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Economic viability of cucumber cultivation under NVPH

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The economic analysis was conducted for cultivation of parthenocarpic cucumber cv. Dinamik under naturally ventilated polyhouse for two consecutive years, 2013 and 2014. The actual value of economic inputs along with subsidy component (65 and 75%) imparted by Government of Gujarat in coordination with Government of India was considered for fitting into simulation model. The differences in net realization of Rs. 371642.00 (BCR 1.36) and Rs. 164723.00 (BCR 0.55) for the years 2013 and 2014, respectively represented maximum dependency on prevailing market selling rate in respective years besides some minor difference in yield component. BCR of 2.03, 0.95 and 2.17, 1.03 could be anticipated by availing 65 and 75% subsidy in each individual year for a crop of short duration, thus opening new avenues for small farmers of the Gujarat, India.

Key words: Cucumber, parthenocarpic, protected cultivation, economics, subsidy.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is an edible cucurbit popular throughout the world for its crisp texture and taste. Cucumber is truly a versatile vegetable because of wide range of uses from salads to pickles and digestive aids to beauty products. The caloric and nutritional value of cucumber is very low but it is a primary source of vitamins, minerals and fibre for human body (Keopraparl, 1997).

The annual production of cucumber in India is 698000 MT from 45000 ha area with productivity of 15.5 t ha^{-1} only during 2012-2013 (Anonymous, 2014). However, the major concerns are low productivity, diminishing return from farming as a whole and lack of awareness among the vegetable growers regarding scientific crop management and quality product (Chattopadhyay et al., 2007). The structure of land holding has also been changing very fast in India because of too much fragmentation leading to more percentage of small and marginal famers. With the advent of modern technologies, the scenario of vegetable industry in India is changing at a fast rate. Now, it is not only a question of providing enough vegetables for a balanced diet, but also to produce quality vegetables throughout the year that are acceptable and competitive in international market. But due to erratic behaviour of weather, the crops grown in open field are often exposed to fluctuating levels of temperature, humidity, wind flow etc., which ultimately affect the crop productivity and quality adversely.

Protected cultivation being the most efficient means to overcome climatic diversity, has the potential of fulfilling the requirements of small growers as it can increase the yield manifolds and at the same time improve the quality of the produce significantly as per the demand of the market. In the recent times, the introduction of partheno-

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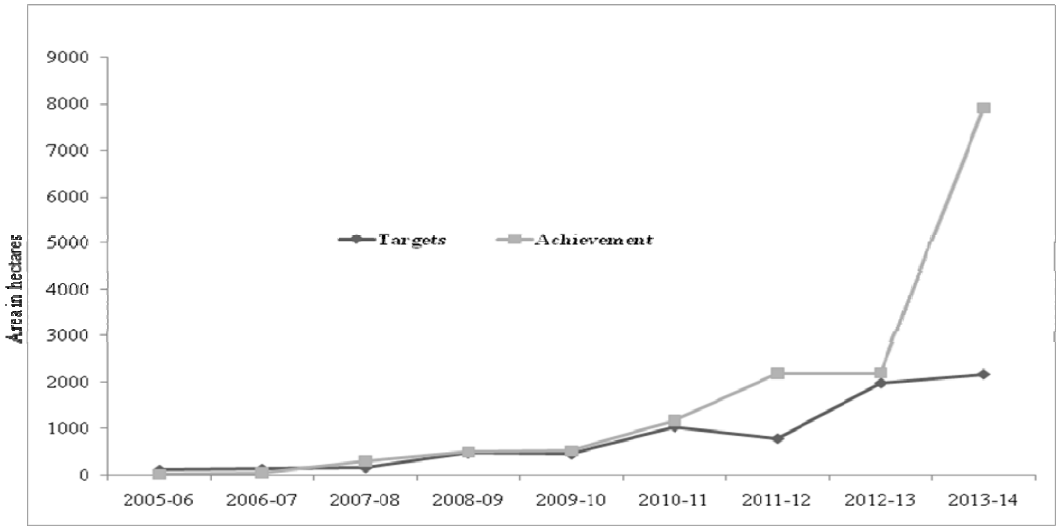

Figure 1. Phase-wise implementation of protected cultivation by Government of Gujarat, India. Source: (http://nhm.nic.in).

carpic varieties in cucumber has revolutionized its cultivation under protected culture in India. Simultaneously, implementation of protected cultivation through various financial schemes such as National Horticulture Mission (NHM), *Rashtriya Krishi Vikas Yojna* (RKVY) and many more at state level have bolstered the adoption of protected cultivation across the country. The Government of Gujarat have been implementing protected cultivation in phase-wise manner by fixing physical targets for each year. It is only due to these efforts that area under protected cultivation in Gujarat has increased from 18.08 (2005-2006) to 7900.74 ha (2013-2014) as illustrated in Figure 1.

The situation of market is always unpredictable and responds varyingly over a period of time even for same growing season in different years. The profitability of any project largely depends on financial gain over a period of time. So, under these circumstances it becomes very interesting to work out the economic feasibility of cucumber cultivation under protected cultivation by taking into account the subsidy factor.

MATERIALS AND METHODS

The economic analysis of two experiments laid under naturally ventilated polyhouse (NVPH) of 1,000 m^2 during April, 2013 and 2014, at Regional Horticultural Research Station, Navsari Agricultural University, Navsari (Gujarat) was carried out. The location is situated at latitude 20°57'N and longitude 72°54'E with an altitude of 12 m above the mean sea level characterized by high humid climate with high annual rainfall of 1,600 to 2,400 mm, mostly concentrated during monsoon from 2nd fortnight of June to September. More specifically, the area falls under Agro-Ecological Situation-III characterized by high humidity in the atmosphere during most parts of the year. A parthenocarpic cucumber cv. Dinamik (Yuksel Tohumculuk Ltd., Turkey) was grown on raised beds having dimensions of 100 of 100 x 40 x 50 cm (width, height and path) at the spacing of 60 x 45 cm and fertigated with N:P:K at the rate of 90÷75÷75 kg per hectare along with common doses of organic manures, *Trichoderma viridi, Pseudomonas inflorescens*.

The produce from both the years was marketed at *Shree* Navsari Jalalpore *Taluka* Horticulture Cooperative Society Ltd., Navsari, Gujarat and average selling rate was worked out accordingly. As the cropping period of cucumber under protected conditions varies from 105-120 days, so three crops per annum can successfully be taken up under agro-climatic conditions of South Gujarat, India. Therefore, data of single season have been considered to work out the annual account. To work out and simplify calculations, the data generated through accounting method was subjected to analysis as suggested by Berry et al. (1979) and Gittinger (1982). The actual values on fixed investment were subjected to amortized accounting by adopting certain assumptions (Table 1). As far as calculation of variable components is concerned, the prevailing market value at that point of time was accounted into analysis first for single season in each year and then converted into expected per annum value.

The component of protected cultivation is being strengthened under National Horticulture Mission by Government of India by imparting 50% subsidy to the farmers. Incentives in terms of subsidy to the tune of 65 and 75% are imparted by Government of Gujarat State (India) to encourage the farmers for adopting protected cultivation by adding its share of 15 and 25% in Central Government subsidy depending upon socio-economic status of the farmers. Therefore, an attempt has also been made to work out comparative trend of economic returns for cucumber cultivation under NVPH in each case (without subsidy, with 65 and 75% subsidy) for the respective year.

RESULTS AND DISCUSSION

Components of fixed cost

It was only the cost of structure, which made huge difference in economic gain for cucumber as protected cultivation is highly capital intensive farming requiring substantial investment during the initial period of establishment. Rezende et al. (2011) and Sreedhara et

Table 1. Adopted assumptions.

S/ No.	Particulars	Useful life (yrs)
1	Polyhouse Structure	10
2	Red soil*	10
3	Rice husk	3
4	Plant support system	5

*Conditional life of red soil has been considered equivalent to that of structure's life assuming that sufficient organic matter will be incorporated into it over the period of time.

al. (2013) had similar observations regarding expenditure incurred on fixed component, thus showing slow response of growers for adoption of this technology. Considering 10 years life of structure, the annual capital investment was divided equally and worked out to US$ 1511.48 per annum. With the involvement of Government in boosting this technology financially, the initial capital investment came down to US$ 529.02 and 377.87 only with 65 and 75% subsidy, respectively. So, it is recommended for the farmers to encash this facility to lower down the huge pressure of initial investment for erecting such structure to economize protected cultivation of crops to a greater level.

Generally, use of red soils for cultivation of crops under protected conditions is suggested because pH of such soils falls in neutral range thus making available most of nutrients applied to the plants. Nevertheless, farmers can use other types of soil owing to the availability and financial status, but care must be taken to amend the soils appropriately depending on the pH of soil and be enriched with organic matter periodically. Rice husk is an important component of protected cultivation for maintaining proper aeration in soil based growing media and also possesses antifungal properties because of the presence of silica. Rice husk is easily and reasonably available in this part of the country as rice is one of the commercial crops being grown in the region. It is also clearly depicted in Table 2 that annual cost of rice husk was very nominal (US$ 1333.00) and remained unchanged over the period of study. Cucumber being a viny crop, needs support to train the plants vertically and moreover, the concept of utilizing vertical space under protected structure is fully justified. The capital investment on this component was also found to be nominal (US$ 32.33) based on its expected life of five years. Going through above enumeration, it is undoubtedly evident that provisions made by the Government in this direction have truly lowered down the financial burden from the shoulders of farmers.

Components of variable cost

Practically, three crops in tandem can successfully be raised in NVPH under Agro-climatic Situations of this region making it possible to supply cucumbers throughout the year. The actual cost of individual components for single season in each year was taken into consideration for calculating the annual investment. The cost of seed, farmyard manure, formaldehyde, *T. viridi, P. inflorescens,* micro-nutrients, vermicompost and pesticides remained the same exhibiting negligible fluctuations in the price of these components in both the years. However, it was the other components like labour wages and packing material, which showed significant variation over the years. It is always recommended to follow sterilization of soil with formaldehyde or any other chemical once in a year to avoid the build up of soil borne pests. So, labour involved in its application made a difference during second year of cultivation as a result of hike in minimum wages. Rezende et al. (2005) also considered labour as the heavier component in total operational cost accounting for 20.6%. Similarly, Rodrigues et al. (1997) in an experiment under protected conditions observed 17% representation of labour in total operating cost. The raised beds were prepared in the first season and would not be dismantled and used with minor cultivation and levelling with labour involved in performing other operations.

The analysis of production system of cucumber under NVPH displayed overall expenditure to the extent of US$ 4428.68 (without subsidy), 3446.22 (with 65% subsidy), 3295.07 (with 75% subsidy) and 4813.89 (without subsidy), 3831.43 (with 65% subsidy), 3680.28 (with 75% subsidy) for respective years of study, 2013 and 2014. So, it could be envisaged that the subsidies imparted by Government of Gujarat made a huge difference particularly in the component of fixed cost. Matsunga et al. (1976) also highlighted the importance of all production factors with a greater emphasis on fixed cost for getting ultimate benefit from a crop. Singh and Kumar (2006) emphasized that economic feasibility of cucumber cultivation largely depends upon the basic cost of erection of greenhouse (Figure 2).

On the basis of average selling rate of cucumber to the tune of US$ 0.32 and 0.22 and average yield of 10.76 t and 11.42 t per 1000 m^2 in the respective years, there was a financial gain of US$ 6007.79 and 2662.84.00 in 2013 and 2014 without considering the subsidy component. Singh et al. (2005) and Sreedhara et al.

Table 2. Economic analysis of cucumber cultivation under naturally ventilated polyhouse.

S/ No.	Particulars	Year 2013-2014			Year 2014-2015		
		Actual	65% subsidy	75% subsidy	Actual	65% subsidy	75% subsidy
(A) Amortized Fixed Cost (US$)							
1.	Structure cost including HDPE sheet and drip irrigation system	1511.48	529.02	377.87	1511.48	529.02	377.87
2.	Red soil	116.39	116.39	116.39	116.39	116.39	116.39
3.	Rice Husk	21.55	21.55	21.55	21.55	21.55	21.55
4.	Plant support system	32.33	32.33	32.33	32.33	32.33	32.33
Total (A)		1681.75	699.29	548.14	1681.75	699.29	548.14
(B) Variable Cost (US$)							
1.	Seed	632.88	632.88	632.88	632.88	632.88	632.88
2.	FYM	45.59	45.59	45.59	45.59	45.59	45.59
3.	Formaldehyde	54.56	54.56	54.56	54.56	54.56	54.56
4.	Application of formaldehye	19.40	19.40	19.40	24.25	24.25	24.25
5.	*Trichoderma viridi*	1.94	1.94	1.94	1.94	1.94	1.94
6.	*Pseudomonas inflorescens*	1.94	1.94	1.94	1.94	1.94	1.94
7.	Micro-nutrients	43.65	43.65	43.65	43.65	43.65	43.65
8.	Vermicompost	77.59	77.59	77.59	77.59	77.59	77.59
9.	Bed preparation	38.80	38.80	38.80	48.50	48.50	48.50
10.	Labour	1396.70	1396.70	1396.70	1745.88	1745.88	1745.88
11.	Pesticides	48.50	48.50	48.50	48.50	48.50	48.50
12.	Fertilizer	208.28	208.28	208.28	215.45	215.45	215.45
13.	Packing	104.36	104.36	104.36	118.67	118.67	118.67
14.	Miscellaneous	72.74	72.74	72.74	72.74	72.74	72.74
Total (B)		2746.93	2746.93	2746.93	3132.14	3132.14	3132.14
Total Expenditure (A+B)		4428.68	3446.22	3295.07	4813.89	3831.43	3680.28
Yield (kg)		32280.00	32280.00	32280.00	34260.00	34260.00	34260.00
Selling Rate (US**$**/kg)		0.32	0.32	0.32	0.22	0.22	0.22
Gross Realization (**$**)		10436.47	10436.47	10436.47	7476.72	7476.72	7476.72
Net Realization (**$**)		6007.79	6990.25	7141.40	2662.84	3645.30	3796.44
Benefit-Cost Ratio		**1.36**	**2.03**	**2.17**	**0.55**	**0.95**	**1.03**

(2013) also substantiated for more remuneration from protected cultivation on account of 3 to 4 times higher and better quality yield. Although, yield of cucumber in 1000 m^2 area was higher during second of experimentation, but average selling rate came down thereby affecting

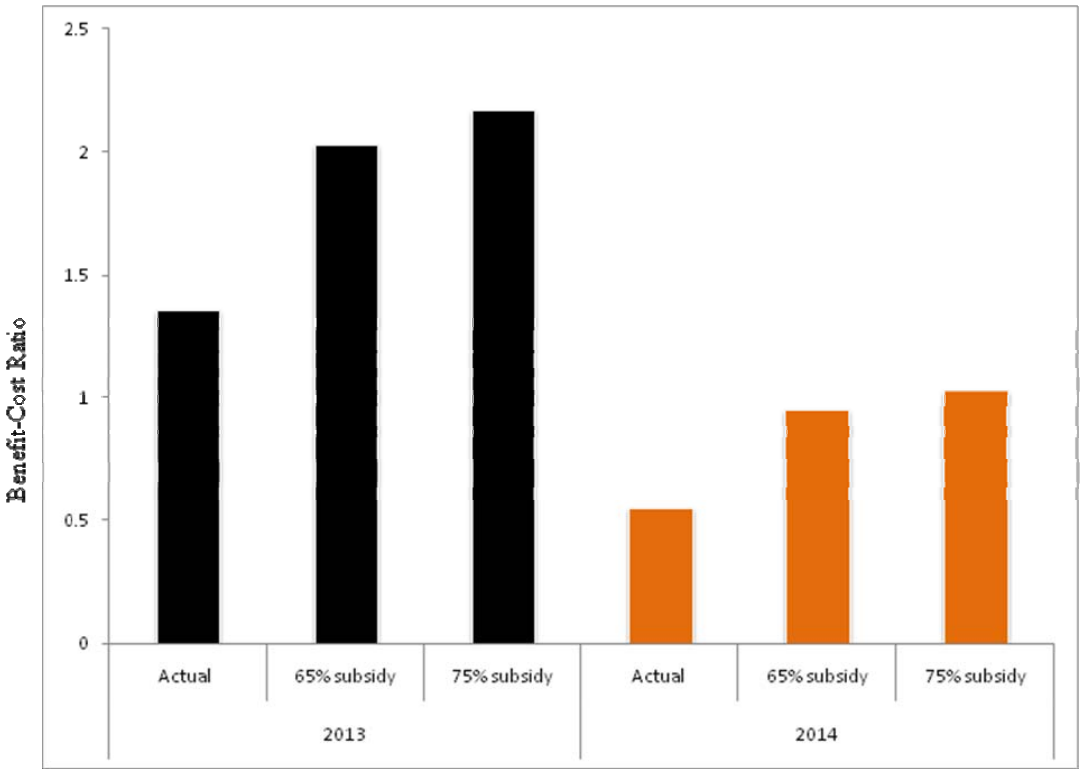

Figure 2. Estimation of benefit cost ratio under various economic situation.

net returns from the crop and highlighting the dynamics of market for the same period in different years. The earlier workers, Engindeniz and Gul (2009) also reviewed that production as well as market risks affect profitability and economic feasibility of vegetables grown under protected structure.

Yilmaz et al. (2005) drew a conclusion that role of local market is very important factor in marketing of greenhouse products and price difference in two production systems indicated that local market has reached to saturation in terms of meeting local demand. So, at this junction it becomes utmost important to encash bigger surrounding markets. Even though, farmers could get very good returns with benefit-cost ratio (BCR) of 2.03, 2.17 and 0.95, 1.03 in the years 2013 and 2014, respectively under different provisions of subsidies and is illustrated in Figure 2. Pozderec et al. (2010) had also highlighted the importance of protected cultivation for better economic returns in cucumber.

Conclusions

The economic analysis shows that cost of fixed component and selling rate of produce were the two important factors deciding net realization of the project. Although, BCR without subsidy was also very good for a crop of short duration under prevailing market price during the period of investigation, but it could be multiplied manifolds with the addition of subsidy component as per the socio-economic status of farmers. Looking in the uncertainty factor particularly in local market as observed in the study, it can opined that this instability must be handled smartly through a cluster approach by the farmers to encash either surrounding/ bigger or even export markets.

Conflict of Interest

The authors have not declared any conflict of interest.

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