

*Full Length Research Paper*

# Socio-economic study of carrot cultivation at farm level in the Punjab province of Pakistan

Tanveer AHMAD<sup>1</sup>, Muhammad AMJAD<sup>1\*</sup>, Aamir Nawaz<sup>1</sup>, Qumer Iqbal<sup>2</sup> and Javed Iqbal<sup>1</sup>

<sup>1</sup>Institute of Horticultural Sciences, University of Agriculture, Faisalabad-Pakistan, 38040.

<sup>2</sup>Nuclear Institute for Agriculture and Biology, Jhang Road, Faisalabad-38000, Pakistan.

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The current status of the carrot cultivation in the Punjab Province of Pakistan was investigated to comprehend the potential of this crop, as this crop is gaining popularity among the local farmers. This model survey was a step forward to reduce poverty and unemployment in the rural areas by engaging the youth in vegetable production for export. Generally, it was observed that farmers were not using the standard procedures for carrot cultivation, mainly because of the lack of capital and up-to-date information on carrot production technology. It was observed that the carrot industry has a potential role in achieving the aforementioned targets. It was concluded that the government and private agencies should work together to achieve the goals for the betterment of the local community, and this could be a role model for other developing nations as well. Processing industry should be established in the major carrot production sites that will enhance the profitability of the crop to benefit the farmers while, on the other hand, it will generate employment opportunities for the local community and contribute significantly to the balanced diet of the local people to improve their health.

**Key words:** *Daucas carota* L., root, investment, production problems, yield, storage.

## INTRODUCTION

Carrot, *Daucas carota* L., a prominent member of the family Umbelliferae, is one of the major vegetable produced and consumed in Pakistan; it occupies a prime position among the winter vegetables. Carrots are cultivated on an area of 13.9 thousand hectares, with 242.3 thousand tonnes production (FAO, 2007, 2008). The national average yield for carrot is only 17.5 tonnes ha<sup>-1</sup>, which is quite low as compared to other advanced countries, such as Belgium (47.64 tonnes ha<sup>-1</sup>), Denmark (44.29 tonnes ha<sup>-1</sup>), and the United Kingdom (44.28 tonnes ha<sup>-1</sup>). However, in India and China, the average yield is 30 and 38.54 tonnes ha<sup>-1</sup>, respectively (Anonymous, 2009).

The world over, healthy eating strategy has forced the general public to eat more fresh fruit and vegetables. Among these, carrots are being increasingly consumed (MAFF, 1997), mainly due to their pleasant flavor and

perceived health benefits related to vitamins, minerals, and fiber that they contain;  $\beta$ -carotene, a dimer of Vitamin A, is abundant in carrots. Furthermore, carrots are rich in dietary fiber, antioxidants, and minerals, and fall in alkaline food. Vitamin A deficiency is a worldwide nutritional problem, especially in the developing countries that severely afflicts the health of pregnant and lactating women, infants, and children. Women are the most vulnerable group affected by vitamin A deficiency during their pregnancy and lactating periods (Butt et al., 2007a). In Pakistan, deficiency of vitamin A was found to be 18.95% among rural adult females aged 20 to 23 years, and females aged 24 to 27 years were also found to be deficient. Among the urban adult females aged 28 to 31 years, the deficiency was 24.16%, and females aged 20 to 23 years and 24 to 27 years were also found in the deficient periods (Butt et al., 2007b).

Carrot is one of the potential sources of natural phytopigments, such as lycopene,  $\beta$ -carotene, xanthophylls, and anthocyanin, found in many colors, such as white, red, pink, purple, yellow, black, and

\*Corresponding author. E-mail: amjaduaf@gmail.com.

**Table 1.** Socioeconomic profile of carrot growers.

Serial number	Characteristics	Level	Frequency	Percentage (%)
1	Education	Illiterate	31.00	25.80
		Literate*	73.00	60.80
		Matric and above	16.00	13.30
2	Age	Up to 30 years	31.00	25.80
		31–40 years	71.00	59.20
		41 years and above	18.00	15.00
3	Gender	Male	120.00	100.00
		Female	0.00	0.00

\* Attended school but left before completing matriculation, and can read and write.

orange. Several health benefits are associated with carrots, such as strengthening the immune system, regulating metabolism, maintaining a healthy skin and vision, and reducing the risks of high blood pressure, stroke, heart disease, and some types of cancer. Carrot cultivation is gaining popularity among farmers in diverse areas of the Punjab Province, which has recently been seen as a lucrative enterprise. Pakistan has a diverse climate that offers a wide range of vegetables to be produced and exported. Today, there is an urgent need to standardize agro techniques compatible with local climatic and edaphic conditions.

As carrots are grown both in rural and as well as Periurban areas, its potential for generating employment is an added advantage to improve the economic conditions of the weaker segment of the society. Moreover, carrots are a cheaper source of essential nutrients in Pakistan, but its use in the daily life of the people is very low because of the limited information on the nutritional importance of this crop. The leaves of this crop are also used as fodder for the farm animals. This is an additional advantage, as at times the supply of fodder is scarce in the region. This case study was planned to assess the present status of the carrot cultivation, identify the problems of the farmers, production, and yield of carrots, study the infrastructural facilities available for carrot cultivation and processing, study the socio-economic conditions of the farming community, and recommend policy measures to uplift the carrot sector.

## MATERIALS AND METHODS

This study was conducted in various locations of the Punjab Province, from 2009 to 2010, where carrots are grown commercially. Four districts, Faisalabad, Nankana Sahib, Sheikhpura, and Gujranwala, were selected to conduct a field survey, as these areas are the leading producers of carrots. Complete biodata of the farmers along with their farm information were noted. In total, 30 farmers were traced in different areas of each district by a simple random method. They were interviewed on detailed formatted questionnaire. The interview questions were

prepared in English and then translated into Urdu for the convenience of the respondents.

Each interview took 30 to 35 min. Personal profile of the carrot growers was prepared in which their name, address, age, educational level, experience, and area under carrot cultivation were noted. The farmers were asked questions related to the cultivation and management of the carrots to assess the present situation of the carrot industry in the Punjab Province. A pilot survey of the project areas was conducted before starting the actual interview. The broad purpose of the pilot survey was to acquire basic understanding of the questions and response behaviour of the respondents of the project area and to find any mistakes in the interview questionnaire.

The collected data were coded, recoded, labeled for data sheet preparations, and statistical analysis in the Statistical Packages for Social Sciences. Chi-Square test was used to determine the statistical significance of nonparametric population and qualitative observation (Levin and Rubin, 2000). Statistical difference of various parameters was tested at 5% of P value.

## RESULTS AND DISCUSSION

In total, 120 respondents (30 in each district) were interviewed on a detailed questionnaire format. Collected data were arranged, coded, and recoded. An effort was made to focus briefly on some important features of the farmers. Socioeconomic characteristics of the farmers affect their production patterns, technology use, and influence their farm decision-making process. Enterprise combination, consumption pattern, and employment of different farm households could be influenced by their various characteristics, as well as some other socioeconomic aspects of the farm households, such as age distribution, level of education, and gender. Data stratification on the basis of the demographic profile of carrot farmers in the Punjab Province is shown in Table 1.

Among diverse educational groups, respondents were sorted out as illiterate, literate, matric, and above. On the basis of gender, respondents were defined as male and female. The results revealed that all the respondents were male. Among the educational group, 63.40%

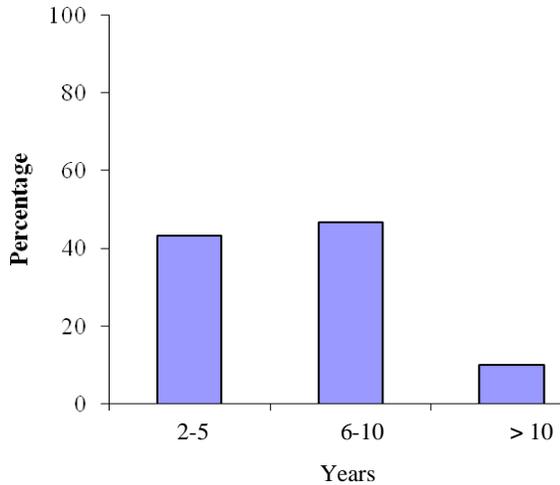


Figure 1. Experience in carrot cultivation.

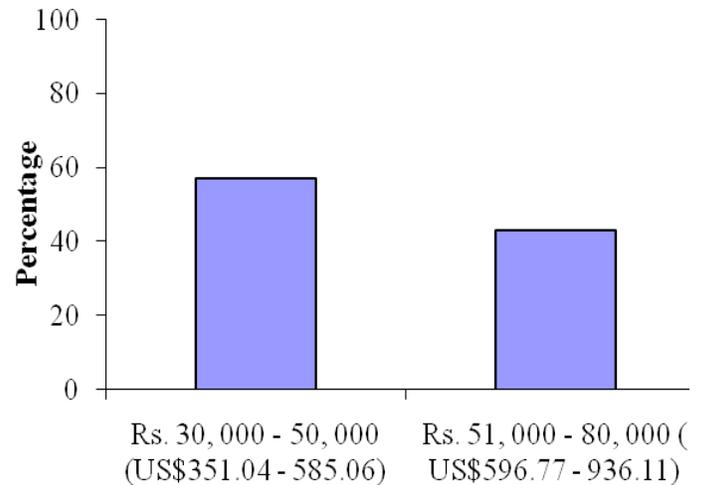


Figure 3. Per acre investment (Rs. and US\$).

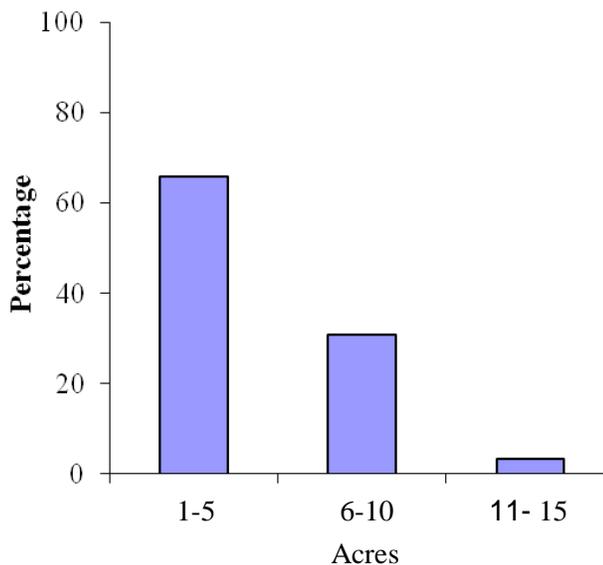


Figure 2. Area under carrot cultivation.

respondents were literate who had attended school but left before completing matric and can read and write, 13.30% have qualifications equal to matric and above, and 23.30% are illiterate. The majority of the respondents were mature adults, as age is the important factor for working in the field. Young farmers worked more than old ones due to their physical and mental energy. Detailed demographic characteristics frequencies are shown in Table 1. Farm sketch of carrot-growing farmers was prepared through a questionnaire in which some fundamental issues, such as “for how many years they are growing carrots, do they only cultivate carrot or grow other vegetables as well, total area under carrot cultivation at the farm and how much they spend on carrot cultivation.” The broad purpose of these questions

was to have a basic idea about the farm.

A question related to the total time of business establishment of carrot was asked to get the familiarity of the farmers in the carrot cultivation. Details illustrated in Figure 1 indicate that 10% of the total farmers surveyed were involved in the business for more than 10 years, 46.7% for the last 6 to 10 years, and 43.3% for the last 2 to 5 years. The growers were asked about the total area under carrot cultivation. Results presented in Figure 2 indicate that 65.80, 30.80, and 3.3% of farmers were growing carrot on an area of 1 to 5, 6 to 10, and 11 to 15 acres, respectively. Land holdings are becoming smaller, with the passage of time after the division of land within the families. This is a very important factor in the reduction of the acreage under any sort of crop. Farmers were asked whether they were cultivating carrot as a monocrop or along with other winter vegetables in rotation. The farmers reported that they are not exclusively dependent on carrot cultivation. They were also growing other winter vegetables, such as radish, turnip, spinach, cabbage, and cauliflower. A question was asked about the expenditures on one acre to appraise the total investment incurred on carrot cultivation per acre. The main objective was initially to prepare an expenditure statement and estimate the profitability of the carrot cultivation. In response to this question, 57.5% of farmers were spending Rs. 30,000 to 50,000 (US\$ 351.04 to 585.06) and 42.5% were spending Rs. 51,000 to 80,000 (US\$ 596.77 to 936.11) (Figure 3). The respondents were further asked to clarify the distribution of expenditures incurred on seed, fertilizer, and cultural practices. Details of these expenditures are given in Table 2.

According to the demographic profile of the farm, 13.30% of the farmers had qualification equal to matriculation and above, 63.40% were literate (those who had attended the school, but left before completing matric

**Table 2.** Expenditures incurred on an area of one acre for carrot production.

Commodity	Value (Rupees per acre)	Frequency	Percentage
Seed	5,000–6,000 (US\$ 58.50– 70.20)	63	52.50
	7,000–8,000 (US\$ 81.90– 93.61)	26	21.70
	More than 8,000 (US\$ 93.61)	31	25.80
Fertilizer	10,000–15,000 (US\$ 117.04–175.52)	19	15.80
	16,000–20,000 (US\$ 187.22–234.02)	58	48.30
	21,000–25,000 (US\$ 245.72–292.53)	43	35.80
Cultural practices	10,000–15,000 (US\$ 117.04–175.52)	88	73.30
	16,000–20,000 (US\$ 187.22–234.0)	18	15.00
	21,000–25,000 (US\$ 245.72–292.53)	14	11.70

and can read and write), and 23.30% were illiterate. The main objective to find the literacy level of the farmers was primarily to understand their educational level and sketch the future strategies for their guidance to adopt international standards for carrot production. Literacy level advocates the need for informal education through extension services for enhancing the profitability to the farmers. Education enables a farmer to take risk and adopt new technology. Gross and Tales (1952) observed that the educated farmers differentiated themselves from the non-educated ones, with respect to the acceptance of recommended farm practices. Education helps a farmer go to extension workers for solving any problem regarding crop production.

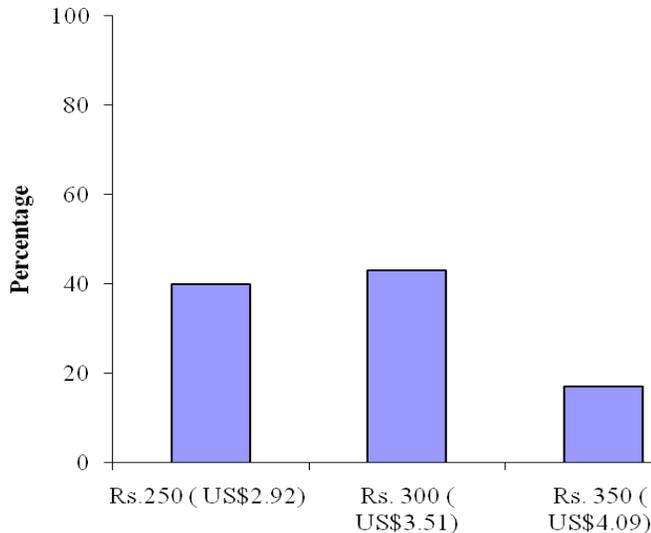
Maximum growers surveyed were involved in the business for more than 10 years. It was observed that the local market is dominant by the already recognized growers who produce carrot for domestic use. A very small percentage is being added to the total number of farmers cultivating carrot.

Majority of the farmers surveyed were growing carrot on a small area of 1 to 5 acres, which suggested that most of the farmers are producing carrots only for the local market. Land holding is another socioeconomic condition, which sometimes indicates the financial condition of the farmers. All the farmers surveyed were also growing other vegetable crops; no farmer had reported growing carrot as a monocrop. In total, the investment made on carrot cultivation per acre range from Rs. 30,000 to 80,000 (US\$ 351.04 to 936.11). The extent of investment depends on the type of seed and cultural practices used to grow carrots. The farmers were asked questions, related to the cultivation and management of the carrot, to know whether they were adopting standard cultivation practices or not and to assess their future needs for the introduction of modern technology. A question also asked related to the organic production of the carrots.

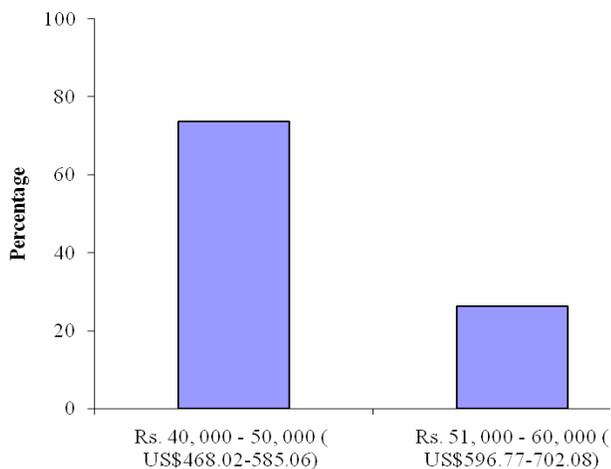
No farmer had reported growing organic carrots. According to the survey, they had no awareness

regarding organic carrot production. Many consumers believe that organic food benefits health more than conventional food, as fruits and vegetables are rich sources of different phytonutrients many of which have antioxidant properties (Prior et al., 1998). Organic agriculture does not allow the use of pesticides and synthetic fertilizers. There is some information about how various levels of fertilization influence nutritionally relevant components. There is virtually no knowledge about how the use of pesticides per se affects the contents of the “traditional” nutrients (vitamins, minerals, fibers, protein, and energy). Probably, it is possible that differences in other aspects of plant composition, such as secondary metabolites, nutrient bioavailability, and characteristics that describe the picture-developing properties, may be at least as important for its impact on health (Brandt et al., 2004). Of the total farmers surveyed, 90% were using the local seed (the only local recommended variety is T-29) and 10% were using the hybrid seed. There are many variations of the number of lines, spacing between lines, and bed width depending upon the shippers’ needs and ultimate product use. Planting fewer seeds produces large carrots for the shredder processing use, and planting large amounts of seeds is necessary for smaller diameter carrots for short cut use. The seed size varies tremendously from variety to variety and year to year in the same variety and seed lot.

These factors of shape and size variance aggravate the difficulty of handling seed for precision seeding, as well as the associated problems with seedling establishment in the field. Plant-to-plant variation arises before and during crop establishment to a great extent. Variation in seedling size at emergence is magnified at later stages by plant competition. Smaller plants decrease relative to that of the larger plants, mainly due to the competition for food and light. This situation occurs because larger plants surround smaller plants where the smaller plants become increasingly deprived of light and other growth factors. So, the level of variation among plants at the time of



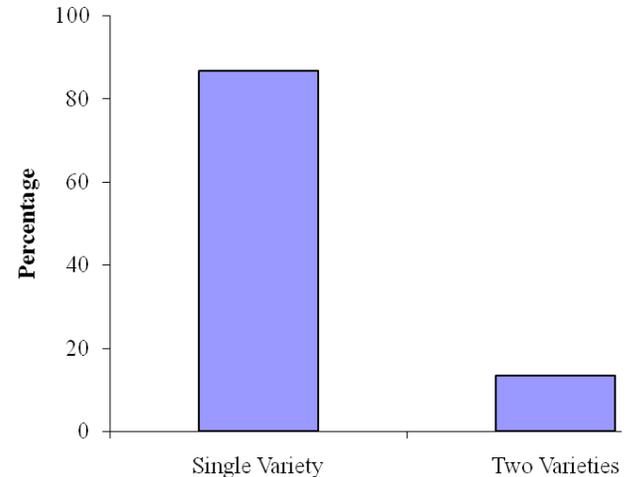
**Figure 4.** Sale price of carrot seed (Rs. and US\$).



**Figure 5.** Income from carrot seed.

seedling emergence drastically affects root size variation at harvest many months later. Carrot yield depends strongly on plant density. Higher seeding rates increase yield, but the yield increase is largely made up of smaller-size roots that require more time to mature or size up. Of the total farmers surveyed, only 5% were producing their own seed and the extra sold to other farmers. Seed production is a highly specialized job and Pakistan is lacking in this sector. Pakistan imports vegetable seed worth Rs. 1 billion (US\$ 11,701,380.89) per year (MINFAL, 2009). There is an urgent need to produce highly skilled workers in this field, to save foreign exchange and ensure the best quality and high yielding seeds are easily accessible to local farmers at cheaper rates.

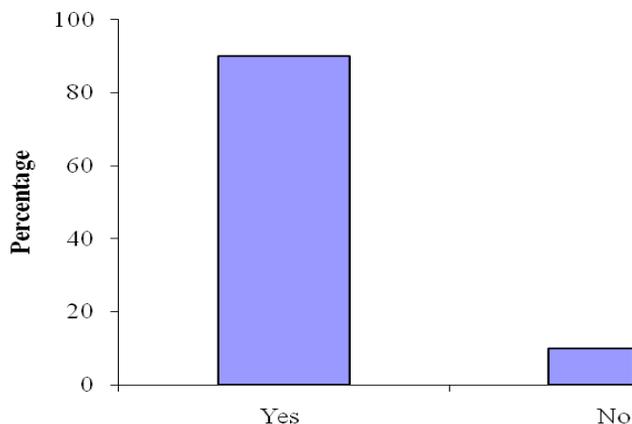
A question was asked about the storage of the seed to know the type of the packaging material used by the



**Figure 6.** Number of varieties grown by farmers.

farmers to store seed. Of the farmers producing their own seed, 90% were using the local gunny bags for storage and 10% were using plastic bags. Seed storage is very important for the sustainability and health of the crop. Packaging materials are of utmost importance as far as the storage life of the seed is concerned. Proper packaging can improve the shelf life of seed without compromising on its quality, whereas improper packaging can produce negative results. Some deficiencies, such as improper packaging material and storage conditions, were found in the seed storage methods at the farm level that need to be improved. In response to a question related to the selling price of the seed, 49.2% were selling their seed at Rs. 250 (US\$ 2.92) per kg, 29.2% at Rs. 300 (US\$ 3.51), and 5.8% at Rs. 350 (US\$ 4.09), as shown in Figure 4. Of the total farmers producing own seed, 73.75% were earning Rs. 40,000 to 50,000 (US\$ 468.02 to 585.06) and 26.25% were earning Rs. 51,000 to 60,000 (US\$ 596.77 to 702.08) as illustrated in Figure 5.

The total number of farmers, who purchased local seed for cultivation, was buying the seed between Rs. 250 (US\$ 2.92) and Rs. 400 (US\$ 4.68). Of the total farmers surveyed, 86.7% were cultivating only one variety and 13.3% were growing two varieties, as indicated in Figure 6. A question was asked about the selection criteria of the carrot varieties for cultivation. The farmers reported that they selected the varieties on the basis of the colour and root length. Carrot has several varieties with a wide range of colors. In Pakistan, mostly the orange color is preferred for local consumption. Here, the carrots are used mostly fresh as there is no specific processing industry for this crop. However, dehydration is done locally for the storage of this crop at the household level. Regarding crop rotation, 90% farmers reported that they had adopted crop rotation with other winter vegetables, such as radish, turnip, spinach, cabbage, and cauliflower, as demonstrated in Figure 7. A question pertaining to the



**Figure 7.** Crop rotation performed by the farmers.



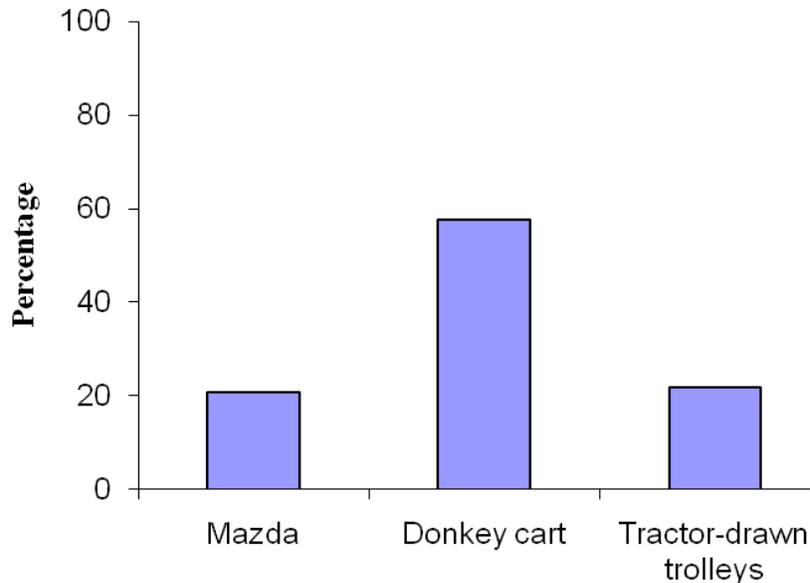
**Plate 1.** Washing of carrots at the farmer's field (Photo by Tanveer Ahmad).

source of irrigation was asked. The response: 39.1% farmers used canal water and 61% used water from the tube well to irrigate the carrot field. However, in most cases, mixed water from the tube well and canal was used. Water shortage is an emerging problem for Pakistan. Fresh water resources are becoming limited, emphasizing the adoption of new techniques for irrigation to save this precious resource.

A question was asked to know the prevalence of the diseases in the farmers' fields. Of the farmers surveyed, 65.83% reported that diseases attack their crop and 34.50% reported that no diseases were found on the carrots. The farmers whose fields were attacked by diseases managed through the use of chemicals. They also reported that attacks on their crop were taken care of through chemical means. Carrots are usually free of insect and disease problems. However, occasionally aster yellow becomes a major concern that is multiplied by leafhoppers. Infected leafhoppers feeding on carrots spread the disease and in 3 to 5 weeks symptoms begin to appear. Leaf bronzing, the proliferation of new growth from the crown and hairy roots, are visual symptoms of disease development. Several insecticides are efficient in

limiting leafhopper populations through insecticides on a weekly basis. Diseases in the field are rare. Under very wet soil conditions, particularly in areas with standing water, soft rot can occur. Plants may survive marginally; however, lower root sections may be decaying. Under such circumstances, it is strongly advised not to harvest carrots in these areas, as they spread the disease in storage. Farmers reported that they dig their carrots by hand with no machinery used and therefore, making it more difficult and laborious to harvest. There is a need to introduce mechanized harvesting. Mainly, there are two types of harvesters, that is the top-lifter and the digger-elevator. The top-lifter is more popular because of the reduced incidence of root damage and greater versatility.

A question about the washing of carrots was asked to comprehend the type of water used for carrot cleaning. Of the total farmers surveyed, 90% were using tube well water and 10% were using canal water. Carrots must be washed before packing or storing, and dirty roots may stain and are also subject to increased incidence of storage disease. The washing procedure of the farmers is very poor at the farm level, as illustrated in Plate 1. These methods need to be improved for the greater market



**Figure 8.** Mode of carrot transportation from farm to market.

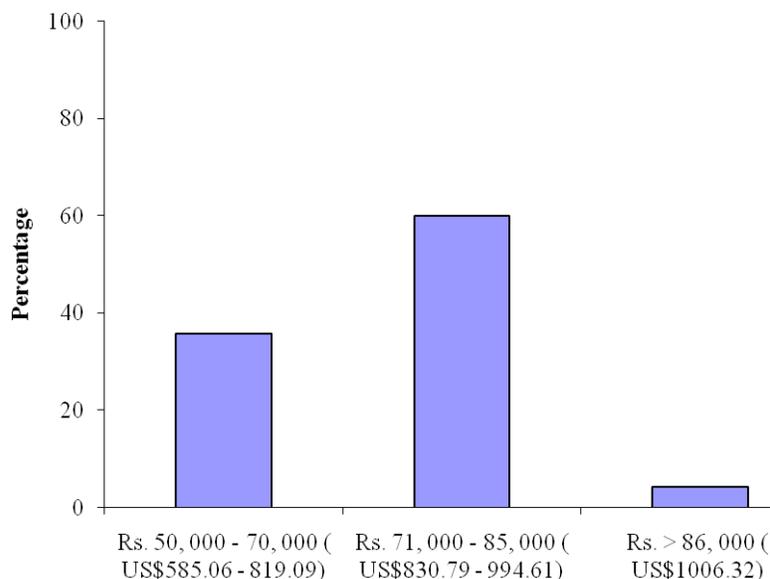
value of the crop. A question was asked to comprehend the problems being faced by farmers during cultivation. Of the total farmers surveyed, 90% reported that water was the main problem because of shortage and 10% reported that fertilizer is the main problem. Among those who said that fertilizer is the main concern, 56.67% responded that high prices of the fertilizer were responsible, whereas 43.33% reported the unavailability of fertilizer at the appropriate time. There was no report of any organizations taking interest in carrot cultivation. Of the total farmers surveyed, 90% reported that the government provided loans to the farmers and 10% said that the government did not provide any loans. In response to a question about the damage of the crop by birds and animals, 19% reported that birds and animals harm their crop and 81% reported that they did not harm the crop. The farmers reported that they manage insect pests and diseases by their own means.

No farmers reported on how carrots were stored. All the farmers surveyed stated that they graded the carrots for marketing on the basis of carrot length, diameter, colour, and variety. Regarding the mode of the transportation, 20.80% farmers reported that they transport carrots through Mazda, 57.5% through donkey cart, and 21.7% through tractor-drawn trolleys to nearby markets, such as Faisalabad, Gujranwala, Lahore, etc., as shown in Figure 8. Regarding income from one acre, 35.8% reported earning Rs. 50,000 to 70,000 (US\$ 585.06 to 819.09), 60% earning Rs. 71,000 to 85,000 (US\$ 830.79 to 994.61), and 4.2% earning more than Rs. 86,000 (US\$ 1006.32 Table 3), as shown in Figure 9. No farmer had reported exporting carrots. When a question about the main hurdle in export was asked, the farmers replied that marketing problems are the main hurdles.

Furthermore, it was observed that the farmers were ignorant of the quality standards of the carrot production for international trade. In response to a question regarding facilities required from the government, all had demanded the best quality seed and modern implements. The seed production sector needs more attention from the government and private agencies to fulfill the demands of the local growers. Per month income distribution of labourers working on one acre is approximately double as (Table 4) compared to the salary for such a person who starts from Rs. 6,000 (71 US\$) per month from other employment sources. This income distribution underlines the importance of carrot cultivation for the local people in relation to employment generation. When the growers were asked about preferences for support, all the growers demanded better quality seed of red coloured varieties as these fetch higher price in the domestic market.

## Conclusions

From the earlier information, it can be concluded that carrot cultivation is a lucrative business for the farmers in the Punjab Province. The practices adopted for carrot cultivation are not up to international standards. Furthermore, the ignorance of this sector by private and governmental agencies has aggravated the problems of the farmers. There is an immediate need for closer cooperation from government and private sectors to fully exploit the potential of this product. Carrot processing industry should be established for value addition, generating the employment opportunities in the province as well.



**Figure 9.** Income from carrot of an area of 1 acre.

**Table 3.** Per month income distribution of labourers.

Total income per farm from carrots	61,000-80,000 (Rs.acre <sup>-1</sup> ) (718 – 942 US\$)
Average No. of labourers	2 Labourers per acre
Per Month Income per labourer	Approx. Rs./ 12,000 (142 US\$)

**Table 4.** Growers' preferences for support.

Which support would be most valuable to improve the cultivation?	Better seeds of red cultivars
Why must they be red?	The consumers prefer red carrots to orange ones

This will also ultimately lead to the improved per capita intake of vegetables and improve the health of the people to a greater extent. This close working of the agencies will overall help in uplifting the whole olericulture enterprise in general and the carrot industry in particular. However, the following concrete steps should be taken to uplift the vegetable sector and generate employment, particularly in the rural areas, thereby increasing the standard of living of the farming community:

1) Majority of the farmers have small land holdings and can spend a limited amount of money, whereas vegetable production needs high investment to cater to modern demands. There is a strong need to help farmers by providing loans and expertise through government and private institutions.

2) Because vegetable production needs advanced technology and capital, introduction of corporate farming could be helpful initially in transfer of technology and, later on, in establishing export-oriented production.

3) The literacy level of the farmers and their knowledge and skills to produce crop suggests that concerned institutions should take strong initiatives for the provision of informal and formal training, to help them learn modern practices in crop production.

4) Survey results clearly suggest that farmers are unaware in the existence of modern techniques involved in the production of carrot. Local research-based technology transfer is needed.

5) Field problems, such as water shortage, nonavailability of fertilizers, and improper use of pesticides, warrants a strong system for supplying production-related commodities on a regular basis and at subsidized prices.

6) Transport system is poor and needs to be strengthened.

7) Seed production procedures are meager and need to be streamlined.

8) Vegetable processing industry should be established at all the main production sites to regulate the production and price of the crop, so that farming community may

avoid losses in view of glut production.

9) Pests and diseases have been reported to attack the crop. Farmers are managing the problems on their own.

Furthermore, WTO demands sanitary and phytosanitary measures based on science for the trade of commodities. The Agriculture department should develop diseases and pests compendium and disseminate to the farmers.

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