Research Article

An Assessment of Economic Gains of Off-Season Vegetable Production in Faisalabad, Pakistan

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Abstract | This paper empirically quantifies vegetable production (off-season and on-season) in terms of economic returns. The data on bitter gourd *(Momordica charantia)* is considered for analysis. The primary data was collected from a sample of 110 farmers in the district of Faisal Abad, Punjab Pakistan. The data was analysed using Ordinary Least Square (OLS) technique. The results show that there is a significant difference between the on-season and off-season application of pesticides to bitter guard crop. The results clearly reveal that bitter guards' yield is significantly higher in the off-season than on-season. It was also found that off-season bitter guard fetches 66% higher price in the market than on-season bitter guard. The analysis also revealed that the cost of pesticides is 43% higher for on-season bitter gourd production than the off-season. The findings also indicate that the cost of fertilisers for the on-season crop was 14% less than the cost of the off-season. On the contrary, the cost of irrigation was 71% higher during on-season than the cost of irrigation in the off-season. Similarly, the cost of seed for on-season bitter guard production is 10% higher than the cost of seed for the off-season. It is concluded that off-season vegetable production is more profitable than on-season vegetable production in Punjab, Pakistan. It is recommended that farmers may be facilitated by the relevant authorities for growing the off-season vegetable production. The farmers should be provided with the necessary requirements for off-season vegetable production to enhance farmer income and improve their socioeconomic status.

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Introduction

Vegetables are an integral part of human food. They are an important source of vitamins, minerals, carbohydrates, and proteins that are required for good human health. In Pakistan, vegetables are cultivated on an area of 350,000 hectares while in Punjab 136,000 hectares are cultivated with vegetables (CRSP, 2012). Nonetheless, the production is below the standard of many developed countries. The low production is attributed to unavailability of quality vegetable seeds, poor land management practices and less area under vegetable cultivation among others. This has further aggravated the vegetable consumption situation in the country. Therefore, the current average, daily per capita consumption of vegetable is only 100 grams which is well below the Food and Agriculture Organization (FAO) recommended level of about 285 grams. Vegetable farming is an extensive input enterprise. In recent years, there has been a growing trend in

the practice of off-season vegetable production in the country. There specific niches across the country where quality vegetable can be produced. Taking into account, the modest profit margins in off-season farmers are inclined to produce vegetable in the off-season. This is attributed to the fact farmers expect that vegetable produced in the off-season is likely to fetch a better price than those which are grown the normal growing seasons.

It has also been observed that in the normal growing season crop require excessive use of pesticides and studies have shown that the use of such chemicals has increased by 70 percent (Tariq, 2002) and the use of pesticides results in residue accumulation in crops (Kavitha et al., 2007). It has further increased the cost of production and has reduced farmers' revenues. Experience has shown that off-season vegetable production requires less frequent use of pesticides and other chemicals than normal season vegetable production. Studies have also shown the use of pesticides are related with the farmers' attitudes and behaviour (Matthews, 2008; Ntow et al., 2006).

It has been empirically established that crop yield varies across different field conditions and regimes (Bamire and Oke, 2004). As farmers are becoming aware from the benefits of the off-season crop production vis-à-vis the increasing demand of certain types of vegetables in the market when the supply of such vegetable declines from other areas, they are adopting the cultivation of off-season vegetable. Over the last couple of years, farmers have switched to the off-season vegetable production across the country. Like many other parts of the country, in the province of Punjab, there is an increasing trend of off-season vegetable production in the province.

Taking into account, the economic significance of off-season vegetable production and its contribution to the farmers' income, this research was designed to assess the economic gains of off-season vegetable production in the province of Punjab.

Materials and Methods

This study was carried out in the District of Faisalabad in the Province of Punjab Pakistan. Geographically, the city of Faisalabad has bounded the districts of Gujranwala and Sheikhupura in the North. In the East by *Sahiwal* and on the South by *Toba Tek Singh*. To the West lies the *Jhang* district. The area is famous for vegetable production. This is mainly attributed to its favourable ecological and soil conditions. This is the reason that both on-season and off-season vegetable production is very common in the area. Such production is more prevalent in the peri-urban areas of the city.

For the purpose of this study, a total of 110 farmers were selected who growing off-season vegetable. In order to solicit the relevant information, a questionnaire was designed for the farmers. The questionnaire was pre-tested and was modified to suit it to the actual field situations. The data was gathered through face to face interviews with farmers. The farmers were visited in their farms, and the objectives of the study were explained to them so that to avoid any unwanted expectations. The farmers took a keen interest in the process of data collection. They were also ensured of the confidentiality of information as some of the farmers were reluctant to share the information cornering income and production.

The data was entered to the Excel Sheet and was cleaned. It was then imported to the Statistical Package for the Social Science (SPSS). The data was initially analysed for major descriptive statistics such a mean, and standard deviation (SD). The data was analysed using Ordinary Least Square (OLS) technique.

To estimate the production of bitter gourd (*Momordica charantia*), the Cobb-Douglas Production function is used. This model is used to examine the impact of various independent variables on the bitter gourd *(Momordica charantia)* production in both off-season and on-season. The general form of the Cobb Douglas production function is specified as follows:

$$lnY = \alpha + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + \beta_7 lnX_7 + \mu i$$

Error term α denotes the intercept and β is the coefficients of regressors while the μi is the error term. Table 1 details the Dependant and independent variables used in the model. In addition to Cobb-Douglas production function, gross margin analysis was applied to investigate the yield and profitability of growing vegetables in on-season and off-season.

Gross margin technique

Gross margin was estimated to make a comparison. The formula used to calculate the gross margins as follows:

$$Gross\ Margin\ (GM) = Total\ Revenue\ (TR) - Total\ Variable\ Cost\ (VC)$$

Usually in the form of a percentage: %

Cost of goods sold (COGS) includes variable cost and fixed cost directly linked to the sale. These include material costs, labour cost, supplier profit, shipping-in costs (cost of getting the product to the point of sale, as opposed to shipping-out costs which are not included in the cost of goods sold. It does not include the indirect fixed costs like office expenses, rent, administrative costs, etc. Higher gross margins for a manufacturer reflect greater efficiency in turning raw materials into income. For a retailer, it will be their mark up over wholesale. Larger gross margins are generally considered ideal for most companies, except discount retailers who instead rely on operational efficiency and strategic financing to remain competitive with lower margins.

Table 1: *Dependent and independent variables and their explanation.*

Variable and unit	Symbol
Yield (kg/acre)	lnY_0
Education (years)	lnY_1
Experience (years)	lnY_2
Seed (kg/acre)	lnY_3
Frequency of irrigation	lnY_4
Fertilizer (Kg/acre)	lnY_5
Labour	lnY_6
Pesticide (bottles/acre)	lnY_7

Results and Discussion

Inputs use comparison in off-season and on-season production

The comparison of inputs used both in off-season and on-season are reported in Table 2. The comparison is made between the average quantity of the use of pesticides, the frequency of irrigation, the quantity of fertiliser, the quantity of seed and the number of hours of labour spent in the field.

The results show (Table 2) that pesticide spray count is higher in on-season as compared to the off-season. There is a significant difference between the number of pesticides sprays in on-season and off-season. Nonetheless, there is no significant difference in fertiliser application between the two seasons. Similarly, there is a significant difference between the frequency of irrigation in on-season and off-seasons. Their frequency of irrigation is two times higher in on season than off-season. This is attributed to the fact that the requirement of water is higher in summer seasons (Shaheen et al., 2009). The results for the number of hours of labour spent in the field indicate that there is a significant difference between the labour hours spent in the field between the two cropping seasons (on-season and off-season). This is attributed to the fact that extra labour is required for the installation of tunnels during off-season vegetable production and hence more labour is used.

Table 2: *Mean comparison of inputs used in on and off-season production.*

Variables	On season (N=110)	Off-season (N=110)
Pesticide spray (no./season)	11.09***(1.00)	6.9(0.81)
Fertiliser (kg/acre)	79.81(21.04)	78.18(47.00)
Irrigation (no./acre)	18.71***(6.92)	8.72(1.2)
Seed (kg/acre)	0.93*(0.48)	0.81(0.60)
Labour (no./season)	33.51***(4.86)	37.81(11.10)

, **, * indicates significance at 10%, 5% and 1%, respectively. Note: Figures in parentheses are standard deviations.*

Mean yield in on-season and off-season

Table 3 reports the comparison of yield in on-season and off-season for bitter gourd *(Momordica charantia)* production. It is evident from the results that yield in the off-season is 45 percent higher as compared to yield in on-season. This is mainly due to the factor that farmers are using high yielding hybrid varieties for the off-season cultivation of bitter gourd. Off-season crops fetch a comparatively better price in the market (Foord, 2004). The results indicate that the price of bitter gourd *(Momordica charantia)* per mound in the off-season is 66 percent higher as compared to the on-season price for bitter gourd *(Momordica charantia)*. It is concluded that the production of off-season vegetable is profitable than on-season in the study area.

Table 3: *Mean comparison of yield and price between on and off-season farmers.*

Variable	On season (N = 110)	Off-season (N = 110)
Yield (mound/acre)	43.53***(10.97)	79.01(2.87)
Price (per mound)	400***(0.00)	1178.18(41.49)

Source: *Field survey.*

Gross margin analysis

Table 4 shows the gross margin analysis. The important inputs in vegetable production are the seed, irrigation,

fertiliser, pesticides and labour etc. The cost incurred on these inputs makes up the Total Variable Cost (VC) of production in vegetable production.

Table 4: *Gross margin analysis of on and off-season bitter gourd (Momordica charantia).*

Variables	On season (N = 110)	Off-season (N =110)
Pesticide cost	1853***(444.78)	1297(536.05)
Fertiliser cost	8277***(2395.39)	9648(2203.36)
Irrigation cost	11161***(11863.74)	6492(1009.92)
Seed cost	2241(1174.06)	2029(1394.31)
Labour cost	10055***(1458.26)	11343(3331.95)
Tunnel cost	-	40,000
Total cost	33557***(14044.76)	70809(5300.03)
Total revenue	42654***(16451.22)	129581(16056.88)
Gross margin	9,097***(15103.39)	58773(14771.84)

, **, * indicates significance at 10%, 5% and 1%, respectively. Note: Standard deviations are given in parentheses.*

The results of the Gross Margin (GM) analysis show that the average cost of pesticide in on-season of bitter gourd is 43% higher than that applied in the off-season. This is attributed to the fact that as in the on-season, the insects attack is likely to be more than the off-season, so more pesticides are used in the on-season. This higher quantity of pesticides uses, in turn, increase the cost of pesticides application. As in on-season, the weather is warm, and hence the insects' incidence is more than the off-season. These results are in conformity with Lee et al. (1991) and Bhatia and Mahto (1969) who reported that longer periods of sunshine, high temperature and plantation activities persuade the occurrence of melon fly (*Bactroceracucurbitae*) which is a major pest of Cucurbitaceae vegetables in North-east Taiwan. Another reason for lower pesticide use in off-season vegetable is due to the reason that the cultivation in tunnels which helps to control pests in a better way. This result is in line with the study of Chen (1991) and Ajayi (2000) who reported that the use of pesticides was reduced to one fourth as compared to open field in the first year and up to half in the second year. The lower quantity of pesticides also uses due to the reason that most of the farmers use hybrid seeds for vegetable production. Hybrid seeds are found to be resistant against many insects and pests of bitter gourd *(Momordica charantia)* as reported by Gogi et al. (2010). The fertiliser cost in the on-season crop of bitter gourd *(Momordica charantia)* is 14 percent lower as compared to the off-season. It was found that the off-season crop requires more fertiliser (Shaheen et al., 2009). The results further show that the cost of irrigation is71 percent higher during on-season. This is because water requirement for bitter gourd *(Momordica charantia)* is higher in summers as compared to winter. Shaheen et al. (2009) observed that the share and cost of irrigation in the off-season for bitter gourd was higher as compared to on-season. Irrigation cost is also found to be lower in the off-season because the off-season crop requires lesser irrigations. This is because that off-season crop is grown in tunnels and furrows are made in tunnels. The irrigation requirements of the off-season crop are lower as compared to on-season. Farmers irrigate their fields after every week in their on-season but after every ten days during off-season crop. Seed costs are 10 percent higher in on season because farmers use more quantity of seeds in the on-season crop. However, the difference is not very high because in the off-season, farmers use hybrid seed and hybrid seeds are comparatively expensive. Labour costs are high in both the season because growing vegetables is a labour intensive enterprise as a whole; the off-season labour cost is higher because of extra labour required for installation of tunnels. The total cost of growing bitter gourd *(Momordica charantia)* was higher in the off-season. This is because the revenue generated by the off-season crop is due to the higher output price. This enterprise is very profitable for the farmers, as observed by Foord (2004) that crops are grown out of season to fetch the best price when sold in the direct market.

Table 5: *Estimates of Cobb Douglas Production function.*

Variables	Co-efficient
Education (Years)	-0.012(0.007)
Experience (years)	0.002(0.004)
Seasonal (Dummy)	-0.711***(0.015)
Hybrid seed dummy	-0.008(0.013)
Seed	-0.020***(0.005)
Irrigation	0.024*(0.012)
Fertiliser	0.002(0.002)
Labour	0.018*(0.010)
Pesticide	0.025*(0.014)
Constant	4.26***(0.048)
R-squared	0.98

, **, * indicates significance at 10%, 5% and 1%, respectively. Note: Figures in parentheses are standard Errors.*

The determinant of off-season vegetable production.

The estimates of the Cobb Douglas production

function in Table 5 show that the coefficient of education has a negative impact on yield. This is because education is expected to improve access to higher paying off-farm activities. This is because higher education farmer is expected to spend less time on farming activities.

Similar results were observed by other studies (Kouser and Qaim, 2013). The coefficient for the variable frequency of irrigation shows that if the hours of irrigation are increased by one percent, the yield of bitter gourd *(Momordica charantia)* is increased by 0.024 percent. These results are consistent with the results observed by Battese et al. (1993) and Ahmad et al. (2000). Labour hours used in different farming practices of bitter gourd *(Momordica charantia)* production has an important role. The coefficient for hours of labour spent in the field shows that if labour hours are increased by one percent the yield is enhanced by 0.018 percent. This is because bitter gourd *(Momordica charantia)* is a very labour intensive crop. These results are in conformity of with Battese et al. (1993) and Hassan et al. (2005). Use of pesticide is showing a positive relationship with the yield of bitter gourd *(Momordica charantia)*. The coefficient shows that a one percent increase in the pesticide spray there is a corresponding increase of .025 percent in the yield of bitter gourd *(Momordica charantia)*. Pesticides application has a positive impact on vegetable yield because they help to control pests that damage crops and to protect the crop against their attack. The seasonal dummy (on-season =1 and off-season = 0) shows that the yield in off-season crop was almost 70 percent higher as compared to the on-season. One reason for this is could also be the fact that the incidence of insect-pest is controlled due to cultivation in tunnels.

Conclusions and Recommendations

This paper has analysed the economic return to farmers in on-season and off-season bitter gourd *(Momordica charantia)* production. We found that the total cost of growing bitter gourd *(Momordica charantia)* was higher in the off-season. The greater revenue generated by the off-season crop is attributed to its high price. It is concluded that growing off-season vegetable is a profitable enterprise for the farmers. Moreover, the farmers harvest more yield in the off-season than on-season for vegetables grown in the study area. The results of Cobb-Douglas production function showed that the yield in off-season crop was almost 70 percent greater as compared to the on-season; which could be attributed to the use of high valued hybrid seed and intensive care during the off-season. Farmers should be encouraged and facilitated to grown more off-season vegetables. Furthermore, there is less application of a pesticide in the off-season than on-season vegetable production, so off-season production is more environmentally friendly and is good for human health. Therefore, it is recommended that the policy should focus on the incentives to promote off-season vegetable production. During the off-season, the extension services should be delivered to off-season vegetable farmers so that they are encouraged to adopt off-season production to increase farmers' yield and income.

Novelty Statement

The study brings a new contribution to the literature in the field of off-season vegetable production. The investigation shows profitability of off-season vegetable production and explores the potential for farmers' socioeconomic uplift.

Author's Contribution

Zara Ahmad and Shahzad Kouser conceptualized the idea of research and contributed in the development of the data collection tool. The data were collected by Zara Ahmad. Fazli Rabbi and Tariq Shah help in the data entry, data cleaning and development of the econometric model and statistical analysis. Muhammad Zamin and Bushra Kiran reviewed the literature and researched the agricultural and horticulture side of off-season vegetable production.

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