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Cost and Revenue Analysis of Strawberry Production in the Sub-Tropical Areas of NWFP, Pakistan

Ghulam Sadiq Afridi, M. Ishaq[1] and Sarfraz Ahmad[2]
Social Sciences Division, Pakistan Agricultural Research Council (PARC), Islamabad-Pakistan
[1]Technology Transfer Institute, PARC, Ternab, Peshawer-Pakistan
[2]Department of Economics and Agricultural Economics, Arid Agriculture University, Rawalpindi-Pakistan

Abstract

Keeping in view the increasing trend of short tenure high profitable crops like strawberry, this study was conducted in the sub-tropical areas of NWFP namely Jandai (district Mardan) and Sarkai (district Charsadda) in order to trace out the comparative advantage of strawberry cultivation in the Rabbi season. Data were collected through a comprehensive interview schedule to cover almost all the strawberry growers. For averages, frequencies and cross tabulation SPSS was used, while MathProg was used for Linear Programming (LP) model.

The results showed that strawberry was cropped on 0.91 acres (25 %), wheat on 1.70 acres (46.70 %) and sugarcane on 1.84 acres (50.41%). The gross revenue per acre for strawberry, wheat and sugarcane was estimated at Rs.154751.00, Rs.16094.00 and Rs.39059.00, respectively. The cost for various operations was summed to Rs.42890.00, Rs.4689.00 and Rs. 8535.00 resulting in net revenues at Rs.111861.00, Rs.11385.00 and Rs.30524.00 for strawberry, wheat and sugarcane, respectively on per acre basis. Summery for cost and revenue for all the important Rabi crops showed comparative advantage to the strawberry, as net revenue of strawberry is about four times higher than sugarcane and about nine times higher than wheat crop. The LP model results suggested that strawberry should be cropped on 0.68 acres and sugarcane on 2.8 acres to realize the maximum net revenue of Rs. 161263.00. Wheat was not included in the optimal solution in allocating the land. Optimal allocation of land to these crops spares 0.97 acres of land.. Research work for production of saplings locally, imparting training to the farmers in appropriate packing materials is strongly recommended for the development of this valuable crop in the area.

Corresponding author: Sarfaraz Ahmad
Department of Economics and Agricultural Economics, Arid Agriculture University, Rawalpindi- Pakistan
Email: drsarfraz94@yahoo.com

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Introduction

Strawberry is one of the important small fruit among the berries. Various strawberry species grow wild all over the world, but the cultivated strawberry is based upon two species Fragarin chiloensis and fragarin Verginiana. Hybrid between these two species was the ancestor of all the modern strawberry cultivar (John, 1994). Strawberry has great dietetic value and is one of the potential source of vitamin C. 100 gm edible portion contain 89 gm water, 0.07 gm protein, 0.5gm fats, 8.4gm carbohydrates and 59mg ascorbic acid. The strawberry fruit is commercially consumed both in fresh form and can be preserved like James, Jellies, and squashes that can be used in off-season (Galletta and Bringhurst, 1995).

Strawberry is grown in many countries of the world but it is cultivated extensively in USA, Italy, Japan, and Mexico. Worldwide production during 1970s-1980s is 987-1726 metric tones out of which USA being the largest producer provides an annual production of 224-314 metric tones (Childre, 1983).

Nature has gifted Pakistan with a variety of climatic environment. The climatic condition of Pakistan is very suitable for the cultivation of strawberry. Strawberry requires low chilling temperature. It can be grown in many soil types. The harvest of strawberry begins in early summer and generates revenue when few other crops are available. Therefore, strawberry is very demanding enterprise (Asad, 1997). It is grown in specific areas of Punjab and NWFP. At present Islamabad, Lahore, Charsada and Mardan are the major producing areas, which usually supply to Islamabad and Lahore markets.

Since strawberry is newly introduced crop in Pakistan, therefore its average yield per acre is very low as compared to other strawberry producing countries of the world. The reason for this might be

the lack of systematic research work, poor agronomic practices, and lack of market and economic value of strawberry production among the growers (Mabood, 1994). One of the food processing companies in Swat has planted exotic varieties and has reported a yield of 1 ton/acre.

In NWFP strawberry is cultivated at lower altitudes in the month of November, fruit occurs in April till late May. Since it has low chilling requirements therefore it can be grown successfully in tropical and sub tropical regions. At elevations above 800m above sea level strawberry may be cultivated as a perennial but below this level it can be grown successfully only as an annual crop. The fruit maturity period is short and ranges from 30-40 days. For home consumption the fruit should be consumed just after picking because it is highly perishable. While for transportation to distinct market the fruit should be handled properly because the chance of deterioration is much more during transportation (Amin, 1996).

Nonetheless, the future of strawberry production and processing might be very much bright in our country in general and in Swat valley, NWFP in particular because this fruit fetches maximum economic returns for the farmer. Moreover low chilling temperature, technically skilled labor force, improved and high yielding varieties, capacity to rapidly disseminate the latest technology and good market access further brighten the future of this crop. But the competition it faces with other important Rabi crops like wheat and sugarcane may hamper its cultivation. This study is mainly conducted with the aim to compare its return with other competiting crops including wheat and sugarcane of the area. The objectives of the study are as under:

- To make compare the economics of strawberry production with the other competing crops including wheat and sugarcane
- To allocate optimally land resources to different competitive crops of the area.
- To make recommendations on the basis of the results of the study

Materials and Methods

This research study was based on primary data that were collected through field survey in districts Mardan and Charsadda of NWFP province. An interview schedule was used to collect the data. All 52 farmers engaged in strawberry production were interviewed in two villages namely Jandai (district Mardan) and Sarki (district Charsadda).

Farm budgeting technique was applied to compute and compare cost and revenue estimates of crops including strawberry, wheat and sugarcane. At a later stage general Linear Programming (LP) model was used to arrive at optimal allocation of land resource among the crops included in the study.

According to Fredrick and Gerald (1995), the standard form of the LP model is:

Maximize $Z = CX$

Subject to $AX \leq B$ and

$X_1, X_2, X_3 \geq 0$

where Z = Profit or net revenue from all crops per acre

$C = (c_1, c_2, c_3)$ and

c_i = profit from individual crop i

$X = (x_1, x_2, x_3)$

x_i = area in acres allocated to individual crop i

$B = (b_1, b_2, b_3)$

b_i = resource availability i.

Important assumptions of the model were:

Proportionality:
that if the xi were (say) doubled, its contribution to the objective function (Z = CX) and to each constraint (AX) would be doubled.

Additivity:
that total profit is the sum of the individual profits and that total impact on the ith constraint is the sum of the individual impact of the decision variable.

Divisibility:
that the decision variable can be divided into any desired functional level.

Non-negativity:
that the decision variable are restricted to values of zero or larger than zero

Results and Discussion

Strawberry, wheat and sugarcane are the major and competitive Rabi crops grown in the study area. Beside these crops, sugarbeet, melon and tomato were also grown as reported by few farmers. The sample growers, in general, cultivated strawberry on 0.91 acres (25 %), wheat on 1.70 acres (46.70 %) and sugarcane on 1.84 acres (50.41 %). The practice of sugarcane intercropped with strawberry and wheat was found common in the research area (Table 1).

Comparison of cost and revenue

Strawberry

Cost of production and gross and net revenues on per acre basis of strawberry production are given in Annexure II. The gross revenue per acre was estimated

at Rs. 154751.00. The cost of various operations was accounted to Rs.42890.00. The net revenue came to be Rs.111861.00 per acre. Strawberry production indicated higher operational cost that is mainly due to the cost of saplings i.e. Rs.14942.00 per acre, which was the highest cost item than the overall cost of any other crop in the area. Not only strawberry is labor intensive crop that requires about 196 person days on average for all the operational and management activities. Even though the overall cost of production of strawberry was very high yetRs.42890.00 per acre yet farmers were motivated to grow strawberry due to its high net returns.

Wheat

Cost of production and gross and net revenues on per acre basis of wheat production are given in Table II. The gross revenue per acre was estimated at Rs.16094.00. The share of grain in gross revenue was 78 percent while bhusa (straw) contributed about 22 percent. The net revenue was estimated at Rs.11385.00 per acre.

Cost of land preparation (Rs.1030) proved to be the highest cost component in wheat production followed by threshing cost (Rs.907) and harvesting cost (Rs.783) on per acre basis. The other important cost components include cost of DAP, cost of Urea, and cost of seed.

Sugarcane

Sugarcane was the other major Rabi crop of the study area. This crop was cultivated on major area as compared to strawberry and wheat or any other crop. Sugarcane was not only cropped as a sole crop but it was also intercropped with strawberry and wheat. The cost of production and revenue associated with sugarcane production are presented in Table II. The gross revenue came to be Rs.39059.00 per acre. The total cost of production was Rs.8535.00 per acre. The net revenue came to be Rs.30524.00 per acre.

Seed cost was the highest cost component (Rs.2342) followed by land preparation and marketing cost (Rs.900 each), harvesting cost (Rs.840) and hoeing and weeding cost (Rs.768) on per acre basis. Majority of the farmers reported that they pay no harvesting cost. The laborers were remunerated in term of by-products mainly of the harvested crop.

In summery net revenue of strawberry was about four times higher than sugarcane and about nine times higher than wheat crop. Strawberry cultivation requires Rs.42890.00 for its operational activities per acre as compared to wheat requirement of Rs.4689.00 and sugarcane Rs.8535.00 for operational activities per acre which is quite high and requires high capital requirement. But at the same time strawberry is much profitable than sugarcane and wheat crop. In case capital is managed by the farmers strawberry cultivation could be a profitable venture as compared to other competing crops like wheat and sugarcane.

Optimal allocation of land

The results presented in the last section indicated that net revenues from strawberry, wheat and sugarcane respectively were Rs.111861.00, Rs.11385.00 and Rs.30524.00 per acre. Similarly, total cost of production came to be Rs.42890.00, Rs.4690.00 and Rs.8535.00 for strawberry, wheat and sugarcane per acre, respectively. Labour employed and fertilizer applied proved to be the major components of total cost of production. In case of each crop the requirements of labour and fertilizer were 196 person days and 5.92 bags for strawberry per acre, 16 person days and 2.34 bags for wheat per acre and 44 person days and 2.36 bags for sugarcane per acre (Table II). The output data were used at a later stage to formulate and run Linear Programming (LP) model to find optimal allocation of land which is a limiting resource in the area among these competing crops; strawberry, wheat and sugarcane. The standard LP model using the above data is formulated as under:

Objective Function

Maximize $Z = 111861X_1 + 11385X_2 + 30524X_3$

Subject to the following constraints

$196\ X_1 + 16\ X_2 + 44\ X_3 \leq 256$
(labour constraint)

$5.92\ X_1 + 2.34\ X_2 + 2.36\ X_3 \leq 10.62$
(fertilizer constraint)

$42890\ X_1 + 4690\ X_2 + 8535\ X_3 \leq 56115$
(capital constraint)

$X_1 + X_2 + X_3 \leq 4.45$
(land allocation)

$X_1, X_2, X_3 \geq 0$
(non-negativity constraint)

where

X_1 = area to be allocated to strawberry (acres)
X_2 = area to be allocated to wheat (acres)
X_3 = area to be allocated to sugarcane (acres)

The results of estimated LP model are presented in Table 3.

Value of the objective function (maximized):
Z^* = Rs.161263.00
Value of the decision variables:
$X^* = (x_1, x_2, x_3) = (0.68, 0.00, 2.80)$
Values of slack variables:
$S = (s_1, s_2, s_3, s_4) = (0, 0, -3072, -0.97)$, i-e; slack variables representing the unused labour (s_1), unused fertilizers (s_2), unused capital

(s_3) and unused land (s_4)

The results of the model suggest that 0.68 acres of land should be planted under strawberry and 2.80 acres of land should be devoted to sugarcane. Wheat crop is not part of the optimal solution. Thus, the optimal allocation will maximize net revenue of Rs.161263.00. Similarly, there is slack capital to the tune of Rs.3072.00 and slack land of about 0.97 acres. The surplus resources can be utilized for other activities during the season.

Conclusions and Recommendations

Agriculture is the apex sector of Pakistan's economy. With the ever-increasing population of the country, poverty reduction and other challenges of WTO regime Pakistan's agriculture has to increase its production. This objective can be achieved by either bringing more land under cultivation, by increasing crop yield and/or bringing land under more crops per annum. It is unlikely that Pakistan will be able to increase its output by bringing more land under cultivation as it has inelastic supply of land resources. Therefore the only feasible option is to increase crop productivity and cultivation of short duration crops. Farmers are always interested in more returns and less in more productivity. The increasing trend of growing off-season vegetables and other short duration crops like strawberry is the other example of farmers' interest in high returns crops.

The results of the present research indicated that strawberry production has the comparative advantage over other competing crops of Rabi season like wheat and sugarcane. Strawberry acts as a complementary crop for sugarcane. It not only save the land preparation cost but also the high doses of different fertility inputs benefits the sugarcane crop later. Due to these reasons the practice of intercropping strawberry and sugarcane is common. However, sugarcane crop reduces the area either for strawberry or wheat by next year. The farmers face no problem with management practices of strawberry cultivation, sapling collection and awareness about different diseases. However, farmers were collecting sapling from distant areas like Swat valley. Therefore research work is strongly recommended for production of saplings locally. As strawberry is highly perishable commodity the farmers should also be imparted with training of handling and packaging of the harvested crop. Due to high capital requirement the strawberry growers should be provided with financial support.

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Table 1 Tenancy status, education level and cropping pattern

Tenancy status	No. of Farmers	% of farmers
Owner	18	36
Tenant	26	52
Owner-cum-tenant	06	12
Total	50	100
Education level		
Illiterate	18	36
Primary	10	20
Secondary	16	32
Above Secondary	06	12
Crop	**Area (acres)**	**% of Area***
Strawberry	0.91	25
Wheat	1.70	46.70
Sugarcane	1.84	50.41

*Percentages are more than 100 due to intercropping of sugarcane in strawberry.

Table 2 Cost and net revenue from crops (Rupees per acre)

a. Strawberry				
Operations	**Unit**	**Quantity**	**Price/unit**	**Cost**
Land Preparation	Tractor Hours	8.22	192.0	1576.8
Ridge making	Bullock days	01.8	195.0	352.0
Sapling	No.	55340	0.27	14942.0
Transportation				825.1
Transplantation	Person days	18.06	70.0	1264.2
DAP	Bags	01.96	740.0	1450.4
Urea	Bags	03.0	410.0	1230.0
SSP	Bags	0.42	320.0	130.2
Nitrophos	Bags	0.54	510.0	291.6
Farm yard manure (FYM)	Trolley	1.98	781.2	1546.8
Hoeing	Person days	56.6	70.0	3962.0
Insecticide/Pesticides				1252.5
Harvesting	Person days	121.82	70.0	12527.4
Packing	Crates	370	4.2	1557.2
Transportation				3981.74
Total cost				**42889.9**
Main product	Kgs	4683.44	33.04	154750.9
Total revenue				**154750.9**
Net revenue				**111861.0**

b. Wheat				
Land Preparation	Tractor Hours	5.34	192.8	1029.60
Seed	Kgs	44.70	8.84	395.30
DAP	Bags	0.96	730.00	700.80
Urea	Bags	1.38	420.00	579.60
Farm yard manure (FYM)	Trolleys	0.00	0.00	0.00
Insecticide/Pesticides	--	0.00	0.00	0.00
Harvesting	Person days	11.18	70.00	782.60
Transportation	Person days	4.20	70.00	294.00
Threshing	Threshing Hours	3.24	280.00	907.20
Total cost				**4689.00**
Main Product	Mounds	30.18	414.00	12494.50
By-Product	Bhusara	2.00	1800.00	3600.00
Total revenue				**16094.50**
Net revenue				**11385.50**
c. Sugarcane				
Land Preparation	Tractor Hours	4.70	192.80	900.00
Ridge Making	Person Days	6.30	60.00	378.00
Seed	Mounds	35.80	65.50	2342.00
Sowing	Person Days	10.80	60.00	644.40
DAP	Bags	0.50	730.00	335.80
Urea	Bags	1.74	420.00	730.80
Nitrophos	Bags	0.00	510.00	30.60
SSP	Bags	0.10	330.00	33.00
Farm yard manure (FYM)	Trolleys	0.40		348.00
Irrigation (including labor)				252.00
Hoeing	Person Days	12.80	60.00	768.00
Insecticide				32.00
Harvesting	Person Days	14.00	60.00	840.00
Marketing (including loading /unloading and road toll)				900.00
Total cost		**03.00**	**300.00**	**8534.60**
Main Product	Mounds			38219.00
By-Product	Bundles	519.30		840.00
Total revenue			**73.60**	**39059.00**
Net revenue				**30524.40**

Table 3 Optimal allocation of land among competing crops

Objective Value (Z)*	161263.45			
Variables (X)*	Value	Objec Coeff	Obj Val Contr	
x_1	0.68	111861.00	75769.66	
x_2	0.00	11385.00	0.00	
x_3	2.80	30524.00	85493.78	
constraints	RHS	Slack (S)		
1	256	0	labour	
2	10.62	0	fertilizer	
3	56115	-3072.44	capital	
4	4.45	-0.97	land	
Sensitivity Analysis				
Variable(X)*	Current Coeff	Minimum	Maximum	Reduced Cost
x_1	111861	76568.68	135086.09	0
x_2	11385	infinity	18878.45	7493.45
x_3	30524	26362.99	44593.24	0
Constraints	Current RHS	Minimum	Maximum	Dual Price
1	256	200.84	268.18	412.16
2	10.62	7.8	11.91	5249.51
3	56115	53042.56	infinity	0
4	4.45	3.48	infinity	0