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Short communication

Economic feasibility of polyhouse vegetable cultivation in Kerala

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Abstract

The conventional vegetable cultivation in Kerala is limited by several biotic and abiotic factors. Protected cultivation involving polyhouse has emerged as a novel technology to increase the productivity, to protect the plants from biotic and abiotic stresses and to break the seasonal barriers of production. The paper analysed the economic feasibility of vegetable cultivation under polyhouse production in Kerala. Among the major polyhouse grown crops and crop sequence, sole crop of salad cucumber and crop sequence with two crops of cowpea and one crop of salad cucumber were found economically feasible and profitable. Even though high profitability was observed for sole crop of salad cucumber, the cultivation of the crop sequence is recommended considering agronomic and market related factors. Selection of crops according to the market demand, coinciding cultivation with higher market price, farmer's cluster approach in polyhouse cultivation etc. are suggested to further improve the profitability and to tackle market instabilities. Research efforts directed towards reducing the establishment cost of polyhouse, development and release of high yielding and hybrid varieties in public sector, development of farm machineries suitable to polyhouses are also recommended.

Key words: Capital productivity analysis, Economics, Polyhouse

Vegetables constitute an essential part of our daily diet. National nutrition guidelines recommend an average consumption of 300 g of vegetables per day per person (ICMR, 2009). With a total production of 8.25 lakh tonnes of vegetables from a total cultivated area of 31,449 ha, the per capita availability of vegetables produced in Kerala is far below the recommended per capita consumption (Economic Review, 2014) and the state depends heavily upon neighbouring states for meeting its daily requirement of vegetables. Conventional vegetable cultivation in the state is constrained by limitations of land holdings, market price fluctuations, perishable nature of crops, constraints in marketing, erratic climatic conditions etc. In this context, protected cultivation offers a new dimension to produce more from a limited area. Protected cultivation or controlled environmental agriculture involves cultivation of horticultural crops in a controlled environment wherein factors like temperature, humidity, light, soil, water, fertilizers etc. are manipulated to attain maximum produce as well as allow a regular supply of them even during off-season (Sabir and Singh, 2013). Polyhouse is one of such protected cultivation technologies aimed at increasing productivity, protecting the plants from biotic and abiotic pests and to break the seasonal barriers of production. Polyhouse cultivation is an intensive production system requiring relatively high investment in production and marketing. The cost of the polyhouse structure was reported as the decisive factor for adoption and sustainability of vegetable production in polyhouses elsewhere (Engindeniz and Tuzel, 2006; Murthy et al., 2009). In this backdrop, a study was undertaken to analyse the economic feasibility of polyhouse vegetable cultivation in Kerala.

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Out of the five agro ecological zones of Kerala, central and high range zones were selected as the study location as these zones accouneds for the maximum number of polyhouses in the state. Idukki and Wayanad districts of the high range zone and Ernakulam, Thrissur and Palakkad districts from the central zone were selected. From each zone, 20 polyhouse farmers were selected randomly, proportional to the total number of farmers in the selected districts. Thus the total sample size comprises of 40 polyhouse vegetable farmers. Data were collected by personal interview method using pre-tested structured interview schedule during November 2014-February 2015. Economic feasibility of production of polyhouse crops were analysed employing Capital Productivity Analysis using Payback Period (PBP), Benefit Cost Ratio (BCR), Net Present Value (NPV) and Internal Rate of Returns (IRR). A discount rate of 12 per cent has been fixed for the study, being the rate of interest for medium and long term loans from commercial banks. As the farmers receive sizeable amount as subsidy from the state government and central government through SHM for the establishment of polyhouse, the economic feasibility analysis has also been worked out considering the subsidy factor. Due to the lack of sufficient temporal data on the income stream of polyhouse for its entire life span; the life span of polyhouse is taken as 10 years and the income stream is assumed to be uniform over the entire life span of polyhouse.

The most widely adopted design of polyhouses in central as well as high range zone was the saw-tooth type naturally ventilated polyhouses. Majority of the farmers in the study area owned polyhouses of area 400m^2 and salad cucumber was found to be the most commonly cultivated crop in the polyhouses. A crop sequence with cowpea – salad cucumber – cowpea was also observed as the most common sequence of cultivation in a year.

Murthy et al.(2009) described three types of costs *viz.*, fixed cost, annual variable cost and seasonal variable cost in polyhouse cultivation of vegetables.

Fixed costs include the cost of establishment of polyhouse, which is a major component of cost of production of polyhouse vegetables. Out of the total initial establishment cost, the major share was incurred on GI pipe assembly (43%), followed by labour charges on erection and fabrication (18 %). The proportion of other major items of expenditure contributing to the establishment cost is presented in Table 1). It requires Rs. 1,136 per m^2 for constructing a polyhouse of 400m^2 area. The UV stabilized polythene sheet usually last for 4-5 years and has to be replaced on wear and tear.

Table 1. Cost of establishment of poly house

Particulars	Cost per 400 m^2 (Rs.)
GI Pipe assembly	196900 (43)
Aluminium channel	20160 (4)
UV Stabilized sheet	34040 (7)
Antivirus net	1359 (3)
Shade net	14700 (3)
Irrigation system & fertigation unit	45680 (10)
Microclimatic regulation system (fogger)	15000 (3)
Erection & fabrication charges	84260 (18)
Miscellaneous	30000 (7)
Total	454330 (100)

(Figures in parentheses indicate per cent to total)

Annual variable cost comprises of the costs incurred on inputs which last for one year. Items of annual variable costs are listed in Table 2. As the crop duration is four months for salad cucumber, three crops could be taken in a year. Hence, the cost of inputs that last for three cropping seasons of salad cucumber are listed as annual variable cost of salad cucumber. The cost incurred on inputs for the cultivation of cowpea – salad cucumber – cowpea

Table 2. Annual variable costs of sole crop of salad cucumber and cowpea – salad cucumber – cowpea sequence in polyhouse

Item	Cost (Rs. Per 400 m^2)	
	Salad cucumber	Cowpea – salad cucumber – cowpea
Twines, propping materials	1172	1172
Plastic mulch	2497	2497
Soil solarisation chemical	-	108
Total	3669	3777

in a sequence in a year is accounted as annual variable cost of the crop sequence. The average annual variable cost for cultivation of salad cucumber in polyhouse was estimated to be Rs. 3669 per 400 m^2 and that of cowpea – salad cucumber – cowpea sequence was Rs. 3777 per 400 m^2. Though it is a standard recommendation to adopt soil solarization in polyhouse cultivation, none of the farmers cultivating sole crop of salad cucumber were found to adopt this method using chemicals. Covering the moistened soil with plastic mulch for about a week before commencement of planting was the common practice adopted in salad cucumber cultivation. At the same time, chemical soil solarisation using Formaldehyde and Hydrogen peroxide was found common in polyhouse cultivation of cowpea. Increased susceptibility of cowpea to soil borne diseases and nematodes might be the reason for wider adoption of chemical soil solarisation.

The details of seasonal variable cost incurred on the polyhouse cultivation of salad cucumber and cowpea are shown in Table 3. The average seasonal variable cost for salad cucumber in polyhouse was worked out as Rs. 40,609/ 400m^2 and that of cowpea as Rs. 25,998/ 400m^2. In both the cases, the breakup of cost indicated that highest cost was incurred for labour followed by manures, fertilizers, growth promoters and soil ameliorants. Hired human labour is mostly employed for initial land preparation and application of soil ameliorants and basal dose of fertilizers. For all other purposes family labour is utilized. Salad cucumber requires more labour for training, pruning and harvesting than for cowpea which is reflected as higher imputed value of family labour. In the case of salad cucumber, the cost of seed is a significant factor which adds to the seasonal variable cost. Only parthenocarpic hybrid seeds are used in polyhouse cultivation of salad cucumber. The generally observed seed rate was 750 – 1000 numbers per 400 m^2. On an average a farmer spends Rs. 6.30 for a single seed of salad cucumber. It is also noteworthy that production of cowpea does not involve any sorting, packing or post harvest handling and is either sold out through farm gate sale or in the local retail markets. At the same time, salad cucumber is subjected to minimal visual sorting for length and presence of thorns and is packed in plastic cling films or cardboard crates of 2 or 5 kg capacity before marketing. The main sales centers of salad cucumber are supermarkets. All the respondents were relying on private seed companies as a source of salad cucumber seeds. The average yield of salad cucumber is 3132 kg/ 400 m^2 per season. The farm gate price received by farmers ranged from Rs. 30 to 40 per kg. The average yield of cowpea is 1167 kg/ 400 m^2 per season and the average farm gate price is Rs. 41/ kg. Economic feasibility of vegetable cultivation in polyhouse was analysed employing Capital Productivity Analysis. The income stream of polyhouse cultivation was assumed to be uniform over the entire life span of polyhouse (10 years) and the cash flow has been projected for the remaining years. During the 5th and 10th years an extra cost towards the replacement cost of the UV stabilized sheet of polyhouse was added. The details of Capital Productivity Analysis are given in Table 4. In the polyhouse cultivation of sole crop of salad cucumber throughout the year, the Payback period was found to be 3.2 years. Considering the large amount of initial investment made, 3.2 years is a reasonable time to get back this initial outlay of money. Net Present Value

Table 3. Seasonal variable cost of salad cucumber and cowpea in polyhouse

Item	Cost (Rs. Per 400 m^2)	
	Salad cucumber	Cowpea
Seed	5452	352
Hired human labour	7932	6464
Machinery	118	0
Manures	5457	5609
Fertilizers, growth promoters	3268	2574
PPC and bio control agents.	959	272
Soil ameliorents	1266	1044
Packing materials & post harvest handling	269	0
Transportation	289	197
Family labour (valued at prevailing wage rate)	15599	9486
Total	40609	25998

(NPV) for 10 years worked out to Rs. 5.30 lakhs/ 400m^2 with a Benefit Cost Ratio (BCR) of 1.5 at 12 % discount rate. The Internal Rate of Returns (IRR) for the cultivation of salad cucumber in polyhouse is sufficiently high at 42 per cent per annum. Thus, all the economic indicators point out that the cultivation of salad cucumber in polyhouse is economically feasible and profitable.

When the crop sequence (cowpea – salad cucumber – cowpea) is considered, the payback period worked out to 5.2 years. Net present value came to 1.04 lakhs/ 400 m^2 at 12% discount rate, with a benefit cost ratio of 1.1. The internal rate of returns was found to be 19 per cent per annum for the crop sequence. Hence, it could be concluded that cultivation of crop sequence involving two crops of cowpea (first and last crop) and one crop of salad cucumber (second crop) is an economically feasible option. The economic feasibility indicators signify a higher profitability for the sole cultivation of salad cucumber in polyhouse than the crop sequence under study. However, this better fits in a situation where the salad cucumber farmers are assured of a stable market for their produce and are not affected by extreme price fluctuations. Even then, cultivation of any crop continuously in a piece of land being not advisable from an agronomic point of view, the farmers have to come up with measures especially to restore the lost soil fertility or go for options like soilless cultivation. They may also have to tackle problems like severe pest and disease attack or even pest outbreaks in a mono-cropping situation. Hence it could be concluded that though economic profitability is comparatively less for the crop sequence, cowpea – salad cucumber – cowpea, and this can be a better option for polyhouse farmers of Kerala in the long run. Considering the polyhouses in Kerala, where a complete climatic control inside the polyhouse is not practiced, pests and disease problems are a menace, soil being the common growing medium; cultivation involving diverse non host crops - especially, leguminous crops - would be advisable. Marketing problems faced by the farmers can also be taken care to some extent by the adoption of crop sequence. The major challenge faced by salad cucumber farmers is the lack of demand for the produce in seasons other than summer. So, growing salad cucumber in summer, when it fetches high price and growing cowpea, which is a most preferred vegetable in Kerala in the other two seasons can be a viable option.

Table 4. Cash flow of production of salad cucumber and cowpea – salad cucumber – cowpea sequence

Year	Salad cucumber		Cowpea – salad cucumber – cowpea	
	Cash outflow (Rs.)	Cash inflow (Rs.)	Cash outflow (Rs.)	Cash inflow (Rs.)
1	454330	0	454330	0
2	125496	328716	96384	210003
3	125496	328716	96384	210003
4	125496	328716	96384	210003
5	159536	328716	130775	210003
6	125496	328716	96384	210003
7	125496	328716	96384	210003
8	125496	328716	96384	210003
9	125496	328716	96384	210003
10	159536	328716	130775	210003

Economic feasibility of vegetable production in the subsidy regime is presented in table 5. The Cash flow statement was re-estimated after deducting the subsidy amount from the initial establishment cost (fixed cost) for the analysis. All the indicators showed improvement in both the cultivation situations. The payback period has reduced from 3.2 years to 1.6 years in case of sole crop of salad cucumber and 2.5 years in case of the crop sequence compared to earlier 5.2 years. This means that, the farmers would be able to get back their initial investment on polyhouses almost 2-3 years earlier in a subsidy regime. The BC ratio has also been

Table 5. Capital Productivity Analysis of poly house cultivation

Economic feasibility Indicators	Salad cucumber	Cowpea – salad cucumber – cowpea sequence
Payback Period (Years)	3.2	5.2
Benefit Cost Ratio*	1.5	1.1
Net Present Value *(Rs. Per 400m^2)	530864	104600
Internal Rate of Returns (%)	42	19

*at 12% discount rate

Table 6. Results of Capital Productivity Analysis after accounting for subsidy factor

Economic feasibility Indicators	Salad cucumber	Cowpea – salad cucumber –cowpea sequence
Payback Period (Years)	1.6	2.5
Benefit Cost Ratio*	1.99	1.54
Net Present Value *(Rs. Per 400m^2)	777097	350833
Internal Rate of Returns (%)	112	61

*at 12% discount rate

improved significantly. NPV has multiplied to several manifolds than the earlier situation. Change in IRR also shows an improved economic viability than the earlier situation.

As per the norms of National Horticulture Mission (2014), 50 per cent of the estimated cost of Rs. 650/ m^2 for artificially ventilated polyhouses and Rs. 250/ m^2 for naturally ventilated polyhouses (limited to 1000 m^2 per beneficiary) has been fixed as the pattern of assistance for small and marginal farmers and it is 33.3 per cent of the estimated cost for other category of farmers. Along with this, 25 per cent of assistance from the state government share is also given. Even though the actual establishment cost is much higher than the estimated cost by government agencies for providing financial aid, the subsidies provided are a great support to the farmers entering into polyhouse cultivation. On an average a farmer received Rs. 2,75,780 as subsidy for a polyhouse of 400 m^2 area (Rs. 690/ m^2). The financial aid provided to farmers significantly improved the economic viability and profitability of polyhouse cultivation of vegetables and also reduced the financial burden imposed on farmers for establishing polyhouses as it involves a substantial initial investment.

Polyhouse cultivation of vegetables is an economically feasible and profitable venture in Kerala provided the farmers selected the crops according to market demand, coinciding cultivation with price advantages. Adopting a crop sequence involving salad cucumber and cowpea was found to be better than mono crop in the long run. Subsidy provided by government agencies has been a significant factor which attracted many farmers towards polyhouse cultivation and improved the profitability of polyhouse cultivation. But, profitability alone could not be reckoned while considering long term sustainability and efforts have to be undertaken to develop sustainable technologies in polyhouse cultivation.

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Reference

ICMR [Indian Council of Medical Research]. 2009. Nutrient requirements and recommended dietary allowances for Indians. Indian Council of Medical Research, Hyderabad, 334p.

GOK [Government of Kerala]. 2014. Economic Review 2014 [on-line]. Available: http://www.spb.kerala.gov.in/images/pdf/er14/Chapter2/chapter02.html [09 September 2015].

GOK [Government of Kerala]. 2012. Hi-tech Farming – Operational Guidelines [on-line]. Available: http://www.slbckerala.com//108_slbc/pdf2012 [12 August 2013].

Sabir, N. and Singh, B. 2013. Protected cultivation of vegetables in global arena: A review. Ind. J. Agric. Sci., 83(2): 123–135

Engindeniz, S. and Tuzel, Y. 2006. Economic analysis of organic greenhouse lettuce production in Turkey. Sci. Agric., 63(3): 285-290

Murthy, D.S., Prabhakr, B.S., Hebber, S.S., Srinivas, V. and Prabhakr, M. 2009. Economic feasibility of vegetable production under polyhouse – a case study of capsicum and tomato. J. Hortic. Sci., 4(2): 148-152

Sanjeev, K., Patel, N.B., Saravaiya, S.N. and Desai, K.D. 2014. Economic viability of cucumber cultivation under NVPH. Afr. J. Agric. Res., 10(8): 742-747