

Research Article



With and Without Intercropping Economic Evaluation of Mango Fruits: Evidence from Southern Punjab, Pakistan

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Abstract | After Citrus, Mango is the second prevalent horticultural crop in Pakistan. Pakistan comes at 4th number in the production of mango and comes at 3rd number in the export of Mango. About 80 percent of Mango exports come from Punjab province. Muzaffar Garh district stands at third position in producing good quality mangoes in Punjab followed by Multan and Rahim Yaar Khan. Present research was done to check the economics of mango production with and without intercropping and determined various factors that affect mango production in Muzaffar Garh. Simple random sampling technique was used to select 110 mango growers from 4 union councils of tehsil Ali Pur. To scrutinize the data double log model was renovated from Cobb-Douglés production function. Results showed that Benefit Cost Ratio (BCR) with and without intercropping was 1.72 and 2.48 respectively. Nearly 64 percent of the factors analyzed were affecting mango production and adjusted R² was at 0.62. The whole goodness of fit model was enlightened by the high significance of F-value i.e., 26.5 where p<0.01. Mango plantations with intercropping were 76.6 percent lesser per acre yield as compared to without intercropping. Agri. extension workers should inform mango growers to give up intercropping in order to get a higher yield.

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Introduction

The horticulture sector of Pakistan has a comparative advantage over local competitors because of greater returns and the contribution of horticulture in whole Gross Domestic Product (GDP) of Pakistan. From total cropped area of Pakistan, horticultural crops are planted on 1.28 million hectares area which includes only 5.37 percent total cropped area of Pakistan. From this horticultural cropped area fruits are grown on 0.78 million hectares area (MNFSR, 2018). Among horticultural crops, Mango (*Mangnifera indica*) is second highest prevalent fruit grown in Pakistan after Citrus. Subsequent to

India, China and Thailand, Pakistan keeps the fourth position in producing Mango fruit (FAO, 2012) on 0.16 million hectares (MNFSR, 2018) with 1.73 million tons production (GOP, 2018). Pakistan is third largest exporter of mango after Mexico and the Philippines has a share of 7.60 percent in the global market (CIA world fact book, 2011). Japan, United Kingdom, Germany, Iran, Hong Kong and Middle East Countries are the main importers of Pakistani mango (Saifullah et al., 2007).

Punjab is the leading province of Pakistan where Mango is grown on 0.10 million hectares with 1.3 million tons of production (MNFSR, 2018). Anwar

Retal, Duseri, Chunsa, Langra, Sindhri, Duseri, Desi, Fijri are planted as leading varieties in Punjab (Chaudry et al., 2006). The foremost areas of mango production are the districts of Muzaffargarh, Rahim Yaar Khan, Bahawalpur and Multan (Bakhsh et al., 2006). As compared to other countries that produce mango the yield of district Muzaffargarh is lesser. Socio-economic dilemmas can condense and economic opportunities can enrich in the countryside area of Pakistan due to the horticulture sector (Alam and Mujtaba, 2002).

Intercropping in fruit plants have various pros and cons, intercropping is useful when there is resourceful use of existing labor and capitals, the safety of nutrition, a decline in soil erosion and decline in threats and enrichment in production. While less availability of light, water and nutrients are minuses of intercropping resulted in less yield (Owuor et al., 2002). When mango was intercropped with three different legume varieties, instead of high infestation of insect attack profit was increased (Agreda et al., 2006). Benefit Cost Ratio (BCR) was higher when medicinal plants were intercropped with mango orchard and lower in alone medicinal cultivation (Ravitchandirane and HariPriya, 2011). BCR of French bean, cowpea, tomato and turmeric was higher when these were intercropped in an experiment of mango-guava treatments than other crops such as ginger, ragi, niger, paddy and guava (Swain and Padhi, 2011). When mango was intercropped with CL-1131, BARI-5, Bio Rakshya, BARI-4 and Pussa Ruby then CL-1131 and Pusa Ruby gave greater net benefits (Sharestha and Lal, 2012).

Date palm yielded fewer dates when it was planted with mandarians, mango and papaya but the yield of dates was higher in sole date palm plantation (Badawy, 2012). When oat was intercropped with four varieties of Mango (Mallika, Amrapalli, Deshari, and Langra), the growth of Amrapalli was recorded lowest (Gill and Ajit, 2006). More fungus attack was observed and the nutrient competition was also high when palm date was intercropped with mango (Abouzienna et al., 2010).

About 20.49 thousand hectares area is occupied by mango plantations and on an average 209.26 thousand tons of mangoes are produced every year Muzaffargarh (TDAP, 2009). Keeping in view the importance of this district present research mainly begins over the

economic gap between with and without intercropping in mango orchards in Muzaffar Garh. Furthermore, various factors will be investigated that are affecting the yield of mango plants.

Materials and Methods

A formal survey of the Mango growers was conducted in 2017 in Muzaffar Garh which lies between 29°38' and 30°46' North Latitude while 70°85' and 71°18' East Longitude. A sample size of 110 mango growers (either without intercropping or with intercropping) was selected from 4 union councils of tehsil Ali Pur, by the technique of simple random sampling. Benefit Cost Ratio was calculated both for sole mango producer and mango production with intercropping as calculated by Sattar et al., 2017.

$$\text{Benefit Cost Ratio (BCR)} = \text{Net Revenue (Crop)} / \text{Total Cost}$$

In order to find the impact of various factors affecting mango production, a Cobb Douglas production function (Debertan, 2012) was used:

$$Y = Ax_1^\alpha x_2^{1-\alpha}$$

It was transformed into double log model by taking natural log on both sides and a dummy was added to check the impact of without intercropping mango production on mango yield. As observed by various studies like Abbas et al. (2012), Zafar et al. (2016) and Abbas et al. (2017).

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 D_1 + \mu$$

Where;

Y is dependent variable (Mango per acre yield) and independents are as follows:

X_1 = Age of the respondents (Years); X_2 = Irrigation (No.); X_3 = Labour cost (Rs.); X_4 = NPK amount (Kg); X_5 = Pesticides (Applications); X_6 = Weeding (applications); D_1 = Dummy variable of Mango orchards without intercropping = 1 and 0 for otherwise. β_0 is the constant, β_s are the elasticities and μ_i is the random error.

Results and Discussion

Socioeconomic characteristics of the study area

The diversified nature of the socioeconomic characteristics was present in the study area (Table 1).

Most respondents were mature, had an age between 41 and 83 years which resulted in an authentic collection of the data. Likewise, most respondents (35 percent) of the study area had attended college and universities. The respondents (29.1 percent) had experienced between 21 and 30 of growing and managing the Mango orchard.

Table 1: Age, education and experience profile of the study area.

Characteristics	Frequency (%)
Age(years)	
16-30	7(6.4)
31-40	26(23.6)
41 and above	77(70)
Education(years)	
Illiterate	17(15.5)
Primary	12(10.9)
UptoMiddle	14(12.7)
Upto Matric	28(25.5)
Inter and above	39(35.5)
Experience (years)	
Upto 10	25(22.7)
11-20	27(24.5)
21-30	32(29.1)
30 and Above	26(23.6)

Out of 110 mango growers, 66 growers were intercropping and 44 growers were experiencing sole mango production (Figure 1). Farmer were cultivating different crops for intercropping with Mango. They were cultivating Lucern, Torea, Cotton, Sugarcane, Sorghum, Pomegranate, Maize and vegetables in Kharif season and were cultivating Barseem, oat, wheat, sorghum and vegetables in Rabi season.

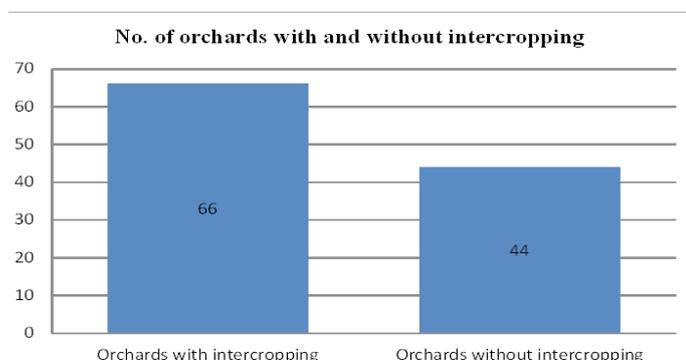


Figure 1: Distribution of number of respondents with and without intercropping.

The average size of mango orchards with intercropping was 5.31 acres and the average orchard size of mango

orchards without intercropping was 8.17 acres (Figure 2). So the average size of sole mango plantations was greater as compared to the size of mango plantations in which other crops were cultivated with a mango tree.

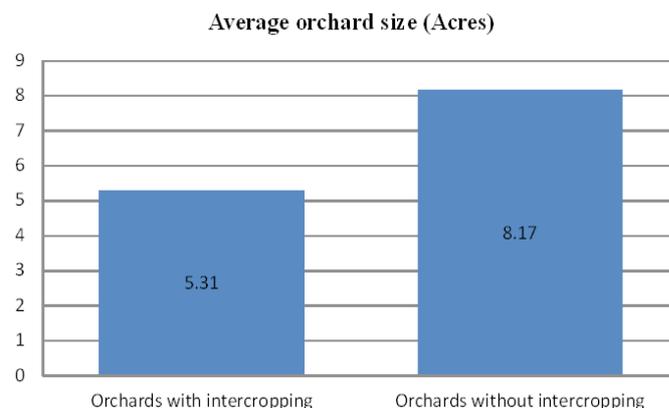


Figure 2: Distribution of size of orchards with and without intercropping.

Table 2 explains the economic analysis of with intercropping and without intercropping of the mango orchard. Total Income from mango orchards without intercropping was Rs. 101436 and net profit was Rs. 60565, while with intercropping net profit was Rs. 43833. Income of orchards without intercropping was higher due to large number of mango plants in an acre. On an average 46 number of mango plants were cultivated in without intercropping orchard and 33 number of mango plants wer cultivated on other hand. Total income from mango orchard and crops was Rs. 37413 and Rs. 67089 respectively. BCR in mango orchards without intercropping was high (Rs. 2.48) as compared to with intercropping (Rs. 1.72).

Table 2: Economic analysis of orchards with and without intercropping.

	Orchards without intercropping (per acre)	Orchards with intercropping (per acre)
Total income (Rs.)	101436.36	Orchard income (Rs.) 37413.26
Total Cost (Rs.)	40870.91	Orchard cost (Rs.) 32578.18
Net Profit (Rs.)	60565.45	No. of plants 33
No. of plants	46	Income/plant (Rs.) 1885.76
Income/plant	2205.14	Yield/plant (monds) 7.14
Yield/plant(monds)	11.45	Yield (monds) 234.83
Yield (monds)	538.92	Total income* (Rs.) 104503.03
BCR	2.48	Total cost(Rs.) 60669.05
		Net profit (Rs.) 43833.98
		BCR(Orchard + Intercrop)
		1.72

*Income both from crops and orchard.

Table 3: Regression results of factors affecting yield of mango.

Variables	Coefficients	Standard error	T - Value	Significance (P-Value)
Constant	5.32	.633	8.403	.000
Age of the respondent (years)	.017	.087	.195	.846 ^{Ns}
Labor cost (Rs.)	.023	.010	2.279	.025**
Amount of NPK (kg)	.106	.035	3.014	.003*
Irrigations (number)	-.146	.142	-1.029	.306 ^{Ns}
Use of Pesticides (number of sprays)	.084	.053	3.243	.042**
Intercultural practices hoeing + weeding (number)	-.021	.070	-.295	.769 ^{Ns}
Without intercropping in orchards, (Dummy Variable)	.766	.089	.692	.000*
R ² .647				
Adjusted R ² .622				
F - Value: 26.66				

*, ** = Significant at 1 and 5 % level where ^{Ns} is non-significant.

Regression analysis was used to interpret the change in the explained variable which was caused due to explanatory variables consistent with [Dhimmar and Raj \(2009\)](#) and [Srivastava et al. \(2007\)](#). In [Table 3](#), results revealed that slope coefficient of the age of the mango grower was directly related to the mango yield. The slope coefficient of the age of the respondent was 0.17, illustrated that one year increase in the age of the respondent results in 0.17 percent increase in mango yield. These results are in line with [Ashfaq et al. \(2008\)](#), who estimated that education had a direct relation with farm diversification. The amount of NPK was directly proportional to mango yield and highly significant which means one kilogram increase in the amount of NPK, the yield of mango increase by 10.6 percent. Likewise, an additional increment of labor cost and pesticide number used for mango production, brought changes in the average yield of mango at the rate of 0.23 and 0.76 percent. On the other hand, irrigation (No.) and intercultural practices had a negative and non-significant relationship with average mango yield. The result of dummy used (without intercropping), had direct and statistically significant relation with average mango yield. These results are in line with [Lachungpa \(2004\)](#) and [Ijaz \(2012\)](#).

Bruesh Pagan Test was used to check heteroscedasticity and Variance inflation factor was used for multicollinearity of model ([Gujrati, 2003](#)). The overall model was different from zero, indicated by the F-test (26.6) showing good fitted of the model. R² (67 percent) of the model showed all the explanatory variables explained the dependent variable by 67 percent.

Conclusions and Recommendations

The profitability of sole Mango plantation and Mango plantation with intercropping was the first study in Pakistan. The research concluded that net profit, benefits and yield of sole mango plantation was significantly higher than that of mango plantation with inter cropping. It was found that pesticide use, NPK amount, and labor cost had a significant impact on mango yield. Likewise, dummy variable of mango intercropping had a significant impact on yield. Furthermore, dummy variable for without intercropping had significant impact exhibiting more yield with sole mango production. As it was found that intercropping in the mango orchards was less profitable as compared to sole mango orchards so government should take some possible steps through agriculture extension workers, to educate mango growers about their losses due to intercropping.

Novelty Statement

Different studies shaped the significance of mango fruits in various ways but present research binge over the gap between productions of mango fruits with inter cropping and without inter cropping.

Author's Contributions

MRM presented the idea, collected the data and conducted research. TM carried out statistical analysis and paper write up. AA helped in paper write up. UAM helped in statistical analysis.

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