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Economic Analysis of Groundnut Cultivation on the Basis of Gross Margin: A Case Study of Pothwar Region in Punjab Pakistan

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ABSTRACT

Groundnut (*Arachis hypogaea*) is a major cash crop of the Pothwar region. Different research had been carried out for the promotion and commercialization of groundnut. However, this study is formulated to compare per acre gross margin, per acre yield, and area under cultivation of three different districts of Punjab i.e. Chakwal, Talagang, and Attock. Data is collected from 43 farmers of three districts of the Pothwar region i.e. Talagang, Chakwal, and Attock through a well-structured questionnaire Performa. In this study, we also economically analyzed the BARI-2016 variety of groundnut crop on the basis of financial metrics like return on investment, Net farm income, and benefit-cost ratio. Similarly, the main focus of this study was to compare the gross margin of the BARI-2016 variety to the Desi variety of the groundnut crop. For varietal gross margin comparison, this study employed the paired sample t-test technique. Descriptive statistics results showed that Chakwal's district per acre yield and gross margin are higher in comparison to other two districts. Financial matrices results directed that BARI-2016 variety has increase potential for farmers regarding highest benefit-cost ratio. However, paired sample t-test results indicated that there is a significant difference between per acre gross margin of the BARI-2016 and Desi variety and the BARI-2016 variety's gross margin is higher as compared to the conventional Desi variety. Based on the findings, thereby farmers should adopt to cultivate new approved varieties of groundnut along with new production techniques to increase their per acre yield and gross margin which in turn will boost their level of profit.

Keywords: Groundnut cultivation; economic analysis; benefit-cost ratio; return on investment; Pakistan

1. Introduction

Likewise, other developing countries Pakistan has a strong Agri. background evidenced by accounts of agricultural contribution to the overall GDP of 24% in the preceding year, and nearly half of that country's labor force directly or indirectly engaged with Agriculture sector (PBS, 2023). Meanwhile, to strengthen the agriculture sector much focus has been driven on the oil seed industry for the last couple of years. In this regard, one of the most common oil seed crops of Pothwar areas is groundnut (*Arachis hypogaea*) but oil extraction in its initial stage and normally groundnut is used for eating purpose. Groundnut that is also famous with the name of peanut worldwide mainly cultivated in the rainfed areas of south Asia whereas China and India are the biggest

cultivators of that crop in this region (Rami et al., 2013). As a major food crop groundnut has 13th ranked while the 4th largest oil seed crop worldwide. It is cultivated on the 26.4 million hectares of the world cultivated area and produced 37.1 million metric tons (FAO, 2011). In Pakistan, groundnut is cultivated in the Pothwar region (Barani areas of Pakistan), which comprises Attock, Jhelum, Rawalpindi, and Chakwal District. It is also being cultivated in different areas of KPK and Sindh as well with a production of 91.4 thousand tones out of which 85 percent groundnut is being produced in Punjab and the remaining 10 percent is produced in KPK and Sindh. In Pakistan groundnut production takes 81.5 thousand hectares of area under cultivation (Hayat et al., 2022; Wajahat et al., 2022). Pothwar groundnut contains a rich amount of healthy

nutrients e.g. vitamins, proteins, and minerals that are essential for human body development. Similarly, Pothwar groundnut has much economic significance. On the one side it promotes local farming, and generates a rich amount of cash income. On the other hand, it reduces local unemployment and poverty, thus boosts the local oil seed industry (Wajahat et al., 2022; Usman et al., 2016).

This study is an initiative to compare the gross margin of traditional (Desi) and new approved (BARI-2016) varieties of groundnut because no research had conducted before. In 2016 division-wise profitability of groundnut production was analyzed in Ndhiwa Sub-Country of Kenya based on gross margin (Onyuka, 2016) but no research is still designed in Pakistan. In 2017 research was conducted to compare the gross margin of two different varieties of groundnut in Gombe State, Nigeria but that was based on the oil extraction (Abdullahi et al., 2017). In 2020 one research was also undertaken regarding BARI-2016 but the main focus was just on the bumper yield of that variety and the economic perspective remains undefined. Literature showed that BARI-2016 had a 2900 Kg/acre yield on average in addition to specific characteristics of drought resistance. One of the most distinguished qualities of BARI-2016 is having more than 40% of pods with 3-4 seeds per pod (Shah et al., 2020).

Even though groundnut is the cash crop of the Pothwar region of Punjab, Pakistan but it was founded that rare research had carried out regarding economic analysis of groundnut.

Thereby, considering all previous literature underlying study was purposed to economically analyze the groundnut crop in different Pothwar areas like Talagang, Chakwal, and Attock. The focus of this study was to compare the descriptive statistics of district wise (viz., Talagang, Chakwal, and Attock) regarding per acre yield, gross margin and area under cultivation, thus analysing the economic outcomes of new approved groundnut variety BARI-2016 with the help of economic matrices e.g. cost, revenue, net profit, return on investment, BCR and gross margin. Similarly, focus was also to find that how much significant difference exists in the per acre gross margin of BARI-2016 and Desi variety of groundnut.

On the basis of the proposed research work, authors' hypothesized following statements,

H_0 = There is no difference between mean gross margin of Desi and BARI-2016, and

H_1 = There is a difference between mean gross margin of Desi and BARI-2016

2. Materials and Method

2.1. Sampling and Study Area

A multi-stage simple random sampling method was adopted to collect data. Three different districts of Pothwar region (Talagang, Chakwal, and Attock) were selected for study shown in table 1. At first stage, 13 progressive farmers from Chakwal, at second stage with 20 from Talagang and at third stage almost 10 from Attock were chosen because these are major areas of cultivation. After selection of the above-mentioned farmers from each district. Data were collected through a well-constructed questionnaire perform. Questionnaire was filled with personal interviews where farmers are not understanding the described objective.

Table 1. Proportion of farmers by district

District	Percentage of farmer	Number of farmers
Talagang	46.5%	20
Chakwal	30.2%	13
Attock	23.3%	10
Total	100	43

2.2. Data Analysis

Data is analyzed through farm cost, revenue, net profit and gross margin matrices. Theories proposed the following formula to compute cost, revenue, and profit (Mankiw, 2014; McConnell & Brue, 2005).

$$\pi_i = TR_i - TC_i$$

Where;

π_i Represent the net profit/Gross revenue of groundnut farmer

TC_i Represent total cost of groundnut farmer

TR_i Represent total revenue of groundnut farmer

Hereafter, the gross margin model was used that precisely depicts the overall economic return to farmers. The basic purpose for the application of gross margin model is that most of the farmers have their own land for cultivation instead of taking on lease or rent. That's how the described model clearly depicts the overall profit margin.

Such model had most frequently used by different researchers from a few last couple of years in their research work. (Girei et al., 2013; Onyuka, 2016; Abdullahi et al., 2017). Model equation is specified as under

$$GM = TR - TVC$$

GM = gross margin

TR = total revenue

TVC = total variable cost

John Maynard Keynes represents the revenue theories in 1930 according to this theory total revenue can be calculated

$$TR = P \times Q$$

P = price of commodity, Q = total quantity of commodity

In this research total variable cost is the sum of all running expenses involved in cultivation of groundnut crop. For instance, land preparation cost, sowing cost, seed cost, seed sowing cost, fertilizer cost, hoeing cost, weedicides cost, crop harvesting cost, marketing cost. The equation of total variable cost is given below.

$$TVC = LPC + SC + SSC + FC + HC + WC + CHC + MC$$

Furthermore, in this analysis different financial approaches were utilized like return on investment, and cost benefit ratio their respective equations are specified as follow

$$RI = \frac{NP}{TC}$$

RI = Return on Investment

NP = Net profit/ net farm Income

TC = TFC + TVC

$$BCR = \frac{TR}{TC}$$

2.3. Statistical Techniques

After analyzing and processing the data on the ground of concerned objectives, paired sample t-test model and descriptive statistics techniques (mean, standard deviation, minimum, and maximum) were applied for variety wise and district wise analysis respectively.

Abdullah et al., 2017 also used paired sample t-statistic technique in his research work and model

of paired sample t-test statistics is commonly defined as (William Sealy Gosset, 1908)

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1}{n_1} + \frac{s_2}{n_2}}}$$

\bar{x}_1 = mean gross margin of sample one

\bar{x}_2 = mean gross margin of sample two

s_1 = variance of sample one

s_2 = variance of sample two

n_1 and n_2 Sample size of two groups

3. Results and discussion

3.1. Cost and return for groundnut (BARI-2016) cultivation in Pothwar region

Cost included all the expenses involved in the cultivation of groundnut crop that brings raw seed to full flesh edible peanut. Meanwhile cost of production comprises into total variable cost (TVC) and total fixed cost (TFC). In this research total variable cost is the sum of all those running expenses that have made on the different items and activities involved in groundnut cultivation e.g. (land preparation, sowing, seed, fertilizers, hoeing, weedicides, harvesting, and marketing) that is Rs. 74900/- per acre and total fixed cost just based on land rent per annum that is Rs. 25000/- per acre. Although here fixed cost is only 25% of the total cost but maximum farm activities are personally carried out by farmers which is the large profit incentive for farmers. Table 2 results demonstrated that for the year 2023-2024, total cost of production (on average) and total return (on average) for groundnut cultivation are Rs.99,900/- per acre, and Rs.450,000/- per acre respectively. Meanwhile table 3 results are showing that gross margin and net profit for groundnut are Rs.375,100/- per acre and Rs.350,100/- per acre respectively while return on investment and BCR are 3.5% and 4.5%. On account of described results it is clear that groundnut variety BARI-2016 has much potential for Pothwar region farmers. Same economic matrix analysis regarding cost and revenue of any crop had been carried out by (khan et al., 2023; Stoyanova et al., 2022; Akhter et al., 2021; Yadav et al., 2020; Onyuka, 2016) in their research work.

Table 2. Cost and Return for Groundnut (BARI-2016) Cultivation in Pothwar Region, 2023-2024

Items	Amount
Average yield of groundnut (Kg/acre)	960
Average selling price of groundnut (Rs/Kg)	450 (960@450 = 432000)
Average selling price of Groundnut straw (Rs/acre)	18000
Total revenue	450000
Land preparation	8000
Sowing (1 acre@2500=)	2500
Seed (40 kg@625=)	25000
Fertilizers	9000
Hoing (per acre)	8000
Weeding (per acre)	5000
Harvesting (Digging and Threshing)	15000
Marketing cost (24 md@100)	2400
Total Variable Cost	74900
*Total Fixed Costs	25000
Total Cost of production	99900

*Fixed costs include land rent per annum/acre.

Table 3. Financial Analysis of Groundnut

Gross Margin (Rs./acre)	375100
Net Farm Income	350100
Return on investment	3.5
Benefit Cost Ratio	4.5

*Net farm income/ Net Profit (π) = TR - TC

* Return on investment = Net farm Income/Total Cost of Production

* Benefit Cost Ratio = TR/TC

* Gross Margin = TR - TVC

3.2. District wise Comparative Assessment of Groundnut Yield, Cultivated Area, and Gross margin

The basic quest behind the district wise comparison of area, yield and gross margin is that which district is economically efficient and progressive. The similar division wise analysis was also undertaken by (Onyuka, 2016) in his research. In table 4, results depict that Chakwal having highest gross margin/acre as compared to the other two districts which is Rs.233,938/- mean while Attock, and Talagang are at second and third numbers with Rs. 190,443/-, and Rs. 136172/- gross margin/acre, respectively. Similarly, among the three described districts, Chakwal was found on top, Talagang on second, and Attock on third number as they are producing 18.15 md/acre, 17.76 md/acre, and 15.67 md/acre respectively. Although Chakwal having the highest yield and gross margin but having the lowest area under cultivation which is 3.20 acres side by side with the lowest gross margin/acre, Talagang has first rank regarding area under cultivation which is 10.42 acres a while district Attock ranks third.

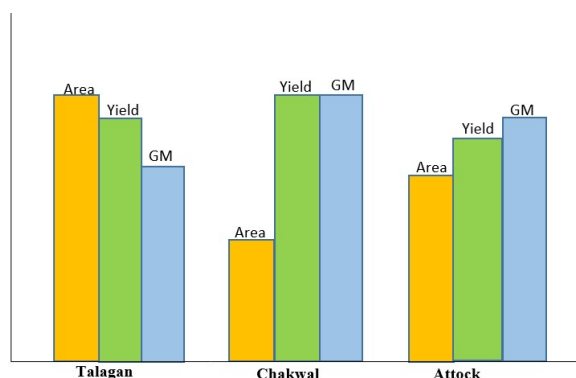


Figure.1 Ratio of area, yield and gross margin

Ratio Scale:

- ✚ District Talagang area under cultivation is standard (100%) for other two districts out of which Chakwal has 30% area while Attock has 60% area under cultivation.
- ✚ District Chakwal yield/acre is standard (100%) for other two districts out of which Talagang has 94% Yield/acre while Attock has 83% Yield/acre.
- ✚ District Chakwal gross margin is standard (100%) for other two districts out of which Talagang has 58% gross margin while Attock has 81% gross margin/acre.

Table4: District wise descriptive Statistics of groundnut production

District	Statistics	Area per acre	Yield (Mnd/acre)	Gross margin (Rs./-acre)
Talagang	N = 20			
	Mean	10.42***	17.76**	136172.00*
	Std. Deviation	12.45	5.24	81607.65
	Minimum	1	5	26750
	Maximum	80	24	295950
Chakwal	N = 13			
	Mean	3.20*	18.15***	233938.46***
	Std. Deviation	1.48	6.64	130981.80
	Minimum	1	10	32000
	Maximum	6	35	563600
Attock	N = 9			
	Mean	6.78**	15.67*	190443.89**
	Std. Deviation	5.59	4.1	72093.78
	Minimum	1	7	51700
	Maximum	16	20	257890

3.3. District wise comparative assessment of groundnut yield, cultivated area, and gross margin

In this research work, we had compared the gross margin of groundnut varieties. The basic purpose of comparing both varieties was to find out findings generalized and satisfied the economic efficiency of BARI-2016 in contrast to the Desi variety. In this regard, we had formalized a hypothesis either there exists any difference in the mean gross margin of the two varieties or not. For the statistical significance of this hypothesis, we had applied a paired sample t-test result. At $\alpha = 0.05$, it was found that there exists Rs. 96286.1 difference in the gross margin of both varieties on average with Rs.47,513.13/- Standard error. Alternative hypothesis was accepted (there was a difference in the gross margin of BARI-2016 and Desi variety) on behalf of t-value (2.027), which was also significant because the p -value is 0.01.

According to the rule of thumb, if the t-value is 2 or greater than 2 at a 0.05 level of significance then alternative hypothesis should be accepted and the null hypothesis should be rejected. In

these results, the p -value is 0.01 which indicated that there was only a 1% chance of accepting the null hypothesis (there is no difference in the gross margin of BARI-2016 and Desi variety). Hence the results in table 5 are clearly demonstrated that on average Rs.96286/- gross margin/acre difference exists between BARI-2016 and Desi varieties. Same findings had also been done by Khan et al., 2023 and Abdullhai et al., 2016 on different varieties of maize and Groundnut respectively.

Table 5. Paired Sample t-test Results

Variable	Average Gross Margin	Paired sample test				
		Mean	S.E	df	t-value	P-value
Desi variety	104594.7(17139.3)	96286.1	47513.13	12	2.027***	0.01
BARI-2016	200881.6(29389.4)					

T-value is *** Significant at 1% (0.01)

4. Conclusion and Recommendation

This study revealed that even though groundnut is the cash crop of the Pothwar region of Punjab but among the three specified districts Chakwal gross margin and yield per acre is the highest as compared to other the two districts which is Rs. 233,938/- and 18.15 md/acre respectively during 2023-2024. Meanwhile, cost-benefit and return on investment ratios were calculated to be 4.5 and 3.5 which showed that BARI-2016 variety had much potential for farmers. Similarly, paired sample t-test results revealed the significant different between average per acre gross margin of the BARI-2016 and Desi variety of groundnut crop which is Rs. 96,286.1/- per acre as well. Based on the above results, it is recommended that different trainings and seminars should be conducted at village and union council level to aware the farmers about the profit margin of new approved varieties. It is also suggested that farmers of Chakwal used new approved varieties along with approved production technologies. Due to which they are getting maximum return per acre which in turn not only increase their level of income but also increased national income in long-run, thus providing the basis for groundnut industry development in Pothwar region of Punjab.

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Conflicts of Interest

The authors of this manuscript declare no conflict of interest.

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