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An Economic Analysis of Gerbera Under a Climate Controlled Polyhouse

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study was carried out ten varieties of gerbera under naturally ventilated polyhouse during Department of Horticulture, College of Horticulture, SKLTSHU, Hyderabad during the year of 2015-2016. Gerbera cultivating area in India has been increasing gradually during the last decade due to its increasing demand in the market. Polyhouse cultivation of gerbera is used to protect plants from adverse climatic conditions. The freshness and long-lasting characteristics of this flower are delight to use it in the parties, wedding functions, flower arrangements, and flower bouquets in the form of ornamental flowers. Commercial value of this flower is very high in India. Among several cut flowers grown under controlled environments, gerbera has its importance because of its unique petal colors, long vase-life and market demand. In tropical and subtropical climate, gerbera is growing in greenhouses to produce quality flower. Present study was conducted to determine the cost and returns of gerbera cultivation in polyhouse. Benefit cost ratio is an important factor which decides the optimum level of inputs to be used for maximization of production and returns in any crop. The total cost of cultivation of gerbera when cultivated under polyhouse of 1000 m^2 (0.10 ha) was Rs. 394223 with an income of Rs. 875000, resulting in a BCR of 2.22. The financial feasibility tests like NPV, BCR and IRR were also positive and proved that investing on gerbera under polyhouse condition was profitable.

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1. INTRODUCTION

Gerbera (*Gerbera jamesonii* Bolus ex Hooker F) belongs to the Asteraceae family and is native of tropical Asia and Africa. It is an important commercial cut flower crop consisting of 45 species and has a very good export potential because of its graceful appearance, hardiness and ability to withstand during transportation and long shelf life. These are stemless perennial herbs which produce an elegant flower called “head or capitulum”. It is considered as one of the natures beautiful creations because of having excellent flowers with equisite shape, size and bewitching colours. In modern ‘Hi-tech’ method, the gerbera flowers are grown in polyhouse requiring high capital investment. But the quality of flowers produced is superior. The major gerbera producing states in India are Maharashtra, Karnataka, Gujarat, Tamil Nadu, West Bengal, and Himachal Pradesh.

They have a rosette of dark green, glossy leaves that arise from the base. The plant forms a compact clump with multiple stems that can reach a height of around 30 to 60 cm. Cut flowers of gerbera are in high demand due to their vibrant colors, long vase life and use in various floral arrangements. Apart from their use in floral arrangements, gerbera flowers are often used in weddings, special events, and decorations. Gerbera has single, semi double and double flowers. The colour variation, their meaning, size of flowers, prolonged vase life and wide adaptability make gerbera a flower of choice for commercial cultivation in India.

As this crop is highly commercial and needs lot of investment, growing under normal situation might result in severe losses. Traditional farming is always risky due to the unforeseen climatic conditions and exposure to pests and diseases. Hence, such kind of crops need to be grown under protected environments [1]. Polyhouses are one of the kinds of protected environments which provide controlled environment and improve quality & quantity of produce with long shelf life. Polyhouse helps in getting optimum yields, protection from pests and diseases, and extended growing seasons. It is very economical to grow gerbera in polyhouse.

“Gerbera can contribute largely to floriculture industry by virtue of its yield potential, colour variation and long vase life. Further the crops can also be managed successfully throughout the year. It produces very attractive flowers, which are having colours and suitable for pots and floral arrangements. Cultivation of gerbera in green house is more profitable as compared to cultivation in open fields. It extends the growing season and provides the year round production. Farming under greenhouse gave more return with least efforts even under adverse situations It also reduces the total water requirement hence; this technology will be useful for the water scarcity area. Cultivation of Gerbera under polyhouse has emerged as a very important option to progressive farmers in many parts of India. But farmers are facing some problems in gerbera cultivation such as environmental and technological changes, disease pest infestation and physiological disorders which reduces the quality, yield and ultimately the net returns. So, commercialization of gerbera by using modern technologies will improve the cultivation condition and also enhances the quality and yields” [2].

Greenhouse technology has been taken under use for last the last five decades, which was used for research purposes. Presently, greenhouse technology is becoming popular among the farmers to grow high valued flowers, off season vegetables, ornaments and good quality samplings. Raising of seedlings and plant propagations are important commercial aspects of greenhouse technology. Main purpose of greenhouse farming is to enhance agricultural production from the limited space. The main objective of present paper is to study cultivation of gerbera greenhouse unit, economic status of gerbera and cost benefit ratio analysis of gerbera flower. Recently Rangareddy district of Telangana has emerged out as the progressive district for use of greenhouse technology in farming. It would be pertinent to examine and to assess the distributional patterns of greenhouse in the study area. Besides, it is also proposed to examine the input output analysis regarding crops grown. An economic analysis is dealing with crop productivity in the greenhouse.

Therefore, the present investigation was carried out with an objective to find out total cost of cultivation of gerbera along with its profitability when they were grown under naturally ventilated polyhouse.

2. MATERIALS AND METHODS

An experiment was carried out in the field allotted to the Department of Horticulture, College of Horticulture, SKLTSHU, Hyderabad during the year 2015-16. The experiment comprising ten different varieties of gerbera *viz.,* Balance, Stanza, Savannah, Dana Ellen, Goliath, Primerose, Helix, Liberty, Sabrina and Montenegro were selected for cultivation under naturally ventilated polyhouse. The experiment was laid out in Randomized Block Design (RBD) with three replications.

2.1 Polyhouse and Environment Control

"The frame of polyhouse was constructed with galvanized iron pipe with side and top ventilation, a rollable flap was provided on both sides of the polyhouse to regulate the requirements of temperature and humidity depending on the season and weather conditions. A uv-stabilised low density polyethylene film of 200 micron was used as cladding material. The sides of the polyhouse were covered with anti-insect proof rambonet of 60 mesh for natural ventilation and protection against insect pests. Manually operated 50 percent (white colour) shade net was provided inside the polyhoue to regulate the light intensity and temperature. To control the humidity in polyhouse the fogging arrangement was made by providing overhead foggers" [3].

"Open ventilated saw-toothed polyhouse is sufficient for cultivation of gerbera flowers commercially under tropical and subtropical climatic conditions" [4,5]. "Light intensity exceeds during day time and the shade net of inner ceiling should be laid to reduce the intensity. During summer season, shade may be created from 9.30 am to 5 pm, and, in winter, it should be from 9 am to 4 pm. In cloudy weather, there is no need for shade. The side curtains should remain open from 7 am to 6 pm during summer days, and, in winter, 9 am to 5 pm to facilitate air circulation. The optimum temperature is 25-30^{0}C and humidity inside the greenhouse should be 70 -75%. For maintaining the proper humidity, there should be the provision of fogger which can be operated as and when required. Drip irrigation should be there with the provision of fertigation" [6].

2.2 Bed Preparation and Planting of Gerbera

The land was brought to fine tilth by ploughing up to 40 cm depth. Well decomposed farm yard manure, sand and coir pith in 2:1:1 proportion was added and thoroughly mixed with soil. Fumigation was done by using formalin @ 8-10 litres per 100 m^2. Raised beds of 40 cm height, 70 cm width and convenient length were prepared with a walking space of 40 cm in between the beds. Gerbera plants were transplanted on beds when the plant crown should be above 1- 2 cm soil level without disturbing the root ball. Two rows are planted on one bed with spacing 30×30 cm. Basal dose of FYM @ 30 kg m^2, single super phosphate (SSP) @ 2.5 kg per 10 m^2 and magnesium sulphate @ 0.5 kg per 10m^2 area on beds was applied before planting. After three weeks of planting water soluble fertilizers (NPK) 19:19:19 @ 1g per litre was applied through drip irrigation for first three months of planting. During flowering (NPK) 20:20:20 + 13:0:45 and water soluble fertilizers like Mono ammonium phosphate, sulphate of potash, potassium nitrate, calcium nitrate were given through fertigation for better flower quality. Need based plant protection measures were taken up to protect the plants from pest and disease incidence.

The plants were maintained under uniform cultural practices. Due to daily irrigation, the gerbera bed surface became hard, and hence raking of soil was done twice a month as it increases soil aeration. Removing old, dry, infected leaves from the plant should be done. It helps in keeping the disease and pest infestations below the economic threshold level (ETL). After 30-45 days of gerbera planting, the plantation buds initially started, but this bud is of inferior quality. Hence, this bud is removed from the base of the flower stalk. This disbudding helps in making the plant strong and healthy. This operation was carried out up to 80 -85 days. The first flowers are harvested after 12-14 weeks (85-90 days) after planting. Harvesting was done in morning hours when the good gerbera flower has a stalk length of 45-55cm, and the diameter of 10 -12cm. Harvested flowers were kept in a bucket containing clean water.

The total costs incurred and returns were calculated based on CACP (Commission on Agricultural Costs and Prices) methodology of estimation of cost of cultivation. In general, perennial flower crops have two types of costs *viz.,* establishment costs and maintenance costs. Establishment costs include all the expenses incurred during pre-flowering period such as polyhouse construction, seed bed preparation, soil sterilization, Farm yard manure application

etc. Maintenance costs include expenses incurred on human labour, irrigation, fertigation, fertilizers, chemicals etc during process of cultivation. Amortization method was used to include establishment costs of polyhouse with economic life span of 10 years and planting material cum seed bed preparation with life span of 3 years. The amortized cost was included in fixed cost items. Variable costs or working capital were taken for every year.

Total Fixed Costs (TFC): It includes costs incurred on construction of sheds, interiors, implements, permanent seed bed and amortized costs on establishment capital.

Total Variable Costs (TVC): It includes costs incurred on plants, fertilizers, labour wages, chemicals etc.

Amortization: Crops like gerbera which need to be grown in controlled environments like polyhouses need initial establishment costs on construction of polyhouse. The initial establishment costs are included in cost of cultivation and such costs are amortized by using the following formula and included every year till the completion of its life span.

$$A = \frac{P \times i\,(1+i)^n}{(1+i)^n - 1}$$

Where

A = Amortized cost
P = Initial investment made on establishment
i = Rate of interest
n = Economic life span of establishment

Rate of interest was taken at 7 percent as banks offer agricultural loans at this percent.

Benefit Cost Ratio (BCR): It is worked out by dividing gross returns by the total cost of cultivation of gerbera.

2.3 Financial Feasibility Analysis

"The life of polyhouse is assumed to be 10 years. The cost taken into account was establishment cost of polyhouse, input cost, labour cost and maintenance cost. Establishment cost incurred during the first year of planting includes cleaning and preparation of land, cost of seedling and cost of planting *i.e.* ploughing, digging, filling soil, planting and irrigation structure *etc*. The input costs included fertilizer cost and pesticide chemicals cost, *etc*. and labour cost includes cost on manuring, harvesting, packing *etc".* [7].

The financial feasibility analysis was done by adopting the methodology like discounted cash flow techniques used by Kumar *et al.*, 2020. The financial measures such as NPV, BC Ratio, IRR were used by considering the investment period of 10 years and using discount rate at 10 per cent.

2.3.1 Net Present Value (NPV)

Net present value is the present worth of the net benefits or cash flow stream.

Mathematically, the Net Present Value is estimated as follows:

$$NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t}$$

Where

B_t denotes Benefit (Cash inflow) in year t
C_t denotes cost (Cash outflow) in year t
'n' denotes investment lifespan
'i' denotes cost of capital and
't' denotes time measured in years

If the calculated NPV is positive it implies the investment is viable, and where the NPV is equal to zero implies that the investment breaks even. The rule with NPV is to accept all mutually exclusive investments with a zero or greater NPV.

2.3.2 Benefit Cost Ratio (BCR)

It is the ratio of discounted cash inflows and cash out flows which must be unity or more for an enterprise to be considered worthwhile. The minimum ratio required is 1:1, which indicates the coverage of costs without any surplus benefits. But, usually the ratio should be more than unity in order to provide some additional returns over the costs for clear decision.

Its formula for estimation is as follows:

$$BCR = \frac{\sum_{t=1}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+i)^t}}$$

B_t, C_t, n, t, i as defined for NPV

2.3.3 Internal Rate of Return (IRR)

This is the discount rate at which the NPV of an investment equal to zero, i.e.

$$NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+IRR)^t} = 0$$

The internal rate of return is arrived by interpolation technique using different discount rates so as to see that the net present worth is equated to zero. The interpolation formula employed in this study is as follows

$$IRR = LDR + D\left(\frac{NPV_{LDR}}{NPV_{HDR}+NPV_{LDR}}\right)$$

Where,

LDR denotes lower discount rate
HDR denotes higher discount rate
NPV_{HDR} denotes NPV calculated using higher discount rate
NPV_{LDR} denotes NPV calculated using lower discount rate and
D denotes difference between lower and higher discount rates

The decision rule is to accept all independent projects having an Internal Rate of Return equal to or greater than the cost or opportunity cost of capital. The internal rate of returns also ranks the different investment proposals for preference in the order of the magnitude. The IRR should be more than the discount rate to be considered for viable investment and financial soundness.

3. RESULTS AND DISCUSSION

From the Table 1, it was clearly indicated that the total cost of the establishment of polyhouse with a area of 1000 m^2 was Rs. 800000 as the gerbera crop should be grown under controlled environment. The land value is taken hypothetically as 1 lakh and it varies according to the location of construction. Generally, the economic life span of polyhouse was about 10 years. Construction of polyhouse along with shades, irrigation systems *etc* needs initial investment only and thereafter only maintenance costs are there. Hence, this establishment amount should be amortized to be included in the total cost of cultivation of gerbera. The amortized cost was Rs. 113814. Similarly, gerbera cultivation needs established planting material and seed bed which could be used continuously for three years. The establishment cost of both planting material and seed bed materials was Rs. 429000. This amount also needs to be amortized and that cost was Rs. 160409. The total amortized costs of establishment of polyhouse, seed bed, planting material were Rs. 274223. The management costs of gerbera were Rs. 120000, out of which most of the amount was spent on harvesting and packing (Rs. 75000) followed by plant protection (Rs. 40000). Thus, the total cost of cultivation of gerbera per year was Rs. 394223. The number of plants that could be grown in a 1000 m^2 area were 6250 plants when the spacing was 30×30 cm. The average production of flowers per plant per year was 40. A total of 250000 gerbera flowers were produced from 1000 m^2 area of polyhouse. The average price per flower was Rs. 3.50 which gave an income Rs. 875000. The benefit cost ratio worked out to be 2.22. Sharma *et al.* [8] also got a BCR of above 2 from their study on the economics of major flower crops in Himachal Pradesh. The BCR reflected that per rupee investment on gerbera cultivation, the net returns were about Rs. 1.22. Hence, we can say the gerbera cultivation under polyhouse is economically viable and gives profits to the farmers. The results of Bhosale *et al.*, [9] Mali *et al.*, [10] Patil *et al.*, [11] and Manisha *et al.*, [1] also proved the economic benefit of gerbera cultivation.

3.1 Financial Feasibility Analysis

Cash out flow means all the cash that goes out of the farm business which includes structure costs, land preparation costs, annual maintenance costs, fixed costs, variable costs, *etc*. Cash inflows include all the cash that comes in to the farm business from sale of the produce. The cash flows were projected for a period of 10 years as the average life span of polyhouse structure was assumed to be 10 years. The life span of plants and seed bed was 3 years and they need to be replaced after 3 years of establishment.

The sum of polyhouse structural cost, land preparation and annual maintenance costs were considered as the cash out flow for the first year. For the subsequent years' annual maintenance costs along with the interest were considered as cash out flow. The costs and returns were calculated for the first year and for the remaining nine years they were assumed to inflate at the rate of 5 per cent per annum.

Fig. 1. Gerbera cultivation under polyhouse

Table 1. Economics of gerbera cultivation under polyhouse (1000 m^2) condition

Item of Expenditure	Amount spent (Rs.)
Fixed Cost Rs	
Land	1,00,000
Polyhouse @ 1000m^2	6,00,000
Irrigation system	1,00,000
I. Amortized cost	1,13,814
Recurring cost	
A. Planting material @ 30/-plant	1,87,500
B. Bed preparation	
Fym	45000
Sand	25000
Soil	1,50,000
Excavation	3750
Labour cost	16250
Fertilizers	1500
Total B	241500
Total A+B	429000
II. Amortized cost of A & B	160409
Working capital	
C. Soil sterilization	15000
D. Management cost	
Harvesting & Packing of flowers	75,000
E. Fertilization & Pesticides	40,000
III. Total of Working capital (C+D+E)	120000
Total Cost of Cultivation (I+II+III)	394223
IV. Output	
Flower production (40/plant/year)	2,50,000
V. Income or Gross Returns	
Income from sale (Rs 3.5/flower)	8.75 lakh
BCR	2.22

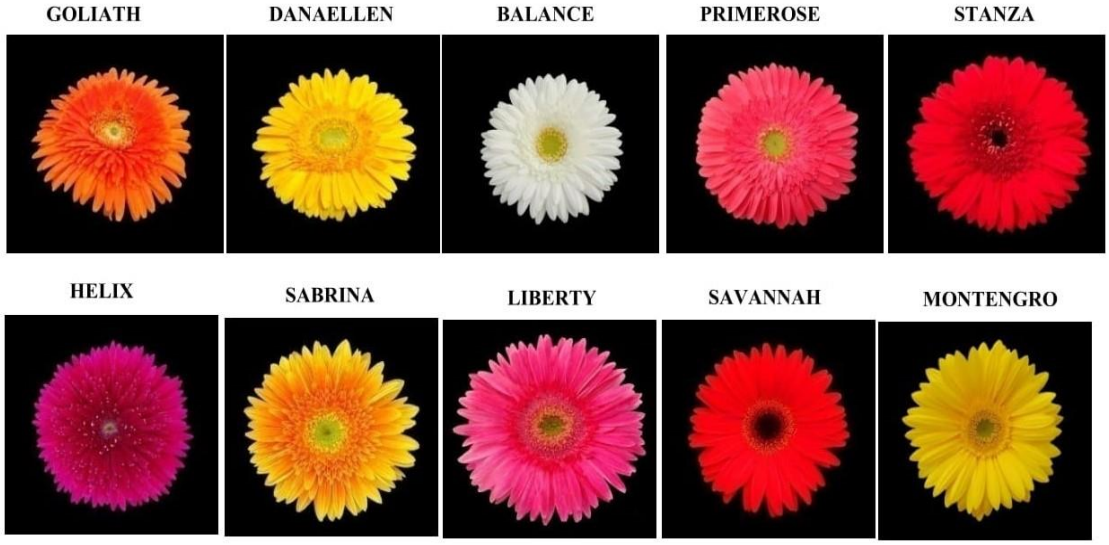

Fig. 2. Variety of gerbera

Table 2. Financial feasibility of gerbera under polyhouse

S. No	Particulars	Cost of capital @10% (Rs.)
1	NPV	Rs. 2601160
2	BCR	1.94
3	IRR	51.23%

The cost and returns are not the perfect measures to assess the profitability from investment made on gerbera. Before making a choice on any enterprise, it becomes necessary to examine the economic feasibility of that enterprise. Several techniques are available for evaluating the economic viability of gerbera plantation under polyhouse. NPW, BCR, and IRR were employed to examine the economic feasibility of investment on gerbera plantation under polyhouse.

"To evaluate the financial performance of gerbera plantation under polyhouse, a spread sheet model was constructed to describe the revenue and costs associated with gerbera over 10 years" [12]. It was considered suitable to determine the cash flow. In the present study the cost and returns had been discounted at 10% to estimate the net present value of future returns. The results of NPV, BCR and IRR values calculated per hectare are presented in Table 2.

It can be observed from the Table 2, that the NPV was highly positive with Rs. 2,60,1160 per 1000 m^2 area of polyhouse at 10 per cent discount rate. This indicates that the investment in gerbera plantation under polyhouse was economically feasible and financially sound. Benefit cost ratio of 1.94 at 10 per cent opportunity cost of capital, indicates that the investment on gerbera plantation was economically feasible and financially viable. Internal Rate of Return (IRR) was 51.23 %, which was five times greater as compared to the present cost of capital. This indicates the investment in gerbera plantation was economically feasible and profitable when cultivated under polyhouse [13].

4. CONCLUSION

Gerbera flower production has emerged as the most profitable agri-business in the study area. From gerbera cultivation economics, we can say that farmers can earn approximately six lakhs per year from 1000 m^2 of land that is almost fifty thousand per month. With Gerbera cultivation, a farmer earns a profitable income and improves their lifestyle. As there is good demand in the domestic as well as international market, progressive farmers can adopt protected cultivation of gerbera by taking advantage of support from different ongoing schemes of central and state governments. Moreover, precision crop management technologies under

protected cultivation are also observed in different parts of the country which needs further research to make them user friendly and cost-effective. The financial feasibility analysis also proved to be positive in case of gerbera under polyhouse conditions. Hence, we can recommend farmers of gerbera for cultivating under polyhouse by utilizing the government subsidies and schemes.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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