COST EFFECTIVENESS OF TOMATO PRODUCTION UNDER POLYHOUSE AND OPEN FARM CONDITIONS: A STUDY IN KARNAL (HARYANA)

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***Abstract*- Agriculture is the backbone of India. Agriculture sector plays an essential role in providing food to the state or nation; generates employment opportunities and provides raw material to the industrial sector. Haryana's immense potential is in the agriculture sector. This segment produces around 28 percent of the GDP and provides business/employment to more than 60 percent of the population of India. It is the prime arbiter for fulfilling the daily needs of 70% of India's population living in the rural area (Dahiya & Singh, 2017). Indian agriculture contributes to 8% of global agriculture gross domestic product to support 18% of world population on only 9% of world`s area and 2.3% of geographical area (Masood & Tabassum, 2014). But Indian farmers confront a few difficulties such as small land holding, less yield due to dependence on inefficient methods of farming, too much reliance on natural phenomena such as rainfall and lack of knowledge of modern packages of practice or modern methods of agriculture. Polyhouse technology is the technique of providing favorable environmental conditions to the plants. This is possible by erecting a polyhouse where the environmental conditions are so modified that one can grow any plant in any place at any time.**

***Keywords:* Tomato, Agriculture, Production, Cost.**

Introduction

Indian agriculture is important to the Indian economy as the majority of the population is involved in agricultural development. It has contributed to India's economy in many ways: income generation of farmers, major share in national income, provides buffer stock, supply of raw materials to industries, earner of foreign exchange etc. Agriculture always occupies a place of pride in our country.

The role of agriculture in India can be classified from the following facts:

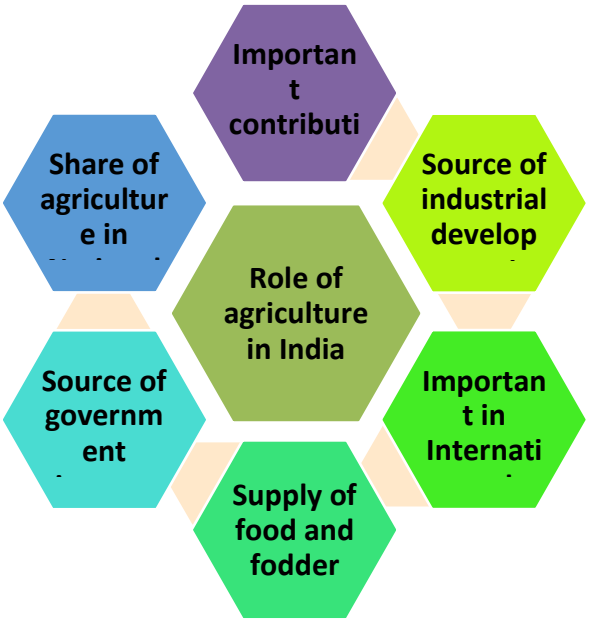


Figure 1. Role of agriculture in India

- **Important contribution to employment**: Agriculture sector at present provides livelihood to 65-70% of the total population (FAO report 2017-18). It provides employment to two thirds of the country's workforce and it is the single largest private sector occupation.

- **Source of industrial development**: In India, various industries find their raw material from the agriculture sector- cotton and jute textile industries, sugar etc. Handloom, spinning oil milling, rice threshing etc. are small-scale industries that rely on the agriculture sector.
- **Important in International trade**: Agricultural products like sugar, rice, tea, tobacco, etc. constitute the main items of exports of India.
- **Supply of food and fodder**: Agriculture sector also provides fodder for livestock.
- **Share of Agriculture in National income**: Agriculture plays a prime role in the Indian economy. The contributory share of agriculture in Gross Domestic product was 55.4% in 1950-51, 52% in 1960 and is reduced to 28% only at present (Mathew 2006).
- **Source of government income**: Many state governments get sizable revenue from the agricultural sector. Land revenue, agriculture income tax, irrigation tax etc. are being taken by the government.

Traditional Farming

Traditional agriculture is a steady and sustained farming system that has been employed to produce the materials required by its producers. Traditional cultivation systems also promote genetic diversity. Before, agriculture technology was not well developed compared to now. Farmers did not use any machinery to farm their land, Machineries have replaced animals used in agriculture. Farmers had to depend on land suitability, climate factors and the availability of required water supply before planting a crop that suited the situation. Farmers worked on their land, produced crops for their own domestic use because the methods used in traditional farming were not very effective to produce a huge amount of yield (Alam et. al.,2014).

Polyhouse Farming

Polyhouse farming is an alternative new technique in farming, gaining a foothold in rural India. It reduces dependence on rainfall and makes the best use of land and water supplies. Polyhouses are structures which are used as microclimate conditions to make the plant grow in unfavoured climates. The need for protected cultivation since the last 10 years has dramatically increased. The various reasons are reduced weed pressure, moisture conservation, reduction of certain insect pests, higher crop yields, and more efficient use of soil nutrients (Negi *et al.*, 2013). Polyhouses are covered with transparent material in which crops are grown in controlled surroundings. The most important parameter controlled is temperature, which provides heat to overcome extreme cold conditions. Environment control also includes sunlight, carbon dioxide levels, water, plant nutrients and pest control.

Statement of the Problem

To gain insights about the Cost effectiveness of Tomato Production under Polyhouse and Open Farm Conditions.

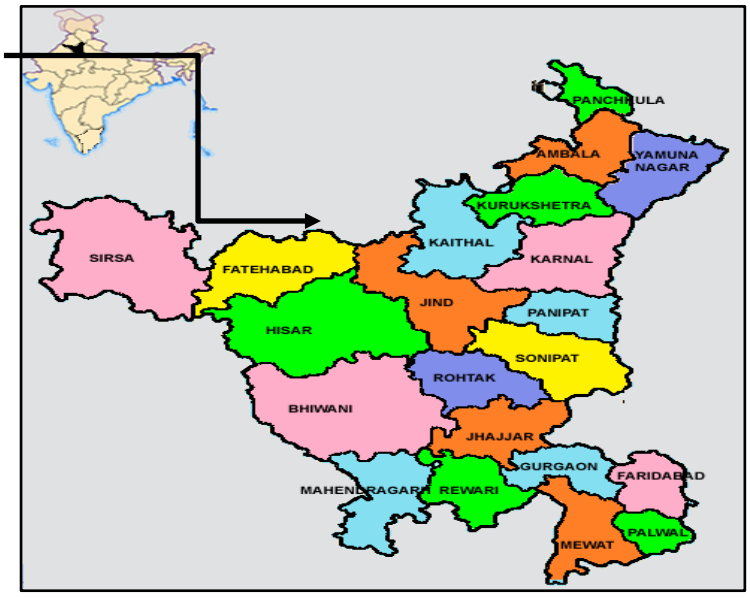
Specific Objectives

- To compare the cost of production of Tomato vegetables between polyhouse and open farm conditions.
- To find out the strengths and limitations of polyhouse cultivation.

Methodology

Locale

The study was conducted in Karnal district of Haryana, which is located in the northern region of the country. Haryana is an agricultural state. In Haryana state 620 different types of polyhouses were reported to be functional. The total number of polyhouses in Haryana are 614 with covered area of 17,57,920 metre square. In Haryana, 1,956 people were found to be engaged in polyhouse farming. Haryana, with just 1.4 per cent (4.4 M ha) of the total geographical area of the country, is the second largest contributor of food grains (17.6% in 2011-12) to the national food basket (Dahiya and Singh 2017).



Sampling Design

The study sample, sample size, sampling technique and inclusion criteria are described in table 1.

Table 1: Sample, sample size, sampling technique and inclusion criteria.

Sample		Sample size	Sampling Technique	Inclusion criteria
1	Polyhouse farmers	30	Purposive sampling	● The farmers having a minimum 3 years of experience of polyhouse farming were selected for the study. ● The farmers who were living in the villages for more than 5 years.
2	Open farm farmers	30	Purposive sampling	● The farmers having a minimum 3 years of experience of open field farming were selected for the study. ● The farmers who were living in the villages for more than 5 years.

Type of Sampling

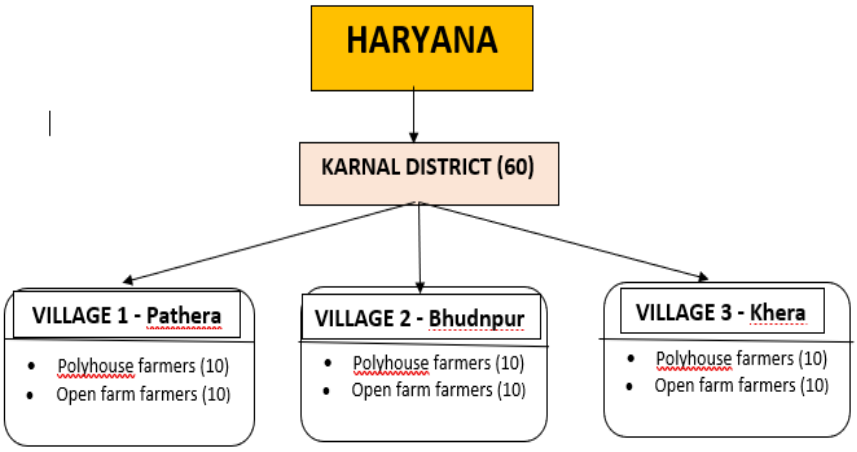
The sample for the study consisted of Polyhouse farmers and open farm farmers. For the present study, the people who were having minimum three years of experience in respective farming and were living in the villages for more than five years were selected.

Sample -: Primary respondents – Farmers

Purposive sampling was used to identify primary respondents for the study i.e. farmers in Karnal district. For the study, sixty farmers were selected from three villages of Karnal district to understand the effectiveness of cultivation of vegetables grown under polyhouse and open field conditions in terms of yield, cost and profit. An attempt has been made through the study to find out the limitations and strengths of both farming methods.

SAMPLING DESIGN

In this study, Karnal district of Haryana was selected. A total of 60 farmers from 3 villages belong to Karnal district i.e. Pathera, Bhudnpur and Khera were selected for the study. 10 farmers from each village of Karnal district who had at least 3 years of experience of polyhouse cultivation were selected. Same selection procedures were applied for the farmers who had three years of experience in open farm cultivation.



Method of Data Collection

Semi-structured interview is a qualitative research technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program or situation.

Semi-structured interview schedule allows freedom for both the interviewer and interviewee to explore additional points and change direction, if necessary. It does not limit the stakeholder. It gives freedom to an interviewee to discuss challenges faced by them. It provides a deep understanding of the study. It is used to understand the effectiveness of both methods of cultivation and problems and benefits regarding these methods. It also allows respondents to discuss and raise issues that you may not have considered.

Findings and Summary

Demographic Profile

Looking at the age groups of respondents of both types of cultivation, in the polyhouse farming, maximum farmers were between 31 to 40 years (70%) of age. In open farm conditions, farmers belonged to 31 to 40 years (60%) and 41 to 50 years (23.34%) were maximum. During the study, there were only two female farmers involved in open farm cultivation, whose husbands have died. These women are solely responsible for the management of the farm. While 100% of the respondents in polyhouse farming were males. In polyhouse farming, some of the laborers were reported to be females. They only pluck the vegetables from the plants and shake the plants once in a day for the pollination process. 36.7 % of the respondents had done primary education, who are involved in polyhouse farming while 56.7% were primary educated, who were involves in open farm farming. 43.4% of the respondents had done secondary education who are involved in polyhouse. During the study, it was also found that 5% of the respondents had done their post-graduation and 5% were graduates.

Comparison of cost of Tomato in Polyhouse and open farm Conditions

Table 2. Comparison of production and marketing cost of tomato

S. No.	Production and Marketing cost variables	Farming in Open farm conditions (Average cost in Rs. Per acre)	Farming in Polyhouse conditions (Average cost in Rs. Per acre)
1.	Preparation of soil	4,632.5 (4.01% of total cost)	5,896.3 (3.4 % of total cost)
2.	Seeds	6000 (5.1% of total cost)	9000 (5.3% of total cost)
3.	Fertilizers	8,966.4 (7.7% of total cost)	23,200 (13.6% of total cost)

4.	Irrigation	6500 (5.6% of total cost)	Included in installation amount
5.	Plant protection	40,000 (34.6% of total cost)	22,500 (13.2% of total cost)
6.	Total Labour Cost	33,000 (28.5% of total cost)	80,000 (47.1% of total cost)
7.	Marketing cost (Transportation, packaging loading and unloading etc)	16,360 (14.1% of total cost)	29,000 (17% of total cost)
8.	Total cost (production + marketing)	115,458.9	169,596

Table 2. explains the comparison of cost (production + marketing) in Poly house and Open field conditions. The mean value of cost per year is mentioned in the table. Total cost (production + marketing) for polyhouse and open farm conditions is divided into eight parts.

- Preparation of soil

Table 3.15 depicts that Field preparation cost for one acre is Rs.4,632.50/-(4.01% of total cost) in open farm condition and Rs.5,896.30/-per acre (3.4% of total cost) in polyhouse condition.
Dr. Duhan (2016) mentioned that field preparation and cultivation cost (per acre) were Rs. 6000/- and Rs.6500/- in poly house and open farm respectively. Whereas, Choudhary & Sengar (2011) did not include the cost of soil preparation in their report. A study was conducted in Khartoum State (Sudan) by Irdis (1999), in which he concluded that average cost of land preparation was 52983.337 SD/fed (1 feddan =1.038acres) which means Rs.76,825.83/- per 1.038 acre. In the study of Kumar (2016), total cost of preparation of soil was Rs.5318.18/- per acre (1.55% of total cost) in polyhouse cultivation and Rs.2229.11/- per acre (1.64% of total cost) in the open farm condition. This study also included the cost of bed preparation which was Rs.5954.54/- per acre (1.74% of total cost) in polyhouse and Rs.1435.29/- per acre (1.05% of total cost) in open farm condition.

- Cost of seeds

During the study, it was found that same kind of seeds were used in both polyhouse and open field farming. But cost differed due to different requirement of seeds i.e. Rs.6000/- per acre (5.1% of total cost) and Rs.9000/- per acre (5.3% of the total cost) in open farm and poly house respectively.
A similar kind of findings were reported by Dr. Duhan (2016), where seeds cost was equal for both polyhouse and open farm farming. In the study of Irdis (1999) cost of seeds was 8252.321 SD/fed, which means Rs.11,965.86/- per 1.038 acre. and cost of seeds was 284166.663 SD/fed, which mean Rs.412,041.66 per 1.038 acre. It represents 14.07% of the total cost in polyhouse condition. Kumar 2016 reported that total cost of seeds were Rs.25072.72/- per acre (7.30% of total cost) and Rs.4261.17/- per acre (3.13% of total cost) in polyhouse and open farm cultivation respectively.

- Fertilizers

There was a huge difference found in present study in cost of fertilizers as it costs Rs. 23,200.00/- per acre (13.6% of the total cost) in a poly house and Rs. 8,966.40/- per acre (7.7% of the total cost) in an open farm. Such a huge difference in fertilizers cost was due to the use of specific kinds of fertilizers which are totally imported and not subsidized. In Shimla, only Rs. 200 per acre was spent on fertilizers in the polyhouse. according to the feature of Choudhary & Sengar (2011). Dr. Duhan (2016) reported that fertilizers cost Rs.22000/- in poly house and it was only Rs.4000/- per acre in open farm condition. In the study of Kumar (2016), total amount spent on the fertilizers was Rs.9058.40/- per acre (2.64% of total cost) and Rs.15061.76/- per acre (11.05% of total cost) in polyhouse and open farm respectively, which is contradictory to other findings.

- Irrigation

Irrigation charges were reported to be Rs. 6500 per acre (5.6% of total cost) in open farm farming, while irrigation system and cost were included in installation charge in polyhouse cultivation. Irrigation cost was only Rs.100.00 for the polyhouse reported by Choudhary and Sengar 2011. Irdis (1999) survey results showed that the average cost of irrigation was 18176.214 SD /fed, which means Rs.26,355.50 per 1.038 acre i.e. 8.33% of the total cost. The high cost of irrigation was due to the high cost of fuel, oil and spare parts while irrigation cost was included in the installation charge of the polyhouse. Total amount spent on the irrigation was Rs.1168.18/- per acre (0.34 % of the total cost) in polyhouse and Rs.1501.17/- per acre (1.10% of total cost) in open farm farming in the study of Kumar (2016).

- Plant protection

The plant protection charges were found to be high in open field as it was Rs. 40,000/- per acre (34.6% of total cost) in open field and Rs. 22,500/- per acre (13.2% of the total cost) in poly house. A similar kind of findings were reported by Dr. Duhan (2016) that plant protection charges were Rs.8000/- per acre in open cultivation and Rs.3400 in polyhouse cultivation. Cost of weed control was also included in the study of Kumar (2016) i.e. Rs.827.27/- per acre (0.24% of total cost) in open farm and Rs.3828.23/- per acre (2.89 % of total cost) in the polyhouse and plant protection cost was calculated separately which was Rs.12295.45/- per acre (3.58% of total cost) and Rs.22541.18/- per acre (16.54% of total cost) in open farm and polyhouse respectively, the researcher was informed that in polyhouse culture, there is less attack of pests leads to less usage of pesticides.

- Labour cost

Moreover, table 3.15 shows that there was a huge difference in labour cost and marketing cost. The labour cost in poly house and open farm are Rs. 80,000.00 per acre (47.1%) and Rs.33,500.00 per acre (28.5%) respectively. This difference was due to heavy use of labor (for spraying pesticides, loading, unloading, packaging and harvesting) in poly houses daily which was not used in open farming extensively. The total labor cost in the poly house reported was Rs. 80,000.00/- per acre and Rs.39,000.00/- per acre in open farm cultivation by Dr. Duhan (2016). While, Choudhary and Sengar (2011) concluded in their feature that labour cost was only Rs.1000.00 in a polyhouse in Shimla. It shows that different parts of India have different requirements due to climatic conditions.

- Marketing cost

The marketing cost found to be in poly house and open farming is Rs.29,000.00 per acre and Rs. 16,360.00 per acre respectively. As per Kumar (2016), cost of marketing was Rs.17159.09 per acre (5.00% of total cost) in polyhouse and Rs.4623.52 per acre (3.39% of total cost) in the open farm farming.

- Total cost (production and marketing)

In case of total cost, table 3.15 shows that it was Rs.169,596.00 per acre for one year and Rs.115,458 per acre for one year for poly house and open farm respectively. Dr. Duhan (2016) concluded that total cost was Rs.209,400.00 per year for polyhouse cultivation and Rs. 137,000 per year for open farm cultivation. Total cost of production of tomatoes in polyhouse condition was Rs.343,080.83 and Rs. 136,263.97 in open farm cultivation (Kumar 2016).

The table explains the percentage share of different cost variables also in total cost. In case of poly houses, the share of labor cost was high followed by marketing cost, fertilizers cost, seeds cost and field preparation. Whereas in the case of open farms, plant protection share was high followed by seeds cost, marketing cost, labor cost, field preparation, irrigation, and fertilizers. It can be inferred that irrigation cost share was less in total cost of poly house while fertilizers cost share was less in total cost in case of open farm.

Conclusion

From the study we can conclude that polyhouse is more economic and beneficial for farmers. Tomato production in polyhouse can reduce the amount of chemicals used in production of high value vegetables compared to open field conditions. Multiple cropping on the same piece of land is possible in polyhouse condition. Production of high quality vegetables. It makes cultivation of vegetables possible in areas where it is not possible in open conditions. Controlled environmental conditions are used for early rising of nurseries, off-season production of vegetables and seeds production. Management and control of insect-pests, diseases and weeds is easier. Vertical increase in agricultural production by increasing the number of plant seedlings per unit area, thus increasing productivity per unit area and financial returns.

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