Pak. J. Agri. Sci., Vol. 58(1), 283-290; 2021
ISSN (Print) 0552-9034, ISSN (Online) 2076-0906
DOI: 10.21162/PAKJAS/21.10050
http://www.pakjas.com.pk

VALUATION OF COST AND RETURNS OF STRAWBERRY IN PUNJAB, PAKISTAN

Asghar Ali[1], Abdul Ghafoor[2], Muhammad Usman[3], Muhammad Usman[1], Muhammad Khalid Bashir[1], Muhammad Ishaq Javed[4] and Muhammad Arsalan[1]

[1]Institute of Agricultural and Resource Economics, University of Agriculture, Faisalabad, Pakistan; [2]Institute of Business Management Sciences, University of Agriculture, Faisalabad, Pakistan; [3]Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan; [4]Agricultural Economics Section, Ayub Agricultural Research Institute, Faisalabad, Pakistan.
***Corresponding author's e-mail: usmanghani99@hotmail.com; khalid450@uaf.edu.pk**

The planned study was conducted to estimate per acre cost of production and net returns of strawberry. It also identified the factors affecting the productivity of strawberry. The research also put fingers on identifying different marketing channels prevalent in strawberry supply chain. Primary data were collected from 110 farmers engaged in strawberry cultivation using a well-structured and field pre-tested questionnaire. Descriptive statistics was used to explain the socioeconomic characteristics of the farm households while multiple regression analysis was employed to examine the factors affecting the production of strawberry. The results purported that per acre yield and farm gate price received were 244 mounds and Rs. 1964/40 kg, respectively. Total revenue from strawberry cultivation was estimated as Rs. 478234 and net profit gained from one acre of strawberry was Rs. 250979. Growing strawberry is profitable enterprise as returns are more than double against the cost incurred. The Benefit Cost Ratio (BCR) was calculated to be 2.10. The results revealed that the education, land holding, dummy of sowing time, climate adaptation and mitigation, and access to loan were contributing positively and significantly to strawberry production. However, owing the existence of fruits and vegetables market far away from farm showed a negative impact on yield. It is need of the time that educated farmers should be encouraged to engage in the strawberry farming. Policy makers and extension workers should motivate the farmers to increase the acreage under cultivation of strawberry. Farmers should be given guidelines regarding the adaptation measures to cope the vulnerabilities of climate. Easy and timely availability of loan should be ensured to the farmers. Finally, output markets should be developed nearby growing areas to fetch higher prices and reduce transportation cost and post-harvest losses.
Keywords: Cost, Returns, Marketing channel, Productivity, Multiple Linear Regression.

INTRODUCTION

Strawberry is a newly emergent exotic berry mostly grown in subtropical countries. During 1980s, it was firstly introduced in KPK and was locally called as ground mulberry. Until planted sporadically on commercial scale in KPK it remained unnoticed (Rajwana *et al.,* 2017). Strawberry, is one of the most imperative small fruit amongst the berries which was originated in France. It is cultivated throughout the world while USA, Turkey, Spain, Egypt, Mexico, Russia, Italy, Japan and Korea are the main producer countries (Childre, 1983; FAO, 2010; Banaeian *et al.,* 2011; Muliar *et al.,*2017). The world largest producer of strawberry is United Sates of America, contributing 30% of the products sold globally (Boriss *et al.,*2012; Ruth and Rumble, 2016). Strawberry has a great dietetic value and a good source of vitamins. Worldwide, strawberry is the most broadly consumed berry and is often consumed as fresh or processed product (FAO, 2010; Banaeian *et al.,* 2011; Muliar *et al.,* 2017). Strawberry is a favorite fruit, all among the children and the adults. It does not become elite anymore, everyone can find it easily. It is consumed as fresh fruit, and also as a raw material being processed as beverage product (juice, syrup, jam and jelly). Furthermore, it has large benefits for good health, so the demand for this commodity is growing day by day (Hanif and Budiyati, 2011).

It is highly valuable crop for processing industry and fresh consumption. It fetches higher prices when harvested early in the season and produce greater yield throughout the season (Galic *et al.,* 2014). Net revenue per acre from cultivation of strawberry is around 4 times more as compared to sugarcane while nearly 9 times than that of wheat crop (Afridi *et al.,* 2009). Growing strawberry is a labor-intensive enterprise as it requires intensive labor from its land preparation to sale in the market. A huge amount of production cost is incurred to control insects, weeds and diseases, and management of strawberry by the use of cultural practices and pesticides (Chandler *et al.,* 2001; Hancock *et al.,* 2001; Rhainds *et al.,* 2002; Stevens *et al.,* 2011).

In Pakistan first time strawberry was grown in 1951. After trials, two verities named Missionary and Klondikew were recommended for cultivation. In Punjab, growing districts are Sheikhupura, Nankana Sahib, Gujranwala, Sialkot, Gujrat, Kasur, Mandi Bahauddin, Sargodha, Multan, Rawalpindi, Jhelum and Chakwal. In Khyber Pakhtunkhwa (KPK), the popular growing areas of strawberry are Peshawar, Abbottabad, Mardan, Haripur, Mansehra, and Charsada (Tariq *et al.,* 2018). Nature has blessed Pakistan with favorable climatic conditions for strawberry cultivation. It can be cultivated in diverse soil types that have low frightening temperature. When there is off season of fruits in the summer, the strawberry earn revenue as its harvesting start in early summer. Consequently, it is utmost demanding business (Asad, 1997; Afridi *et al.*, 2009).

Due to its higher profits as compared to other conservative crops (i.e. wheat, sugarcane, rice and cotton etc.), high market demand and profitability, unique and desirable taste its gardening is swelling among farmers of Punjab, Sindh and Balochistan. Although the climatic and weather conditions of Punjab are not favorable for the cultivation of strawberry but due to the introduction of efficacious runner production in Swat, the runners are traced from here to Punjab and other production regions (Rajwana *et al.*, 2017).

Strawberry cultivation has now changed the mindset of the people even toward broadening in agriculture for enlightening productivity and sustainability. This improves their farm income and is generating gainful employment among them. Further, the harvesting of the crop in the early summer helps in increasing producer revenue. As few other fruit crops are accessible in the market; however, strawberry is an enterprise of high demand. In Pakistan, strawberry is emerging as a newly introduced berry but its average yield per hectare is very low as compared to other countries (i.e. USA, Turkey, Spain, Egypt, Mexico, Russia, Italy, Japan and Korea etc.). This might be due to meagre agronomic practices, lack of awareness about economic and market value among farmers, weak extension services, and dearth of systematic research work. Despite having the potentiality of growing strawberry, farmers are facing continuous problems for cultivating the crop. Growing of this crop depends on the availability of the runners to greater extent. Since, runners need to be imported from outside the production zones; the purchasing price of the runners is high. Therefore, taking in to consideration the cost involved in strawberry cultivation, the study on costs and return from strawberry cultivation have been undertaken to know the economic importance and profitability. In addition, study also determined the past trends and future forecast in term of area under cultivation, total production and per acre yield. There is also a need to diversify the agriculture sector of Pakistan. Considering a high value crop, more profitable for farmers and to develop appropriate policies for its promotion, the present study was undertaken. The study estimated cost of production, net returns and factors affecting yield of strawberry. Moreover, different marketing channels prevailing in the study area was identified. Finally, policy guidelines are suggested on the basis of study findings.

MATERIALS AND METHODS

In this section, description of study area, sample size, data collection, and empirical framework used in the study, has been elaborated.

Data: The study employed multistage sampling technique to collect primary data. In first stage Punjab province was selected. The Punjab was divided into two regions i.e. Central Punjab and Southern Punjab. One district was selected from each region on the basis of higher area under strawberry production. i.e. Sheikhupura and Multan were selected in second stage. Head Muhammad Wala was chosen from Multan and tehsil Sharaqpur of Sheikhupura was finalized at third stage. The list of strawberry growers was obtained from the offices of deputy director agriculture extension Sheikhupura and Multan. Tehsil Sharqpur and Tehsil Mulatan from district Sheikhupura and Multan, respectively have maximum number of strawberry growers. Ninety (90) farmers from tehsil Sharqpur, Shekhupra and 46 from tehsil Multan, Multan cultivated strawberry during 2018-19. The farmers engaged in the cultivation of strawberry were almost double in tehsil Sharaqpur compared to tehsil Mulatn. Based on enlisted strawberry farmers, data were collected proportionately. Finally, 35 farmers were interviewed from Head Muhammad Wala while 75 from Sharaqpur thus making a total sample size of 110 farmers by using systematic random sampling technique. A well-structured and field pre-tested questionnaire was used to collect primary data.

***Analytical Framework*:** This section presents the various statistical and econometric methods, used for the analysis of the data to fulfill the objectives of the study.

***Descriptive Statistics*:** The study focused on basic factors such as means and standard deviation of socioeconomic and demographic characteristics of the households.

***Economic Analysis*:** The study used Chaudhry *et al.* (1992) methodology in assessing and afterward allocating the expenditures and economic profit of different inputs. Average Variable Cost (AVC) of production per acre like land preparation, runner, fertilizer application, insecticides and weedicide, irrigation, picking and labor use was computed. Average Fixed Cost (AFC) include water charges (abiyana) and land rent.

$$TC = TVC + TFC \qquad (I)$$

Total Revenue (TR) per acre earned from the sale of strawberry was calculated by multiplying the farmer's price received per mound with the total output produced (mound) in the season.

$$TR = p \times y \qquad (II)$$

To calculate gross profit, total variable cost was deducted from total revenue.

$$Gross\ \pi = TR - TVC \qquad (III)$$

Total cost was subtracted from total revenue to estimate net profit earned per acre by the farmers.

$$Net\ \pi = TR - TC \qquad (IV)$$

Benefit Cost Ratio (BCR) was estimated by dividing total revenue with total cost.

$$BCR = TR \div TC \qquad (V)$$

***Econometric Analysis*:** To quantify the factors affecting the production, Multiple Linear Regression Model was used.

$$y = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 + a_6x_6 + a_7xa_7 + a_8x_8 + a_9x_9 + \epsilon \qquad (VI)$$

Where; y = Strawberry production per acre (mound), α_0 = Constant, x_1 = Education (years), x_2 = Experience of strawberry growing (years), x_3 = Distance from farm to main market (km), x_4 = Dummy loan used (if yes =1; otherwise = 0), x_5 = Dummy extension services (if yes =1; otherwise = 0), x_6 = Dummy climate adaptation and mitigation (if yes =1; otherwise =0), x_7 = Total land holding (acres), x_8 = Dummy sowing (if early sowing =1; otherwise = 0), x_9 = Dummy use of family labor (if yes =1, otherwise = 0), $\alpha_1 \ldots\ldots\ldots\ldots \alpha_9$ are parameters of the variables., ε = random error.

***Identification of Marketing Channels*:** The study identified the marketing channels of strawberry prevailing at the study area. To identify the existing marketing channels, focus group discussions were conducted with various stakeholders i.e. farmers, agricultural extension agents, commission agents, retailers and consumers.

RESULTS

This section is systematized into different parts as first section discussed descriptive statistics of the farm households. Part two discussed the cost of production and economic returns. Section three provided the econometric analysis of the study. The last section identified different marketing channels to enhance profitability of strawberry crop.

***Descriptive Statistics*:** The average age of the sampled strawberry growers was found 44 years. Most of the farmers were illiterate and their average schooling was 6 years. According to the findings of the study, it has been noted that most of the famers have vast experience in agriculture. However, the experience in strawberry cultivation was about 10 years because it is new business in the study area compared to other traditional crops. The average area under strawberry cultivation of the sampled farmers was 4.83 acres with a minimum of one acre and a maximum of 25 acres (Table 1). The average land rent per acer of strawberry was higher as compared to other crops. The reason behind this is that income received from the cultivation of strawberry is more than other crops like cotton, rice, wheat and sugarcane etc. The agricultural markets in the study area are far from the production units. Due to this, farmers mostly sell their produce to the middleman at lower price than the price prevailed in the market. The average distance travelled by the sampled farmers from their farms to agricultural market was about 52 km. The average daily wages existed in the study area was about Rs. 342 with a minimum of Rs. 200 and maximum of Rs. 600.

***Estimation of Cost and Economic Returns*:** The economic cost and benefits of strawberry enterprise were calculated according to Chaudhry *et al*. (1992) methodology. According to the findings of the study the average fixed cost of sampled farmers in the study area was Rs. 38100 (Table 2). Average fixed cost in Muhammad Wala was found to be Rs. 36100 compared to Rs.40100 in Sharaqpur. Average variable cost in Sharaqpur was calculated of Rs. 192357 while of Rs. 187593 in Muhammad Wala. The AVC (average variable cost) of the overall sampled farmers was Rs. 189155. Average total cost was higher in Sharaqpur (Rs. 232457) as compared to Muhammad Wala (Rs. 223693) while it was Rs. 227255 for the overall farmers of the study area. The farmers in Sharaqpur were using more inputs than Muhammad Wala and they are getting high yield. The quality of strawberry produced in Sharaqpur was comparatively better than Muhammad Wala, Multan. The reason was that the farmers in Sharaqpur have more experience as compared to strawberry growers of Muhammad Wala. The price received per mound in Sharaqpur was Rs. 1969 while Rs.1959 in Multan. However, the average farm gate price received by the sampled farmers was Rs. 1964 per mound. Growing strawberry is a profitable business as it has higher returns than

Table 1. Socioeconomic and Farm Characteristics of the Respondents.

Variable	Unit	Minimum	Maximum	Mean	Std. Deviation
Age	Year	20	70	43.98	10.04
Education	Year	0	16	6.31	4.47
Farming Experience	Year	8	55	28.97	9.99
Strawberry Growing Experience	Year	1	20	9.67	4.23
Total Land Holding	Acre	1	250	16.88	31.78
Strawberry Acreage	Acre	1	25	4.83	4.17
Rent / Acreage	PKR	40000	60000	45532.00	21129.46
Farm to main road Distance	KM	1	8	3.11	1.40
Farm to main market Distance	KM	21	95	52.00	22.41
Wages/Day	PKR	200	600	341.82	96.87

Source: Field survey, 2018

cost incurred. The total revenue earned by the sampled farmers was Rs. 478234 per acre. According to the findings of the study total revenue per acre of Sharaqpur and Muhammad Wala strawberry producers were Rs. 508002 and Rs. 448611. The net profit per acre in Sharaqpur and Multan was Rs. 275545, and Rs. 224918, respectively. The net return of overall respondents was Rs. 250979. There was double return than cost incurred in the production of strawberry of the sampled farmers. The benefit cost ratio of strawberry production in Sharaqpur, Muhammad Wala and in the overall study area was estimated as 2.19, 2.01, and 2.10, respectively.

Table 2. Economic Analysis (per Acre).

Items	Sharaqpur	Multan	Overall
Average Fixed Cost (Rs.)	40100	36100	38100
Average Variable Cost (Rs.)	192357	187593	189155
Average Total Cost (Rs.)	232457	223693	227255
Yield (Maund)	258	229	244
Price (Rs/ maund)	1969	1959	1964
Total Revenue Rs.	508002	448611	478234
Gross Profit Rs.	315645	261018	289079
Net Profit Rs.	275545	224918	250979
BCR	2.19	2.01	2.10

Source: Field survey, 2018

***Econometric Analysis*:** The results of multiple regression analysis purported that the years of schooling has positive and substantial effect on the dependent variable (yield). Education and training of the strawberry farmers can play a vital role in increasing the production efficiency of farmers (Tariq *et al.*, 2018). Educated farmers have more skills and knowledge as compared to their counterpart who are less educated. They use the inputs more efficiently and can market their produce appropriately. The improvement in education of the farmers would generate a higher yield of strawberry at farm level (Fatima *et al.*, 2016). Further, continuing education needs to be provided to narrow the gap among famers engaged in cultivation of strawberry under smart farming (Choi and Lim, 2018). The coefficient of experience in growing strawberry was positive and insignificant. The reason behind this was that the strawberry enterprise is a newly introduced venture in Punjab as compared to other traditional crops. The study of Khan (2003) concluded that there is fluctuation in strawberry yield due to variation in socioeconomic characteristic of farmers, where farmers with greater years of schooling and experience attained high yield as compared to their counterparts who are less trained and experienced.

It was observed that there is no established agricultural market in the study area and markets are situated at larger distance. The farmers had to travel about 90 km to sell their produce directly in the market. Establishment of markets near the production centers are essential for enhancing the farm income. The variable of farm to market distance was negative and significant. There is a need of proper care while transporting strawberry to different markets as it is very delicate and has higher chances of deterioration (Amin, 1996).

Farmers have less resources to start strawberry business and to accomplish the running cost. The availability of timely loan can help the farmers to fulfill their expenditures on strawberry cultivation. The dummy variable of loan used or not was positive and significant. It indicated that by the use of loan, the output of the farmers can be increased significantly. This variable is in line with the study of Tariq *et al.* (2018). In addition, Choi and Lim (2018), reported that the availability of money to be spent on strawberry production helps to increase production efficiencies of the farmers.

The severe alternations of climate change have devastating impact on agriculture. The strawberry fruit is delicate and susceptible to climate change vulnerabilities. It reduces the crop yield, deteriorate quality and decline net income earned by the farmers. The dummy variable of climate change adaptation measures was positive and insignificant. The farmer has no knowledge how to cope devastating effect of climate change which damage quality as well as reduce the yield. Taking climate change adaptation measures, farmers can increase their produce and maintain quality which can fetch higher prices in the market and increased their net profit. Choi and Lim (2018) reported that an environment favorable for strawberry cultivation should be developed in order to increase productivity and economic returns. Further, Samtani *et al*. (2019) indicated that the production requirements of strawberry are influenced by favorable land with adaptable soils and climate. Farm size has positive and significant impact on the strawberry yield. The farmer with larger land holdings has more resources as compared to their counterparts who have less acreage. The variable of total land holding was positive and had significant effect on the production of strawberry. According to Agir *et al*. (2015), farmers who had higher acreage under strawberry cultivation manage the production practices and farm risk more significantly as compared to their counterparts who have smaller acreage under strawberry.

It was observed that mostly the hired labor is being used in the study area for the cultivation of strawberry. The hired labor has more technical skills and expertise for the management of strawberry orchard. The dummy variable of family use was positive and had insignificant impact on yield of sampled farmers. Samtani *et al.* (2019) reported that scarcity of labor availability during the harvest period of strawberry have contributed to decline in yield. The early cultivation of strawberry makes available this fruit in the market which earn more prices, so, it fetches higher prices as compare to strawberry harvested at mid or late time. The dummy variable of early sowing was positive and had significant impact on dependent variable. The strawberry fruits of early fruiting cultivars are projected to benefit on higher prices in the markets (Whitaker *et al.*, 2015). Similarly, the introduction of early flowering and fruiting cultivars of

Table 3. Estimated Result of Econometric Analysis.

Variable	Beta	t-value	Significance
Constant	90.460	44.543	0.000
Education (years)	0.260	3.180	0.002
Experience of strawberry growing (years)	0.081	1.071	0.287
Distance from farm to main market (km)	-0.224	-3.032	0.003
Dummy loan used (if yes =1; otherwise = 0)	0.183	2.433	0.017
Dummy extension services (if yes =1; otherwise = 0)	0.036	0.460	0.647
Dummy climate adaptation and mitigation (if yes =1; otherwise =0)	0.120	1.620	0.108
Total land holding (acres)	0.395	4.948	0.000
Dummy sowing (if early sowing =1; otherwise = 0)	0.244	3.095	0.003
Dummy use of family labor (if yes =1, otherwise = 0)	0.083	1.115	0.267
R^2		0.490	
F-Value		10.53	

Source: Field survey, 2018-19.

strawberry that are resistant to climatic vulnerabilities augment early yields to take benefit of higher prices (Dash *et al.,* 2017). It is also evident that provision of extension services to strawberry growers has positive but insignificant impact on yield. It has been observed during field visits that extension agents were handicapped and had slight knowledge of strawberry production. They are deprived in their capacity building and need update trainings regarding strawberry cultivation.

***Marketing Channel Analysis*:** It has been comprehended that sustainable development in the agriculture and food sector cannot accomplished without assimilating it across the whole value chains since developments in one slice of the value chain could be vanished to complications ascending at successive phases. Therefore, to achieve the goals of sustainable development, the value chain approach is swiftly gaining popularity as an effective and successful model in agricultural and food systems. It has been recommended that sustainable development aims in agriculture and food productions can be attained by methodically integrating social, environmental and economic dimensions into all value chain processes and activities (Badar, 2015).

Generally agricultural commodities are produced at distance from their ultimate consumer. The identification of various channels used by the farmer is important to identify which channel is more suitable to the farmers as well as consumer for the wellbeing of the both. In developing countries like Pakistan there is lack of proper agricultural markets. To identify the existing marketing channels in the study area, focus group discussions were conducted with various stakeholders i.e. farmers, agricultural extension agents, commission agents, retailers and consumers. The following marketing channels are prevailing in the study area:

***i) Channel-1*:** The farmers in this channel sold their produce in the agricultural market. There is auction of the strawberry, starting from a lowest acceptable price to highest price. The produce is sold to the retailer after taking the commission. The retailer sold the product to the final customer. About ninety percent strawberry growers were using this channel. It is the more profitable channel as compared to other channels.

***ii) Channel-2*:** In channel-2, the retailer directly purchases the strawberry fruit from the farmer. In this channel they pay sell price as compared to the price paid in the market. This is not the popular channel because only retailer (about 7 percent) who is near production center has the facility to directly purchase from farmer and sold to consumer. Marketing cost of both the producer and consumer is reduced using this channel.

***iii) Channel-3*:** In marketing channel-3, the consumer directly purchases strawberry fruit from the nearby agricultural fruit and vegetable market. Only about 2 percent consumer adopted channel-3 for the purchase of strawberry fruit because they have less time to visit fruit and vegetables markets that are mostly far away from their residence.

***iv) Channel-4*:** The results of the focus group discussions purported that there are only one percent consumers who directly purchase strawberry fruit from the production centers. The reason behind this is that most of the consumers are far away from the production area of strawberry. Moreover, consumers have less time to visit the farm and directly purchase strawberry fruit. Mostly, the consumers who are involved in direct purchase visits the strawberry production centers on week days.

Under the gravity of globalization, in developing countries like Pakistan the agricultural marketing systems are in the phases of revolution from sustenance level to value chain thinking. Establishing best quality value chain can make larger pie of income to share along the chain adherents, precisely for the farmers, than the outmoded sustenance farming. But discovery potential consumers are crucial to accomplishment for the farmers and a constant provision from the conceded Government department is extremely necessary (Mehdi *et al.,* 2016).

In Pakistan, the agricultural production system particularly horticulture value chains have got high eminence (Mehdi *et al.,* 2020). However, there is petite thinking about the

mechanism of value chain in Pakistan. Consequently, many problems are evolving in value chain of agriculture in Pakistan (Ahmad *et al.*, 2018). There is a need to develop marketing relations in the developing countries for the provision integration of farmers with the recent value chains also called as combined supply/value chains.

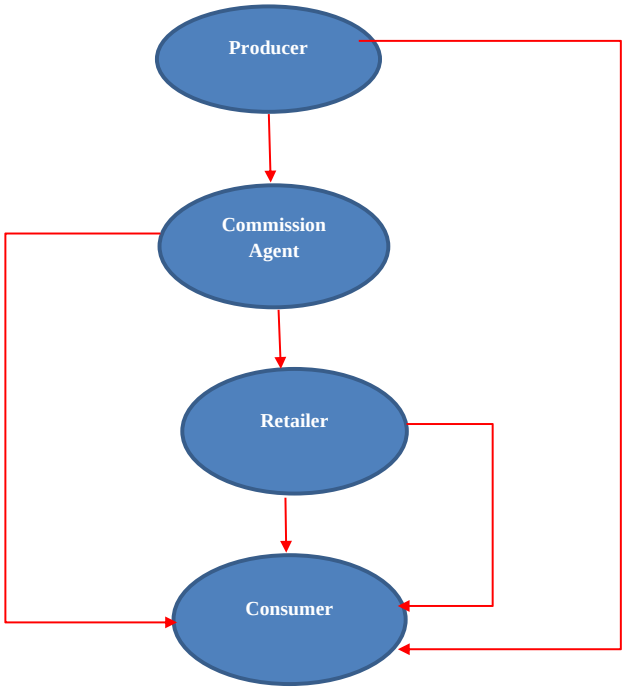

Figure 1. Identification of Marketing Channels

DISCUSSION

Owing to high returns received from strawberry enterprise, it is gaining popularity (Mahat and Chaudhari, 2018). The climatic environments of Pakistan are favorable for the production of strawberry. There is a huge gap between domestic and global demand and supply of strawberry fruit. Unfortunately, production can hardly meet the need of the domestic consumer market. In Pakistan, farmers having small land holding, distant markets, lack of awareness, week extension agent's linkage, complicated loaning procedure, poor adaptation toward climate vulnerabilities are obstacles in the way of less productivity of strawberry as compared to other countries. However, due to higher economic returns as compared to other traditional crops the area under strawberry cultivation has been increasing. There is also a need to diversify the agriculture sector of Pakistan. Income received from the cultivation of strawberry is more than other crops like cotton, rice, wheat and sugarcane etc. The agricultural markets in the study area are far from the production units. Due to this, farmers mostly sell their produce to the middleman at lower price than the price prevailed in the market. Farmers have to travel long distance to sell their produce in the agricultural output markets. Establishment of output markets near the production centers may increase the efficiency of the farmers hence increasing net income and food security. There was double return than cost incurred in the production of strawberry.

Mostly strawberry growers are illiterate or less educated. They don't have information about modern production practices. They are adpting old methods of cultivation which are not harvesting potential yield. Extension department should take initiative to provide appropriate and timely information about modern techniques of strawberry production. Education and training of the strawberry farmers can play an important role in increasing the production efficiency of farmers (Tariq *et al.*, 2018). Educated farmers have more skills and knowledge as compared to their counterpart who are less educated. They use the inputs more efficiently and can market their produce appropriately. The improvement in education of the farmers would generate a greater level of production at farm level (Fatima *et al.*, 2016). Further, continuing education needs to be provided to narrow the gap among famers engaged in cultivation of strawberry under smart farming (Choi and Lim, 2018). There is fluctuation in strawberry yield due to variation in socioeconomic characteristic of farmers, where farmers with greater experience and education attained high yield as compared to their counterparts who are less trained and experience.

There is a need of proper care while transporting strawberry to different markets as it is very delicate and has higher chances of deterioration. Farmers have less resources to start strawberry business and to accomplish the running cost. The availability of timely loan can help the farmers to fulfill their expenditures on strawberry cultivation. The severe alternations of climate change have devastating impact on agriculture. Taking climate change adaptation measures, farmers can increase their produce and maintain quality which can fetch higher prices in the market and increased their net profit.

The farmer with larger land holdings has more resources as compared to their counterparts who have less acreage. Farmers who had higher acreage under strawberry cultivation manage the production practices and farm risk more significantly as compared to their counterparts who have smaller acreage under strawberry. The frontline extension workers i.e. agricultural officers and field assistants are not providing relevant information to farmers regarding production practices and marketing. It is also evident that provision of extension services to strawberry growers has positive but insignificant impact on yield. There is need to develop marketing relations in the developing countries for the provision integration of farmers with the recent value chains also called as combined supply/value chains.

Conclusions: Considering high value crop and to develop more awareness among farmers the present study was undertaken to estimate production cost, economic returns and identification of marketing channels of strawberry. Growing strawberry is profitable enterprise as it fetches high net returns compared to other alternative crops. The BCR was calculated to be 2.10. The linkages between extension agents and farmers should be strengthened and capacity building of the extension workers be enhanced as they have little knowledge about strawberry cultivation. Similarly, awareness among strawberry growers and capacity building of agricultural extension staff is the need of the time. Keeping in view its profitability compared to other crops, government should take concrete steps for provision of runners in different strawberry growing areas of Punjab. In addition, government should launch small entrepreneurship by giving grants to farmers to enhance this business on commercial scale. Moreover, Easy loan through E-credit should be given to farmers. Value addition may also be enhanced by establishing processing industry near production centers. To enhance its shelf life, cooling system is being used while transportation. The government should also establish processing units near markets for facilitating its value addition.

ACKNOWLEDGEMENT

The first author acknowledged the financial support of U.S.-Pakistan Center for Advanced Studies in Agriculture and Food Security (USPCAS-AFS), University of Agriculture, Faisalabad, Pakistan and Punjab Agricultural Research Board (PARB) for this research work under the Project NO. 971.

REFERENCES

Afridi, G.S., M. Ishaq and S. Ahmad. 2009. Cost and revenue analysis of strawberry production in the sub-tropical areas of NWFP, Pakistan. Pak. j. life soc. Sci. 7:59-65.

Agir, H.B., G. Saner and H. Adanacioglu. 2015. Risk sources encountered by farmers in the open field production of strawberry and risk management strategies: A case of Menemen-Emiralem District of Izmir. J. Agric. Sci. 21:13-25.

Ahmad, B., M. Mehdi, A. Ghafoor and H. Anwar. 2018. Value chain assessment and measuring export determinants of citrus fruits in Pakistan: an analysis of primary data. Pak. J. Agri. Sci. 55: 685-692.

Amin. 1996. "Progress and prospects of strawberry production in NWFP". Annual Report, Agricultural Research Station (North) Mingora, Swat. 212:4-7.

Asad. 1997. Strawberry production and marketing potentials. Advisory Leaflet of MFVDP.30:1-2.

Badar, H. 2015. Value chain performance improvement for sustainable mango industry development in Pakistan. PhD Dissertation, School of Agriculture and Food Sciences, The University of Queensland, Australia.

Banaeian, N., M. Omid and H. Ahmadi. 2011. Application of data envelopment analysis to evaluate efficiency of commercial greenhouse strawberry. Res. J.Apld. Sci. Eng. Tech. 3:185-193.

Boriss, H., H. Brunke, M. Kreith and K. Morgan. 2012. Commodity Strawberry Profile. Retrieved May 28, 2014, from http://www.agmrc.org/commodities__products/ fruits/strawberries/commodity-strawberry-profile/.

Chaudhry, A.M., B. Ahmad and M.A. Chaudhry. 1992. Cost of Producing Major Crops in Pakistan 1991-92. Research Report, Department of farm management, University of Agriculture, Faisalabad.

Chandler, C.K., D.E. Legard and J.W. Noling. 2001. Performance of strawberry cultivars on fumigated and non fumigated soil in Florida. Hort. Tech. 11:69–71.

Childre. 1983. "World strawberry production". USA Food J.15: 4-8.

Choi, D.W. and C.R. Lim. 2018. Statistical analysis of Production Efficiency on the Strawberry Farms Using Smart Farming. J. Kor. Soc. Qual.Manag. 46:707-716.

Dash, P.K., C. Chase, S. Agehara, L.Zotarelli and Z. Guan. 2017. Alleviating heat stress during early season establishment of containerized strawberry trans-plants. Hort. Sci. 52:268.

Fatima, H., L. Almas and B. Yasmin. 2016. Allocative efficiency and profitability analysis of high-tech cotton melon multiple cropping system in Punjab, Pakistan. Sar. J. Agric. 33: 117-126.

Food and Agriculture Organization. 2010. Top five strawberry producing countries. FAO Statistics 2010-11. FAO, Rome.

Galic, D., D.Milic and Z.Sredojevic. 2014. Financial results achieved in short-day strawberry production. Econ. Agric. 61:851-859.

Hancock, J.F., P.W. Callow, S. Serce and A.C. Schilder. 2001. Relative performance of straw berry cultivars and native hybrids on fumigated and nonfumigated soil in Michigan. Hort. Sci. 36:136-138.

Hanif, Z. and E.Budiyati. 2011. Diversity technology strawberry cultivation in different regional production centre. Proc. Natu. Res.Clim.Fod. Sec. Dev. Couns. 614-624.

Khan, H. 2003. Estimating returns and cost of strawberry production in District Charsadda and Mardan. Agriculture Economics, KPK Agriculture University, Peshawar, Pakistan.

Mahat, P. and S. Chaudhari.2018. Post-harvest practices of strawberry and its role in income generation in Nuwakot district, Nepal. Nepl. J. Agric. Sci. 16:175-179.

Mehdi, M., M.B. Ahsan, B. Ahmad, K. N. Sadozai, G. Hameed andM. Asif. 2020. Value Chain Development

and Social Upgrading at Upstream of Mango Value in Pakistan. Sar. J. Agri. 36:574-585.

Mehdi, M., B. Ahmad, A. Yaseen, A. Adeel and N. Sayyed. 2016. A comparative study of traditional versus best practices mango value chain. Pak. J. Agri. Sci. 53:733-742.

Muliar, D., R. Singh and S. M. Feroze. 2017. An economic appraisal of strawberry orchard in Meghalaya. Econ.Afair. 62:113-119.

Naseer, M.A.R., M. Mehdi, M. Ashfaq, S. Hassan and M. Abid. 2019. Effect of marketing

channel choice on the profitability of citrus farmers: evidence form Punjab-Pakistan.

Pak. J. Agri. Sci. 56:1003-1011.

Rajwana, I. A., K. Razzaq, S.B. Hussain, M. Amin, A.S. Khan and A.U. Malik. 2016. Strawberry cultivation in southern Punjab Pakistan. In VIII International Strawberry Symposium 1156:909-914.

Rhainds, M., J. Kovach and G.E. Loeb. 2002. Impact of strawberry cultivar and incidence of pests on yield and profitability of strawberries under conventional and organic management systems. Biol. Agr. Hort. 19:333–353.

Ruth, T.K. and J.N. Rumble. 2016. Branding the berries: Consumers' strawberry purchasing intent and their attitude toward Florida strawberries. J.Apld.Comun. 100:4.

Samtani, J.B., C.R. Rom, H. Friedrich, S.A Fennimore, C.E. Finn, A. Petran, and C. Kubota. 2019. The Status and Future of the Strawberry Industry in the United States. Hort. Tech. 29:11-24.

Stevens, M.D., B.L. Black, J.D. Lea-Cox and D.Feuz. 2011. Horticultural and economic considerations in the sustainability of three cold-climate strawberry production systems. Hort. Sci. 46:445-451.

Tariq, M., M.K. Hussain, Z.K. Malik and N. Jehan. 2018. An Estimation of Technical Efficiency of Strawberry Production in District Charsadda Khyber Pakhtunkhwa. Srhd. J. Agri. 34:93-101.

Whitaker, V.M., C.K. Chandler, N.A. Peres, M.C.N. Nunes, A. Plotto, and C.A. Sims. 2015. Sensation™ 'Florida127' strawberry. Hort. Sci. 50:1088-1091.

[Received 01 Jan 2020; Accepted 02 Oct 2020; Published (online) 11 Jan 2021]