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Economic feasibility of gerbera (*Gerbera jamesonii* L.) under protected cultivation with special reference to Chhindwara district of Madhya Pradesh

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Abstract
Gerbera (*Gerbera jamesonii*) is a herb and its flowers are like Daisy. It can be grown as a field crop in open air on raised beds, as a greenhouse plant under controlled conditions (polyhouse) and as a potted plant. Gerbera is the latest sensation to Indian floriculture, commercially grown throughout the world in a wide range of climatic conditions. In India, Greenhouse technology has been taken under use for the last five decades, which was used for research purposes. Presently, greenhouse technology is becoming popular among the farmers to grow high valued flowers, 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. In spite of a considerable decrease during the last decade, energy consumption in greenhouse cultivation remains high. More sustainable greenhouse gerbera production in horticulture can be realised by developing new greenhouse and cultivation concepts. During the past few years, the cut flower growers, especially, rose growers in Chhindwara district have diversified in to other cut flowers due to some lacunae in production and marketing management strategies. In present study an attempt has been made to find out the sustainability of Gerbera cut flower production in Chhindwara district. 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 Chhindwara district of Madhya Pradesh 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.

Keywords: Green house, Gerbera, NPK, cut flower, economy

1. Introduction
Gerbera (*Gerbera jamesonii*) belongs to the family Asteraceae. It is commonly known as Transvaal Daisy, Barberton Daisy or African Daisy. It is an important cut flower, native to tropical Asia and Africa. Success of Gerbera under protected conditions has encouraged farmers to take up its protected cultivation extensively during the past few years in India. It is one among the top ten earners of the world cut flower trade. It ranks fourth in the international cut flower market and is a popular cut flower in Holland, Germany and USA (Choudhary and Prasad, 2000) [5]. Modern gerbera arose from *Gerbera jamesonii* hybridized with Gerbera viridifolia and possibly other species (Leffring, 1973) [9]. It is difficult to get good quality cut flowers of gerbera under open-field conditions. Gerbera as a cut flower has tremendous demand in domestic and international markets. Due to globalization and increase in per capita income the demand for flowers is increasing both nationally and internationally. Though the crop can be cultivated in moderately warmer open sunny conditions, the performance of the crop is enhanced when grown in protected or semi-protected structures. The main advantage of growing the crop under cover or protected conditions is exploitation of genetic potential of the genotypes. 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

situation. It also reduces the total water requirement hence; this technology will be useful for the water scarcity area.

District Chhindwara has emerged for flower cultivation in green house conditions. In this direction the intensive affords has been made by JNKVV, Krishi Vigyan Kendra Chhindwara, in order to improve the economic condition of the small and marginal land holding farmers. Hence the Gadarwara, Mohkhed, Umranala block Mohkhed, Gurria and Jamunia belongs to the block Chhindwara "Green house cultivation of Gerbera" were selected for the study.

Greenhouse farming refers to new farm technology in the form of greenhouse wherein crops are grown in the controlled environment such farming is contributing with growing share to the economy of the region. According to Paul Nelson (1985) [8] "the greenhouse refers to a structure covered with a transport material for the purpose of admitting natural light for plant growth". These structures are usually different from other growing structures with sufficient height permits a person to work inside it. Greenhouse is usually as framed structure covered with transparent or translucent material large enough for a person to walk inside and carryout cultural operations and in which crops are grown under conditions of partially or fully controlled environment. The plastic film acts like a selective radiation filter, which allows solar radiation emitted by the object within, thus contributing to the greenhouse effect (Jadhav and Patil, 1998). In India, 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 Chhindwara district of Madhya Pradesh 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.

2. Methodology

Chhindwara district is one of the most agriculturally developed districts in the country. The experiment was laid out during October 2013 to March 2014 under drip irrigated condition.

Table 1: Physical and chemical characteristics of soil

S. N.	Character	Unit	Value
1	Soil Texture	Sandy loam	
	Sand	Per cent	68.50
	Silt	Per cent	16.30
	Clay	Per cent	15.20
2	Bulk density	g cm^{-3}	1.48
3	Specific gravity		2.41
4	pH		7.50
5	Electrical conductivity	dSm^{-1}	0.12
6	Organic carbon	Per cent	1.05
7	Available nitrogen	kg ha^{-1}	328.00
8	Available phosphorus	kg ha^{-1}	18.50
9	Available potassium	kg ha^{-1}	570.00

The details of materials used, methods and experimental techniques adopted during the course of experimentation are described in this chapter. The experiment was conducted in Krishi Vigyan Kendra, Chhindwara (Madhya Pradesh). The village is located at 21°36′N 78°31′E to 21.6°N 78.52°E, having an average elevation of 474 meters.

3. Polyhouse and environment control

The farmer has erected a controlled polyhouse (exhaust fan and pad) of 100 x 40 m size (4000 m^2). Height at the centre was 4.5 m and at gutter it was kept 2.7 m. G.I. pipes were used for the framework. The structure was covered using ultra-violet stabilized low density polyethylene (LDPE) film of 200 micron thick as a cladding material. The total cost of construction for the entire structure was about Rs.33,76,000/- environment inside the polyhouse was controlled by exhaust fan and cooling pad. To control the light intensity inside the playhouse in 50 per cent green colour shaded net was used. In order to control the humidity in polyhouse the fogging arrangement was made by providing overhead foggers. Bed preparation and planting of gerbera: The raised beds (9.60 x 0.60 m each) were prepared and the planting density adopted was 30 x 45cm. Media were disinfected by using the fumigant formalin @ 25 ml/l and the solution of 5 l/ m^2. Three varieties of gerbera viz., Dana Ellen, Sangria, Carrera and Diablo were planted. The most efficient irrigation method i.e. drip method of irrigation was used in the polyhouse. Water was applied daily through drip round the year. The irrigation was applied at the rate of 70 per cent of daily pan evaporation rate. The water soluble fertilizers were applied alternate day through drip as per the recommended dose of 20:10:24 N P K g/ plant/year. Plant protection and observations: Spraying of pesticides was done throughout the crop period as and when necessary. Yellow and dried leaves of gerbera were removed from time to time. Biometric observations in respect of flower quality and yield viz., stalk length and thickness, diameter of flower, flowers/ plant /year and flowers/ m^2/ year were recorded as and when harvesting was done. The daily pan evaporation data were recorded from USWB class A Pan. The quantity of water applied through drip irrigation as per schedule was calculated by following formula (Doorenbos and Pruitt, 1976).

$$ETc = Ep \times Kp \times Kc \quad \ldots\ldots\ldots\ldots\ldots (1)$$

$$V = (ETc \times Wa) / E \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where,

ETc = Evapotranspiration of papaya

Ep = Cumulative pan evaporation (mm)

Kp = Pan coefficient (0.7)

Kc = Crop coefficient

V= Crop water requirement/emitter

Wa = Wetted area

E = Efficiency of the system (considered as 90%)

Application of irrigation water for each plant, two on-line drippers with 8 litre $hour^{-1}$ discharge was fitted on 16 mm laterals. Double 16 mm laterals with two drippers each lines for $plant^{-1}$ were fitted. Spacing between two adjacent laterals and emitter was 0.6 m. The average emission uniformity of drip irrigation system was estimated as 90 per cent.

Net depth of irrigation = (FC-PWP) /100 X Bulk density X root zone X MAD)

The effective root zone was considered as 0.8 m and hence maximum allowable deficiency (MAD) was taken as 50%. Observations were recorded at 1 day interval on various parameters no of flowers picking, moisture regime and selling cost etc.

Table 2: Fertigation scheduling of gerbera plants under protected cultivation

SN	Name of fertilizer	Quantity	Remarks
1	13:0:45 (N P K)	8000 gms	13400 gms with 10,000 lit water through drip every alternate day
2	0:52:34 (N P K)	5000 gms	
3	Nutriseven (micronutrient)	400 gms	
4	Feeder – Dx (micronutrient)	200 gms	
5	$CaNO_3$	5000 gms with 5000 lit water	Through drip (Twice in a week)
6	Spray	Aspen + Firewall + Dextor @ (0.5 ml + 2 ml + 0.2 ml) / lit	Once in a week
7	Drenching	Hiflex + 0 : 52 : 34 @ (2gm + 2 gm) / lit	

Table 3: Schedule of Pests & Disease Management

SN	Name of insecticide	Method of application	Interval (days)
1	Karathane @ 0.4 ml / lit	**Spray**	**4 days**
2	Sulphur @ 1.5 ml / lit		
3	Topspin @ 1.5 ml / lit		
4	Confidor @ 0.5 ml / lit		
5	Amistar @ 0.5 ml / lit		
6	Kasu-B + strepto @ (1.25 ml + 0.4 gm) / lit	Drenching	**7 days**
7	Kocide + B-10 @ (2 gm + 0.4 gm) / lit		
8	H_2O_2 @ 3 ml / lit (For Red Colour Only)		
9	Blue Copper @ 1.5 gm / lit (For Other Beds)		

Cost economics

Cost Benefit ratio of Gerbera production has been calculated. It is calculated by dividing total input (present worth) by Total output (Present worth of cost).

CBR = NR/ TC

Where

NR = Net Return (Total Input)

TC = Total cost of Production (Total Output)

In the present studies the cost economics of gerbera was worked out by considering the fixed cost, cost of cultivation, operational cost, yield etc as reported in Table 3.

From Table 3 it is revealed that the maximum B:C ratio (2.94) was observed. The maximum net profit per sqm (Rs.624/-) was found.

Table 4: Economics of gerbera for one acre land under polyhouse (4000 m^2)

Crop Name	**:**	**GERBERA (*Gerbera Jamesonii*)**	
Polyhouse Area	:	4000 sqm (1 acre)	
No. of Saplings Transplanted	:	28000 @ Rs. 35/- each	
Transplanting Date	:	26.11.2015	
First Picking Date	:	01.03.2016	
Picking of flowers	:	Alternate Day	
Regular Maintenance	:	Next day after flower picking	
Total Colours Cultivated	:	11	
No. of Labors	:	5 Female + 2 Male	
Sale Rate (Rs. per flower)	:	2 to 10 (Average Rs. 3/-)	
Age of plants	:	4 Years	
A. One Time Expenditure			
		Amount (Rs)	**Subsidy (Rs)**
Polyhouse Preparation (**Unit cost - Rs. 844/sqm**)		3376000	1688000
Red Soil Filling, Paddy Straw, FYM, Bed preparation, Soil treatment, NPK and micronutrients, Tissue culture sapling (26000 @ Rs.35/sapling) Plantation cost – Rs. 610/sqm		2400000	1200000
Total		**5776000**	**2888000**
Amount to be paid (Rs)		2888000	
B. Monthly and Yearly Expenditure			
		Monthly Expenses (Rs)	**Yearly Expenses (Rs)**
Plant Protection + Fertigation (Liquid fertilizer and Pesticides)		30000	360000
Marketing + Transport		20000	240000
Labor (Picking + Other)		22000	264000
Total		**72000**	**864000**
C. Yearly Economics			
C1. EMI Rs. 000/- Month (Term loan period – 7 years)		420000	
C2. Total Yearly Expenses (EMI + Maintenance Cost)		1284000	
C3. No. of Flower in month (7000 X 15 day)		105000	
C4. Yeild (No. of flowers/year) [C3 X 12]		1260000	
C5. Average Price per flower(Rs)		3	
C6. Net Value of Produce(Rs/year) [C4 X C5]		3780000	
C7. Net Profit (Rs/year) [C6 - C2]		2496000	
C8. B/C ratio [C6 / C2]		2.94	

4. Conclusion

It was observed that, the majority of cut flower growers have taken up it as a secondary business. Gerbera flower production has emerged as the most profitable agri-business in the study area. The total yearly expenses was Rs. 1284000/- and the total number of flowers in a month were sold out of Rs. 105000/- and yield were obtain of Rs. 1260000/- from the average price of flower (Rs. 3 each) Net value generated Rs. 3780000/- and Net profit was Rs. 2496000/year from 4000 m^2 area polyhouse. Under the present cost, yield and price structure, the gerbera growers has more cushioning for hike in input prices, reduction in yield and prices of other flowers.

It may be concluded from the study that there is an immense scope for expansion of area and production of gerbera in Chhindwara district of Madhya Pradesh. The cost of cultivation for gerbera is somewhat initially higher but due to good demand in market, the returns are also very good. Producers can get a B:C ratio 2.94 per 4000 square meters by gerbera cultivation in case of good price in the market. There is a huge demand for gerbera in the international market, showing the great scope in the future. The gerbera cultivation is a profitable business for the investors and it can be seen by good Benefit Cost Ratio (2.94).

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