



Key Characteristics and Poverty Differences among Adopters and Non-Adopters of Sunflower Crop in Districts Swabi and Mardan, Khyber Pakhtunkhwa

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Abstract: This study was carried out in two districts of Khyber Pakhtunkhwa, namely, Swabi and Mardan. Primary data was collected with structured questionnaire from 100 responds with purposive sampling technique. Basic descriptive analysis and key characteristic differences were estimated through paired t test and lastly poverty measures were estimated to find out poverty depth and severity among adopters and non-adopters of sunflower. Analysis of the survey data indicated that there were 57 non-adopters and 43 adopters of sunflower. Adopters on the average have 31 years of age against the non-adopters' age of 41 years and farm size average of adopters was 1.39 acres, whereas non-adopters were 2.75 acres. In terms of gross revenue from adopter of sunflower and non-adopter of sunflower, sunflower adopter gross revenue was Rs. 23,915 and gross revenue of tobacco was Rs. 109,862, with a highly significant difference of Rs. 85,947, whereas non-adopter achieved higher profit by growing tobacco than the grower of sunflower, which indicated key difference of income level of adopters and non-adopters. A similar difference was also found significant, in comparing sunflower with sugarcane, while, in case of poverty measures, the headcount poverty index, as well as, the poverty gap index and squared poverty gap index, all appeared to be lower among the non-adopters. This economic loss became the major reason for non-adoption of sunflower crop in its potential growing areas, due to lack of proper price policy and market structure for the growers.

Key words: Rural poverty, Adopters, Non-adopters, Sunflower.

INTRODUCTION

Agriculture is the strength of Pakistani economy, which is providing 43.4% employment to population, contributing about 20.9% in the GDP and providing raw materials to industrial sector of Pakistan. There are two major cropping seasons in Pakistan, i.e., Kharif and Rabi. Main crops of the Kharif season are sugarcane, rice, cotton, maize, mungbean, mash and jowar; their sowing months are April-June and harvesting months are October-December, whereas, Rabi crops, i.e., wheat, gram, lentil, tobacco, sunflower, rapeseed, mustard and barley, are sown in October-December and harvested in April-May. Major crops accounted for 31.9% and minor crops, such as, oilseed crops, added 10.1% of the value added in overall agriculture. A vast majority of people (67%) in Pakistan lives in countryside areas and their livelihood, directly or indirectly, depends on agriculture (GoP, 2011-12). Any technological or productivity enhancement in agriculture, consequently, not only pays to whole financial growth, but it, furthermore, delivers instant microeconomic advantage for an enormous number of rural households.

The major oilseed crops cultivated in the country contain canola, sunflower, cottonseed, rapeseed and mustard. In Pakistan, the local availability of eatable oilseed hardly meets the demand and the same scenario continues since decades. Growing population and incessant increase in urbanization has extended the gap among resident supply and demand. Presently, overall necessity of edible oil is 2.045 million tonnes in the country. Through, during the year 2010-11, the domestic demand of edible oil was 3.079 million tonne and supply was 0.696 million tonne (34% of the prerequisite); while, imports of edible oil or oilseed was 2.383 million tonnes. The import bill reached to Rs. 224 billion (US\$ 2.611 billion) in 2010-11 and in first eight months of fiscal year 2011-12, Pakistan imported 1.46 million tonne worth of \$ 1.65 billion on edible oil (GoP, 2011-12). Pakistan meets only 36% of its demand for edible oil through local production and has to import from abroad the remaining 64% for this purpose, which is a heavy burden on the foreign exchange reserves. Pakistan's import bill of oil and edible products is causing an increase in trade deficit of the country. The situation thus necessitates for the enhancement of the indigenous oilseed production to

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save the country from a major calamity in future (GoP, 2011-12).

Sunflower (*Helianthus annuus* L.) is an imperative oilseed crop, mostly cultivated for edible purpose in the world. It is placed as one of the world's prominent crop in terms of total production and trade (Khosro, 1992). It was cultivated on around 23.31 million hectares all over the world with 29.90 million tonnes of production. Russia, Argentina, America, China, Rumania, France, Canada, Turkey and Hungary are major sunflower growing countries in the world (NARC, 2009).

Sunflower assumes special position in the agricultural economy of Pakistan. Its cultivation was initiated in Pakistan as a complementary oilseed crop in 1970, with a small number of imported cultivars from Russia. It soon became well-liked amongst the farmers and consumers, as a good source of income and edible oil. Sunflower oil is similar to olive oil and suitable for cooking purpose. The seed of sunflower is rich in proteins and also is used for animal and poultry feed. Sunflower-seeds contain oil (47%), protein (24%) and is relatively low in carbohydrates (20%) (Ahmad *et al.*, 2001). Although, sunflower was introduced as an oilseed crop 40 years ago, but its expansion in area and production has been subject to fluctuations, due to various economic and socio-economic reasons. Research on sunflower crop has revealed that there is an abundant prospect of growing it in all types of soil and climatic conditions in different agro-ecological zones (NARC, 2009).

KPK has an exclusive agronomic atmosphere, where growing of double harvests of sunflower in a single year is conceivable by adopting appropriate traditional practices. In Khyber Pakhtunkhwa, a huge area of irrigated and dry land in the high rainfall zones is open for the cultivation of sunflower during the months of June to October. Some land remains fallow after tobacco, barley, wheat, rapeseed and mustard. Sunflower is the suitable substitute, which can fill up this gap, as hybrid varieties of sunflower are obtainable that can mature in 90 to 110 days (Bakht *et al.*, 2006).

In KPK, sunflower was introduced in the year 1976, but commercially, it was adopted by a large number of farmers, by 1990. During the year 1990, there was an increasing trend of cultivating sunflower up to the year 1999. During 1990, the area under sunflower in Khyber Pakhtunkhwa (KPK) was 2,562 hectares, with upward and downward trend, it reached 5,096 hectares, during 1999, while after 1999, there was a continuous decreasing trend in adoption of sunflower, where it decreased down to just 527 hectares in the year 2010 (GoP, 1995-96, 2005-06 and 2009-10). However, in case of yield, sunflower has a great potential. The yield of sunflower in KPK is almost equal to that of Punjab and higher than Sindh, for the last ten years. The facts show that there is a potential for growing sunflower in Khyber Pakhtunkhwa, however, in case of area under

sunflower, Punjab and Sindh areas are leading (GoP, 2009-10).

Currently, D.I. Khan, Swabi and Mardan are leading districts for the area and production of sunflower in KPK province. Considering major producing areas, Swabi and Mardan districts were focused for this study. The average yield of sunflower, in D.I. Khan, Swabi and Mardan districts, was 602, 660 and 655 kg/ha in the year 2009 (Govt. of KPK, 2009). A number of hybrid sunflower varieties, such as, Hysun 33, SF 187, NKS 278 and NK 265, have been introduced and grown in the major sunflower growing districts of KPK (Govt. of KPK, 2011). Although, numbers of hybrid varieties have been reported in these districts, but the productivity statistics indicate that the adoption of hybrid is unsatisfactory. People used low standard seeds that resulted in low productivity despite the fertile land and sufficient water availability (SMEDA, 2009). The objective of the study is to find out key differences and poverty ratio among the adopters and non-adopters of sunflower crop for district Swabi and Mardan, Khyber Pakhtunkhwa.

MATERIALS AND METHODS

This part includes a picture of the study area, the approaches applied for data collection and the sampling framework. An appraisal of the procedure is applied to analyze this type of data. The following methodological strategy was adopted for this scientific venture:

Study area: The study was based on primary data source. Swabi and Mardan districts of KPK were selected for data collection. Swabi district lies between Kabul River and Indus River in KPK. Mardan is the second largest district of KPK after Peshawar in terms of population. Swabi and Mardan districts are sacred with productive farming acreage; as a result, maximum of the people are connected with farming activities of agriculture. Selection of these two districts was based on the secondary data that indicates the fact of increasing trend of sunflower non-adoption from the year 2001 to onward (Govt. of KP, 2011).

Sampling procedure and data collection: Primary data was collected from the sampled respondents in the study area. A purposive sampling technique was applied and 100 respondents were interviewed from Swabi and Mardan districts of KPK. The reason for purposive sampling was gaining access to respondents, who could be interviewed in depth. The population of the study comprised the sunflower adopters and non-adopters of these districts. Swabi, Chota Lahore and Razar tehsils of districts Swabi were selected, from each tehsil, two villages were selected purposely for data collection and from each tehsil of Swabi, 20 respondents were interviewed and total 60 respondents from Swabi district. From district Mardan, 40 respondents were interviewed from Akbar

Abad, Mohdheir and Thordheir villages of tehsil and district Mardan. Total number of respondent was 100, who were selected purposely for the study (Table 1).

Table 1: Number of respondents in selected villages of Swabi and Mardan.

District	Tehsil	Village	Sample size	Total (Tehsil)	Total (District)	Total sample size
Swabi	Swabi	Asota Sharif	6	20	60	100
		Ismaila	14			
	Chota Lahore	Yaquobi	10	20		
		Chota Lahore	10			
	Razar	Karnal Sher Khan	10	20		
		Razar	10			
Mardan	Mardan	Akbar Abad	11	40	40	
		Mohdheir	17			
		Thordheir	12			

Source: Field Survey, 2013.

Descriptive statistics: A category wise, i.e., adopters and non-adopters of sunflower descriptive analysis was carried out. In the descriptive analysis, mostly the mean values were calculated along with minimum and maximum values.

Paired t-test: The data from two farming categories was compared through paired t test to compare the mean differences of adopter and non-adopter characteristics, as it was used in previous research studies by Paula *et al.* (2008) and Ullah *et al.* (2011). Treating the difference as random samples from a normal population with mean $\mu_D = \mu_1 - \mu_2$ and unknown standard deviation σ_D , we performed a two tailed t-test on them.

The hypothesis process for paired t-test is given below:-

1) Testing hypothesis,

$$H_0 : \mu_{SF\ Adoption} = \mu_{SF\ Nonadoption}$$

i.e., there is no farm economic difference among the adopters and non-adopters of sunflower and the alternative is,

$$H_1 : \mu_{SF\ Adoption} \neq \mu_{SF\ Nonadoption}$$

i.e., there is a difference between the adopters and non-adopters of sunflower.

Let $d_i = x_{1i} - x_{2i}$ represent the change among samples observations in the *ith* pair.

2) The Significance level is set at $\alpha = 0.05$ or 0.01

3) The test statistic under H_0 is $t = \frac{\bar{d}}{s_d / \sqrt{n}}$

with $\nu = n-1$ degrees of freedom, $\bar{d} = \frac{\sum d_i}{n}$ and

$$s_d = \sqrt{\frac{\sum (d_i - \bar{d})^2}{n-1}} = \sqrt{\frac{1}{n-1} \left(\sum_{i=1}^n d_i^2 - \frac{(\sum d_i)^2}{n} \right)}$$

where n represents the number of sets and d_1, d_2, \dots, d_n is a random sample of differences and the differences are normally distributed.

4) Computation

5) The Critical Region is $|t| \geq t_{\alpha/2, (n-1)}$

6) **Conclusion:** if the calculated value of t is larger than the tabulated value of t then we reject the null hypothesis and vice versa.

Poverty measures: In order extend the poverty outlines of the agrarians in the study area, numerous approaches were applied to evaluate the level and symptoms of poverty between the adopters and non-adopters of sunflower growers. Precisely, the headcount index, poverty gap index and squared poverty gap index procedures were engaged in the exploration. Headcount measure evaluated the absolute number of the poor in the adopters and non-adopters of sunflower growers. Poverty gap evaluated the percent of the poor in the total sample of the study. Squared poverty gap estimated the strength of poverty founded on the amount of income deficits under the poverty line by the poor in the adopters and non-adopters of sunflower growers (Olubanjo, 1998). Poverty is the state of an individual, who lacks a certain amount of money, i.e., \$1/day. Poverty analysis was carried out for adopters and non-adopters of sunflower by considering their total income earning by farm and nonfarm activities. For poverty estimates, three measures used in the analysis, were those of Foster *et al.* (1984), given as under:

Headcount poverty:

$$P_0 = \frac{1}{N} \sum_{i=1}^N I(y_i < z) = \frac{N_p}{N}$$

where,

P_0 = headcount poverty

N = total population

y_i = income of respondents ($y_i = Y_F + Y_{NF}$)

z = poverty line

N_p = number of poor

Poverty gap: A moderately general poverty is the poverty gap index, which adds up the amount to which persons on usual fall under the poverty line and precise it as the proportion of the poverty line.

Where, P_1 is poverty gap, G_n is poverty gap and z is the poverty line. Poverty gap index can be written as:

$$P_1 = \frac{1}{N} \sum_{i=1}^N \left(\frac{G_n}{z} \right)$$

Squared poverty gap: By squaring the poverty gap index, the amount indirectly places extra weight on explanations that fall under the poverty line. This is simply the weighted sum of poverty gap index and formula for squared poverty gap index is as follow:

$$P_2 = \frac{1}{N} \sum_{i=1}^N \left(\frac{G_n}{z} \right)^2$$

RESULTS AND DISCUSSION

Area allocation to different crops: Availability of irrigation water had a great expand in the farm activity in the Swabi and Mardan districts of KPK. Majority of the farmers has changed its traditional cropping pattern with the high value crops, like, tobacco, sugarcane, wheat and maize and ignoring minor crops, like, sunflower. Generally, farmers were allocating a major share of their land to tobacco and sugarcane. The sampled growers cultivated 51.75% of total area under tobacco and maize, 35.57% area was cultivated under sugarcane and wheat, 10.69% area under sunflower and remaining 1.99% area was for vegetables. The average farm size of sample respondent was reported to be 3.84 acres. Intercropping sugarcane with wheat is also recorded in data from sampled growers of the study. The details are presented in Table 2.

Table 2: Area allocation to different crops of sample respondents (Acres).

Crop	Area	Mean	%
Tobacco and maize	198.72	1.98	51.75
Wheat and sugarcane	136.58	1.36	35.57
Sunflower	41.05	0.41	10.69
Vegetables and other	7.64	0.08	1.99
Total	384	3.84	100

Source: Field Survey, 2013.

Sunflower adoption and non-adoption: This study analyses the adoption and non-adoption percent in Swabi and Mardan districts of KPK. The analysis of the survey data indicated that there were 57 non-adopters and 43 adopters of sunflower. Adopters were those who planted sunflower in 2012 and 2013 season. Thus, farmers, who planted sunflower in 2012 and not in 2013, were still considered as adopters of

sunflower. Non-adopters were those who had not planted sunflower in either 2012 or 2013. This classification of adopters and non-adopters is based on these two agriculture years' 2012 and 2013, on similar lines classification of adopters and non-adopters applied by Morse *et al.* (2007). The details are presented in Table 3.

Table 3: Distribution of adopter and non-adopter of sunflower.

Variable	Frequency	%
Non-adopter	57	57
Adopter	43	43
Total	100	100

Source: Field Survey, 2013

Farm size-wise comparison of adopters and non-adopters: Overall 57% famers were non-adopters and 43% were adopters. 27% small famers were adopters and 19% small famers were non-adopters of sunflower. In medium farmers, 10% were adopters and 9% non-adopters of sunflower. In case of large farming area, 29% were non-adopters and 6% were adopters of sunflower. It can be concluded that sample farm households from KPK, small farmers were more dependent on sunflower crop for their crop sector income as compared with large farmers. The details are presented in Table 4.

Comparison of adopters and non-adopters of sunflower: The farm level data was collected from two types of respondents: adopters and non-adopters of sunflower. In a sample, there were 43 adopters and 57 non-adopters. The characteristic of these groups was different from one another. Adopters on the average have 31 years of age against the non-adopters' age of 41 years, indicating that relatively young farmers prefer to adopt sunflower on their fields. Both types of respondents have significant difference of 10 years in the mean age, which is significant at 1% significance level. Experience is an important factor in taking farming decision on the average, adopters have the experience level of 9.46 years, whereas non-adopters are 12.42 years with an insignificant difference of 2.96 years with t-value of 0.97. Average schooling years of the adopters are 8, whereas non-adopters are 6 with the insignificant difference of 2 years. Average household size of adopters is 4.97 and non-adopters 6.24, with difference of 1.26.

Table 4: Farming area-wise comparison (Acres).

Farm Size	Adopters		Non-adopters	
	Frequency	Percent	Frequency	%
Small farmer (≤ 5 acres)	27	27	19	19
Medium farmers (between 5 and 12.5 acres)	10	10	9	9
Large farmers (≥ 12.5 acres)	6	6	29	29
Total	43	43	57	57

Source: Field Survey, 2013

Total farm size average of adopters is 1.39 acres, whereas, non-adopters is 2.75 acres, with significant difference of 1.36 with t-value of 2.05. The results show that 47 farmers took loan, in which 69% farmers are non-adopters and 31% are adopters, with significant difference of 38%. There is a significant difference in land preparation with tractor of adopters and non-adopters, adopters take 6.25 hours per acre and non-adopters take 8.78 hours per acre with a significant difference of 2.53.

In terms of total cost for sunflower grower and tobacco grower, there was a wide difference between both crops' cost of production. Sunflower average total cost was Rs. 12,798.04, as compared to tobacco average total cost of production per acre that was Rs. 41,316.12, with mean difference of 28,518.08 and significant at 1% significance level. In comparing sunflower and sugarcane, and mean value of sunflower, total cost per acre was Rs. 12,798.04, and sugarcane average total cost of sugarcane was Rs.

41,822.31 with a mean difference of Rs. 29,024.27, and highly significant at 1% significant level.

In terms of gross revenue from adopter of sunflower and non-adopter of sunflower, sunflower adopter gross revenue is Rs. 23,915 and gross revenue of tobacco is Rs. 109,862, with a highly significant difference of Rs. 85,947, whereas, non-adopter achieved higher profit by growing tobacco than the grower of sunflower. Monetary loss of the adopter is significantly higher than the non-adopter by Rs. 85,947.

These results showed that farmers were more interested in growing tobacco rather than sunflower, due to the profitability difference. Sunflower average gross revenue was Rs. 23,915, as compared to sugarcane gross revenue, which was Rs. 94,269, with a highly significant difference of Rs. 70,354 and significant at 1% significance level. The details of the key characteristics of the adopters and non-adopters are presented in Table 5.

Table 5: Key characteristics of adopters and non-adopters.

Characteristics	Mean Adopter	Mean Non-Adopter	Difference	t-value
Age (Years)	30.72	41.01	-10.29***	-3.01
Experience (Years)	9.46	12.42	-2.96	-0.97
Education (Years)	8.70	6.41	2.29	0.88
Household size (Numbers)	4.97	6.24	-1.27	-1.02
Farm size (Acres)	1.39	2.75	-1.36**	-2.05
Credit (Percent)	31	69	-38***	-4.13
Land preparation (Tractor hours)	6.25	8.78	-2.53***	-2.55
Comparative difference of total cost of sunflower and tobacco (Rs.)	12798.04	41316.12	-28518.08***	-23.09
Comparative difference of total cost of sunflower and sugarcane (Rs.)	12798.04	41822.31	-29024.27***	-25.06
Comparative difference of sunflower and tobacco gross revenue (Rs.)	23915	109862.20	-85947.20***	-23.7
Comparative difference of sunflower and sugarcane gross revenue (Rs.)	23915	94269.23	-70354.23***	-14.8

Note: *** and ** indicate that coefficient is significant at 1 and 5% level of significance, respectively

The farm level data was collected by adopters and non-adopters of sunflower and paired differences were estimated. Age, experience, education, average household size, total farm size, credit availability, land preparation (tractor hours), comparative difference of total cost of sunflower and tobacco, comparative difference of total cost of sunflower and sugarcane, comparative difference of gross revenue (in rupees) of sunflower and tobacco, and comparative difference of sunflower and sugarcane gross revenue have paired difference with t values of -10.29, -2.96, 2.29, -1.27, -1.36, -38, -2.53, -28518.08, -29024.27, -85947.20 and -70354, respectively, and with t-values of -3.01, -0.97, 0.88, -1.02, -2.05, 4.13, -2.55, -23.09, -25.06, -23.7 and -14.8, respectively. These results indicated clear differences between adopters and non-adopters, with significant t-values. On similar lines difference between income levels of adopters and non-adopters were found by Khan *et al.* (2012). Ashiq and Ahmed (2001) have also compared and measured

the differences between adopters of sunflower and wheat on similar lines.

Poverty measures for adopters and non-adopters of sunflower: The headcount poverty index of adopters and non-adopters is presented in **Table 6 ?**. The headcount poverty index, as well as, the poverty gap index and squared poverty gap index all seem to be lesser for the non-adopters of sunflower. As shown in **Table 6**, the headcount poverty index, among respondent of the study area, was **21%** resultant from **27%** for the adopters of sunflower and **15%** for non-adopters of sunflower. It may, therefore, be inferred that that overall, **21%** of the respondent farmers and **27%** of sunflower adopters were essentially poor.

The poverty gap of the total sample size was 11%. 17% figure was for sunflower adopters and 7% for non-adopters of sunflower. This suggests that the poor sunflower growers required 11% and non-adopters of sunflower crop growers required 7% of the poverty line to get out of poverty.

Finally, overall squared poverty gap index, calculated by FGT, was 0.07%. This result suggests that a difference is made among the poor and the poorest. There was dissimilarity between squared poverty gap index of sunflower adopter's growers (12%) and non-adopter growers of sunflower (0.04%). The details are presented in Table 6.

Table 6: Poverty level of adopters and non-adopters of sunflower.

Poverty Measures	Adopters	Non-adopters	Overall
Headcount poverty index	0.27	0.15	0.21
Poverty gap index	0.17	0.07	0.11
Squared poverty gap index	0.12	0.04	0.07

Source: Field Survey, 2013.

To compare the poverty differences among adopters and non-adopters headcount ratio, poverty gap index and the squared poverty gap were estimated, which indicated that poverty level among the adopters was higher than non-adopters of sunflower. Similar results were reported by Kassie *et al.* (2010), for improved groundnut varieties adoption and poverty reduction status in rural Uganda. However, the depth and severity of poverty was higher in adopters of sunflower, as compared to non-adopters. These estimations of poverty were followed by the widely used poverty measures proposed by Foster *et al.* (1984).

CONCLUSION

Characteristics of adopters and non-adopters have been estimated by descriptive analysis. There was a major paired difference of income level between adopters and non-adopters of sunflower. The difference of profitability between sunflower and tobacco income (Rs. 85,947), meant that tobacco provided Rs. 85,947, more than sunflower and the difference between sunflower and sugarcane was Rs. 70,354. In this scenario farmers earned more profit from tobacco and sugarcane as compared to sunflower. So, the main reason for non-adoption was the economic, as they were in a better economic condition by growing tobacco and sugarcane instead of sunflower. Keeping in view, the results of the study subsequent recommendations are made:

- To provide high quality hybrid seed to farmers.
- Research efforts should be made to overcome the problems faced by sunflower growers.
- Farmers are not fully aware of the production proficiency of the sunflower, which affects the yield of sunflower. Therefore, extension department should deliver the technical

assistance to the farmers concerning to the production technology.

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