one year to the respondent's age, Table 6 findings show that the sugarcane yield increased by 9% while holding all other statistically significant parameters constant. According to the respondent's level of education, adding one year of schooling boosted sugarcane yield by 0.9% while holding all other variables constant and was statistically insignificant. According to the respondent's farming experience, adding a year to his or her experience boosted the sugarcane yield by 6% while holding all other variables constant and was statistically significant. According to the respondent's data on land preparation costs, a 1% increase in these costs resulted in a 10% increase in sugarcane output while holding all other variables constant.

According to the respondent's data on seed costs, raising seed prices by 1% boosted sugarcane yields by 4% while maintaining all other variables constant and being statistically insignificant. According to the respondent's fertilizer costs, a 1% rise in fertilizer costs resulted in a 5% increase in sugarcane output while holding all other variables constant. According to the respondent's estimate of the cost of spray, a 1% increase in spray costs resulted in a 1% reduction in sugarcane production while holding all other variables equal, which was statistically insignificant. According to the respondent's irrigation costs, a 1 percent increase in irrigation costs increased sugarcane output by 0.5 percent while maintaining all other variables constant, which was statistically insignificant.

Table 6. Result of multiple regression analysis.

Variables	B	St. Error	Sig.
(Constant)	2.797	.752	.000
LnAge	.098	.048	.042
Ln Education	.009	.013	.472
Ln Farming Experience	.060	.025	.018
Ln LandPreparation Cost	.107	.023	.000
Ln Seed Cost	-.042	.060	.478
Ln Fertilization Cost	.051	.017	.003
Ln Spray Cost	-.011	.054	.847
Ln Irrigation Cost	-.005	.004	.238
Ln Harvesting Cost	-.009	.044	.843
Ln Income	.054	.010	.000

The dependent variable may change by 60% when all independent factors are included, as indicated by the R2 value of 0.604. This figure further demonstrated that certain additional factors, whose effects the presented model was unable to account for, were responsible for the remaining change in the dependent variable. The significant value of adjusted R2 is 0.573. When all other factors are kept constant, independent variables explain 57% of the variation, according to the adjusted R2 value. The F-ratio indicates whether or not each independent variable is a major source of variance in the dependent variable. The overall importance of the model was explained by the 19.66 significant F-value.

Ln Yield = 2.797 + 0.098 Ln Age + 0.009 Ln Education + 0.060 Ln Farming Experience - 0.107Ln Land Preparation Cost - 0.042 Ln Seed Cost + 0.051 Ln Fertilizer Cost - 0.011 Ln SprayingCost-0.005LnIrrigationCost-0.009LnHarvestingCost+0.054LnIncome + μ

Conclusions

In this study, the yield of sugarcane is examined using the effects of several variables through the use of regression analysis. Age, farming experience, land preparation cost, fertilizer cost, and income factors all significantly affect sugarcane production, according to the results of this regression. Education, seed, spray, irrigation, and harvesting costs have no discernible effect on sugarcane productivity. R2 and the F-test are used to determine the model's overall significance, and they demonstrate that the model was significant. A conclusion drawn from the regression analysis is that greater soil preparation and timely fertilizer application will boost sugarcane production, which will also increase if sugarcane-selling channels are made more effective.

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