Journal of Crop and Weed, 14(1): 134-139 (2018)

Economic feasibility of vegetable production under polyhouse : a case study from Palakkad district of Kerala

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Received : 08-12-2017 ; Revised : 03-03-2018 ; Accepted : 10-03-2018

ABSTRACT

The present study has examined the economic viability of production of selected vegetables under naturally ventilated polyhouses in Palakkad district of Kerala. Relevant data were collected from a total of 15 polyhouses which were either managed byindividual farmers or Self Help Groups. Data were generated by cost accounting method for estimating the feasibility of production and was analyzed by using project evaluation methods of Pay Back Period (PBP), Benefit Cost Ratio (BCR), Net Present Value in all the vegetables. The study concludes that under the current scheme of subsidy on the establishment of polyhouses, the farmers' investment in poly-houses was found to be economically feasible as NPV (131801), BC ratio (2.17) and IRR (37.51) were impressive.

Keywords: Economic feasibility, farm business analysis, polyhouse cultivation, precision farming

Vegetables are generally grown in India using conventional agronomical practices in which the crops are cultivated in the open field under natural conditions (Thapa and Gaiha 2011). Despite that, India is leading producer of several vegetable crops in the world. Interestingly, the small and marginal farmers are the most vulnerable among all farming classes, contribute largely to the production of high value crops including vegetables (Birthal, 2011). This contribution deserves a huge applause since the small and marginal farming community of India are constrained with almost all the production factors including land and water, in addition to risk due to incidence of pests and diseases. The recent popularity of polyhouses in rural India, which are being adopted as a yield enhancing technology as well as act as adaptation strategy from uncertain abiotic and biotic stress. Polyhouses can reduce dependency on rainfall and make the optimum use of land and water resources. Potentially, it can help the farmer in generating income around the year through growing multiple crops and fetching premium pricing for off-season vegetables. Water-soluble fertilisers and micro-managed irrigation helps in saving labour and pesticides (Phookan and Saikia, 2003). However, in India, the polyhouses are considered as a new phenomenon and is still in its initial stage (Singh and Asrey, 2005). Kerala is a state which is promoting polyhouses in the recent past due to the scarcity of cultivable land. Total numbers of operational holdings in the state are nearly 63 lakhs with an average holding size of 0.22 ha. Of the total operational holdings, marginal holdings accounts for 94 per cent and small and marginal holdings together accounts for more than 98 per cent of total cultivated land. This peculiar nature of the operational farm holdings, along with steep rise in the costs of inputs and scarcity of water and labour are forcing the farmers to install polyhouses for vegetable cultivation. The present study has undertaken to examine the economic viability of production of capsicum, salad cucumber, cowpea and tomato in naturally ventilated polyhouses in Palakkad district of Kerala and to delineate the subsidy and marketing linkages.

MATERIALS AND METHODS

Palakkad district was purposively selected for the present study since it has the highest number of farmers practicing polyhouse cultivation. Primary survey was then carried out in the Chittoor block of the district, and data from all the 15 hi-tech polyhouse farmers of the block were collected using detailed and in-depth questionnaire. Out of these 15 polyhouses, 8 were managed by women Self Help Groups (SHG) and rest by individual farmers. A comparison between the SHG's and individual farmers were done using the data on fixed and operational costs and returns in cultivation of crops under polyhouse farming.

Cost concepts

Differences in input use, productivity, income and employment were examined using cost of cultivation and return concepts. Various cost concept are discussed below:

$Cost\ A_1$ = Value of hired human labour+ Value of hired bullock labour + Value of owned bullock labour + Value of owned machinery labour + Value of hired machinery labour + Value of seed + Value of pesticides + Value of manure + vale of fertilizer + Depreciation on implements and farm buildings + irrigation charges + Land revenue and other taxes + Interest on working capital + Miscellaneous expenses.

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Cost B_1 = Cost A_1 + interest on value of owned fixed capital assets (excluding land)

Cost B_2 = Cost B_1 + rental value of owned land + rent paid for leased in land.

Cost C_1 = Cost B_1 + imputed value of family labour.

Cost C_2 = Cost B_2 + imputed value of family labour.

Cost C_3 = Cost C_2 + 10 percent of cost C_2 accounting for managerial input.

Returns over different costs

Farm business income = Gross revenue – cost A_1
Family labour income = Gross revenue – cost B_2
Net income over cost C_1 = Gross revenue – cost C_1
Net income over cost C_2 = Gross revenue – cost C_2
Net income over cost C_3 = Gross revenue – cost C_3

Table 1: Cropping pattern in polyhouses

Particulars	Self help groups	Private farm
Net sown area (ha)	0.05	0.05
Gross sown area (ha)	0.15	0.15
Cropping intensity (%)	300	300
Area under capsicum (%)	25.0	23.8
Area under cowpea (%)	29.2	19.0
Area under cucumber (%)	33.3	33.3
Area under tomato (%)	12.5	23.8

Financial analysis

Financial analysis were done by using models like benefit cost ratio (B : C ratio) , net present value (NPV) and internal rate of return (IRR) for the investment period of 10 years. In order to measure Economic feasibility of the polyhouse equipments and materials, 8 per cent interest rate were taken as discounted rate.

Benefit cost ratio

The BC ratio (BCR) analysis is the ratio of discounted benefits and discounted cost for the future flow of benefits and costs from polyhouse cultivation**.**

$$BCR = \sum_{t=1}^{n} \frac{Bt}{(1+i)^t} \Big/ \frac{Ct}{(1+i)^t}$$

where i = Discount rate , t = Time period, Bt= Benefits over the year, Ct= Cost over the year

Net present value

The Net present value was found out by using the equation.

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

where C = Initial investment

Internal rate of return

The Internal Rate of Return (IRR) is the discount rate that generates a zero net present value for a series of future cash flows. SOLVER option used in excel to optimize the objective value (NPV) to zero by changing the value of discount rate.

RESULTS AND DISCUSSION

Cropping pattern

Table 1 information about the cropping pattern in Hi-tech polyhouses. The net sown area (0.05 ha), gross sown area (0.15 ha) and cropping intensity (300%) under hi-tech polyhouses were same for both the SHGs and private farms. The mere fact that the area cultivated in case of individual farmer and the SHG farmer was the same sheds light on the dreary plight of group approaches failing to deliver. The synergy of groups approach has failed to increase the area of polyhouse agriculture. The cropping intensity of three times is appealing prospect when compared with the state or national averages. The cropping intensity shows the year round cultivation of the crop continuously without any crop holidays. Cucumber has occupied the maximum area under both SHG and private farm polyhouses (33.3 per cent). Both the SHG farmers and the individual cultivators have devoted one-third area to cultivation of cucumber. This may be due to the high demand of the crop produce in the market especially in Palakkad district which is famous for the inherent appetite for cucurbits because of the hot climate. In SHG polyhouses, cucumber was followed by cowpea with an area of 29.2 per cent of total cultivable area, whereas under private polyhouses, both capsicum and tomato have occupied an area of 23.8 per cent of total ploy house area cultivated.

Cost of inputs

Table 2 reveals the share of different components in the total cost of the crops in polyhouses. For the SHG farmers, 63 per cent of the total input cost was constituted by family wages. Similar trend was found for cowpea, cucumber and tomato with about 70 per cent share. The higher proportion of family wages in total input cost in case of the independent farmer and SHG farmer was a disgusting phenomenon. This tendency needs to be sorted out through mechanisms that can reduce the intensive labour use. The ability of SHGs to magnetize cheap family labour in cultivation needs to be rethinking. For capsicum cultivation in SHG farming, the cost incurred for FYM was about 9 per cent to the total cost. This trend was conspicuous in case of other crops as well. The independent farmer also utilized a major portion of the total input cost to family wage. FYM was found to be the next highest in case of percentage of total input

cost. If the bulky organic manures are influencing the input cost significantly, these should be replaced by cheap fertilizers. The nutrient based subsidy policy of the government can help this cause. The planting material cost is higher in the region. Depreciation charges were also significant in proportion. Cowpea, which is labour intensive crop, accrued higher input cost of around Rs. 37,000. The state of Kerala has high labour wage rate as compared to other Indian states. Effectively reducing real labour wage rate may mitigate the problem of higher input cost.

Farm business analysis

The vegetable cultivation inside poly-houses is a popular polyhouse farming practice adopted in Palakkad. The farmers, who do not have the financial back up to establish a poly-house themselves, formed SHGs to do so. Some of the women SHGs were also involved in polyhouse cultivation. The polyhouses established by SHGs were well managed as compared to that by private farms. The tables 3,4 and 5 represent the farm business analysis of vegetable cultivation in polyhouse by self help groups, private farms and both taken together. The costs and returns are given in per polyhouse terms and per ha terms for comparison. In capsicum cultivation, the gross return was highest in SHG, followed by private farms. The yield also showed similar trend. However total cost was highest for all polyhouses followed by SHG and private farms. The yield of cowpea was highest for SHG running polyhouses than private farms. But in cowpea, the private farms received the highest gross return because of the proper and timely management of labour. In SHG surplus labour usage makes total labour cost higher and directly invites more cost than private running polyhouses. The expenses were highest in case of all polyhouses taken together. The private farms who cultivated cucumber in polyhouses got the highest yield irrespective of farm categories, followed by all polyhouses and SHGs. Interestingly for private farms, the total cost was lowest and gross returns the highest among all the categories. The SHG members management of polyhouses needs appreciation but the own labour usage was found highest and it adds more cost to the total. But the pattern of job distribution provides more employment opportunity to the members and even though the cost is increasing its effects are distributed among the members positively makes the enterprises collectively sustainable. The collective responsibility leads to the more labour usage in the management of tomato under SHG leads to the higher yield, but neither their cost was lowest, nor their returns was highest. The gross returns were highest and the cost was lowest for individual farmers. The individuals are more progressive and have the full control over the crop directs them to have more investment in the polyhouses and attracts more return from the investment.

The variation in returns is mainly due to the differences in the management of daily farming activities and the care given to the crop. Interestingly, the family labour income was highest in the case of SHG poly-houses and not in private polyhouses. The reason for this is the higher availability of family labour for the SHG polyhouse cultivation. Each SHG comprises of at least five farmers, the services of family labour of each of these five farmers can be utilized in SHG poly-houses. Contrary to this, the private farms have to hire the services of labour from outside for most operations. The marginal farmers in practicing polyhouse farming in Palakkad were able to adapt to the market environment, by changing the variety of crops cultivated. Thus their resources were allocated in a better way and which yielded better returns. This led to the better allocative and economic efficiently for this category of farmers.

The SHG based ployhouse cultivation were found more labour intensive than the private firms. The collective action and group dynamics makes the management of the crop in better way and it's way forward to the higher yield. The creation of more family labour employment leads to the extra cost in the SHG based ployhouse directly leads to less net return but it's a way to the members revenue only.

Investment in polyhouse farming

The ployhouse infrastructure requires high investment. Table 6 shows that the total investment cost of polyhouse including its micro-irrigation system is Rs. 2,56,000. Out of this, the subsidy amount availed was Rs. 1,81,656. The co-operative bank of the area sanctioned left amount for the investment through loan. Both the central and state government are providing significant level of financial assistance to the farmers for polyhouse farming. The central government provides a financial assistance amounting to 50 per cent of the total system cost for small and marginal farmers and 40 per cent for general farmers through the National Mission on Micro irrigation. In addition the state government provides 40 per cent of the system cost as assistance through State Food Security Programme and the state share of National Mission on Micro irrigation. The remaining cost has to be borne by beneficiary from his/her own resources or through loan. For demonstration or technology support the assistance for drip and sprinkler is 75 per cent of the cost by central government and the remaining 25 per cent by state government.

All categories of farmers are eligible for taking the benefit of the financial assistance from government. Of the total fund outlay, 10 per cent is exclusively for

Table 2: Percentage share of various inputs in total input cost for self-help group

Values (%)	SHG				Individual				All			
	Capsicum	Cowpea	Cucumber	Tomato	Capsicum	Cowpea	Cucumber	Tomato	Capsicum	Cowpea	Cucumber	Tomato
Family wage	63.0	73.1	60.7	67.7	58.8	68	59.4	63.6	61.4	69.1	60.1	66.1
Hired wage	6.8	1.1	7.1	6.5	11.2	6.6	7.0	7.1	8.5	6.2	7.1	6.7
Planting material	7.2	5.1	6.9	4.6	5.6	5.1	7.2	5.2	6.6	4.9	7.1	4.8
Machinery	0.6	0.6	0.7	0.6	0.7	0.5	0.7	0.6	0.6	0.5	0.7	0.6
FYM	8.9	5.3	6.0	4.1	8.2	4.3	6.2	4.3	8.6	4.7	6.1	4.2
Liquid fertilizers	2.8	3.9	4.8	5.1	1.7	1.4	1.9	1.6	1.8	1.4	2.0	1.6
Solid fertilizers	3.0	3.8	4.9	3.6	1.8	1.4	1.8	1.9	1.8	1.4	1.9	1.9
Plant protection chemical	1.3	1.5	1.8	1.7	3.2	3.0	4.9	6.0	3.0	3.4	4.9	5.4
Cost of propping	1.8	1.4	2.0	1.6	3.5	4.5	5.2	4.0	3.2	4.0	5.0	3.7
Cost of transportation	1.8	1.6	2.0	1.9	1.6	1.7	1.9	2.3	1.4	1.6	1.8	1.9
Other costs	2.9	2.5	3.2	2.7	3.7	2.9	3.8	3.4	3.2	2.7	3.3	3.0
Input cost (Rs '000 ha^{-1})	34.2	36.3	29.6	35.9	29.4	6.9	28.2	31.7	32.1	37.6	28.9	34.2
Depreciation	6.0	6.0	6.0	6.0	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1

Table 3: Farm business analysis (FBA) for Self Help Groups (Rs)

Values per unit (0.02 ha)	Capsicum	Cowpea	Cucumber	Tomato
Yield(Quintals ha^{-1})	23.00	27.25	30.00	32.00
Cost A	18642	15764	17651	17620
Cost B1	21290	18412	20298	20268
Cost B2	31290	28412	30298	30268
Cost C1	42815	44962	38248	44568
Cost C2	52815	54962	48248	54568
Cost C3	58096	60458	53073	60025
Gross returns	96125	78225	81417	66650
Farm business income	77483	62461	63766	49030
Family labour income	64835	49813	51118	36382
Net income over cost C_1	53310	33263	43168	22082
Net income over cost C_2	43310	23263	33168	12082
Net income over cost C_3	38029	17767	28343	6625

Scheduled Caste beneficiaries and 1% for Scheduled Tribes farmers. Self Help Groups are also entitled to avail assistance on behalf of its members. In such cases, the individual beneficiary will receive assistance through the SHG and not directly. The farmers can adopt the improved technology and equipment *viz*. fertigation system, semi- permanent sprinkler system, all types of filters and several types of valves etc. Subsidy for demonstration plot on drip and sprinkler amount to 75% of the cost for a maximum area of 0.50 ha per beneficiary, which will be met by the central government and 25% as state share.

The farmers in Palakkad also depend on the state government and State Horticulture Mission for establishing polyhouses. The state government, through the Peoples' Plan, provides a subsidy of Rs. 467 m^{-2} for establishing polyhouses. Another supporting institution called State Horticulture Mission, which provides an amount of Rs. 374.5m^{-2}. The remaining amount of almost Rs. 374.5/m^2 has to be borne by the farmers themselves. These linkages are working very effectively in the sampling area, which is evident from the successful performance of the fifteen polyhouses established there.

The table suggests that farming under hi-tech polyhouses is feasible only when farmers are provided subsidy from the Government. Majority of the hi-tech polyhouses in Palakkad work under this provision of the Government. The farmers are getting a subsidy of almost 70 per cent for doing hi-tech polyhouse farming. The Net Present Value (NPV) was positive when the farming

Table 4: Farm business analysis (FBA) for private farms (Rs)

Values per unit (0.02 ha)	Capsicum	Cowpea	Cucumber	Tomato
Yield (Quintals ha^{-1})	20.33	27.00	30.33	31.50
Cost A	18317	17771	17643	17745
Cost B1	21258	20711	20583	20686
Cost B2	31258	30711	30583	30686
Cost C1	38558	46011	37333	40861
Cost C2	48558	56011	47333	50861
Cost C3	53414	61612	52067	55947
Gross return	82667	83700	82450	71025
Farm business income	64350	65929	64807	53280
Family labour income	51409	52989	51867	40339
Net income over cost C_1	44109	37689	45117	30164
Net income over cost C_2	34109	27689	35117	20164
Net income over cost C_3	29253	22088	30383	15078

Table 5: Farm Business Analysis (FBA) for all polyhouses (Rs)

Values per unit (0.02 ha)	Capsicum	Cowpea	Cucumber	Tomato
Yield(Quintals ha^{-1})	21.86	27.14	30.17	31.80
Cost A	18515	17707	17636	17691
Cost B_1	23735	22928	22857	22911
Cost B_2	33735	32928	32857	32911
Cost C_1	43450	48942	40207	45561
Cost C_2	53450	58942	50207	55561
Cost C_3	58795	64836	55228	61118
Gross Return	90357	80571	81933	68400
Farm Business Income	71843	62865	64297	50709
Family Labour Income	56622	47644	49076	35489
Net Income over Cost C_1	46908	31629	41726	22839
Net Income over Cost C_2	36908	21629	31726	12839
Net Income over Cost C_3	31563	15735	26706	7282

is practiced with subsidy, but it was negative when the subsidy is taken out. Hi-tech polyhouses are established on an area of almost 5 per cent. This limited area plays its role in restricting the yield to certain level which gives them returns over the variable expense, but fail to compensate for the fixed expenses like establishment cost. Thus, the subsidy from the Government for establishing the polyhouses is inevitable in making this venture, a profitable one. The healthy benefit cost ratio of more than two for farms with subsidy and less than one for that without subsidy, again confirms this. The Internal rate of return (IRR) was above 37 per cent in polyhouses with subsidy. It is to be noted that the hi-tech polyhouses managed by SHGs showed better feasibility compared to that by individuals. The field evidence from the Palakkad district of Kerala suggested that the farming under hi-tech poly houses was feasible only when the Government provides subsidy to the farmers, for establishing the poly houses.

Table 6: Investment on hi-tech polyhouses (Rs)

Particulars	Cost (Rs)	Subsidy amount (Rs)	Beneficiary contribution (Rs)	Loan taken (Rs)
Polyhouse (GI pipe, polythene sheet, labour, shade net and structure and sheet)	201960	181656	20196	20196
Micro irrigation system	54040	-	54040	54040
Total investment	256000	181656	74236	74236

Economic feasibility of polyhouses

Table 7 presents the economic feasibility of polyhouses with and without subsidy.

Table 7: Economic feasibility of hi-tech polyhouse farms

Categories	With subsidy			Without subsidy		
	Net present value (Rs)	Benefit cost Ratio	Internal rate of return (%)	Net present value (Rs)	Benefit cost ratio	Internal rate of return (%)
SHG	130689	2.19	37.80	-50636	0.83	-
Individual	133631	2.17	37.29	-47412	0.84	-
All	131801	2.17	37.51	-49392	0.83	-

The farmers' investment in polyhouses is economically feasible, generating impressive returns and employment. Therefore, self help groups and marginal farmers should be encouraged for adoption of polyhouses farming for doubling their income level. Further, there is a scope for widening the ploy house farming by reducing the subsidy components on individual polyhouses and increase the subsidized units with the same level of government allocation.

ACKNOWLEDGEMENT

This paper is drawn from the M.Sc. thesis titled "An economic analysis of precision farming in Palakkad district of Kerala", submitted by the first author to the Post Graduate School, IARI

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