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RESEARCH PAPER

Economics and resource use efficiency of organic and inorganic cucumber in Bengaluru

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Abstract : A growing interest in environmentally friendly goods and services has been expressed together with concerns for the risks, and broader environmental problems, associated with intensive agriculture. Today, organic production is a combination of new technology and traditional methods. The present study was conducted in Bengaluru district, one of the major vegetable producing district of south Karnataka. In recent years the large numbers of farmers started practicing the organic cultivation of vegetables in the district. For the study, 45 farmers each practicing organic and inorganic cultivation of cucumber spread over the district of Bengaluru rural were selected randomly. The data collected from respondents was analysed using budgeting technique and Cobb-Douglas Production Function Analysis according to the objectives. The estimated per acre cost of cultivation of organic and inorganic cucumber was Rs. 3,14,454.75 and Rs. 2,55,139.91, respectively. The gross returns of organic cucumber were Rs. 4,50,000 per acre as against Rs. 3,00,000 for inorganic cucumber. The B:C ratio for organic cucumber was 2.60 as against 1.91 for inorganic cucumber. The resource use efficiency was higher in organic farming than that of inorganic farming practice. Hence, it is advisable for the farmers to switch over to organic farming which minimizes the environmental degradation and also brings higher net returns.

Key Words : Costs and return analysis, Resource use efficiency, Cobb-Douglas production function, Conventional farming, Organic vegetables farming, NPOP, Cucumber

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INTRODUCTION

India the land of 21 agro-ecological zones already has an added advantage in agriculture due to its different geography in climate and soil pattern facilitating the production of different variety of crops which is definitely a plus point from the point of view of diversity in organic product and market (Gurung *et al.*, 2013). In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market (Anonymous, 2005 and Elisa Morgera *et al.*, 2012).

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Over the last few decades world agriculture has introduced increasing levels of modernization and productivity. Key factors in this evolution of modern, or conventional, farming have been intensive capital endowments, farming specialization, the wide-scale application of chemical fertilizers and nutrients and the selection of high-yield crops and livestock, including genetically modified organisms in some countries.

A growing interest in environmentally friendly goods and services has been expressed together with concerns for the risks, and broader environmental problems, associated with intensive agriculture. Today, organic production is a combination of new technology and traditional methods. As a result of recent research, there are many new tools for organic farmers to use including soil analysis, plant nutrient monitoring and integrated pest management systems. Additionally, there are many new commercial organic fertilizers and pesticide products on the market which have made organic farming more user-friendly than ever (smallfarms.ifas.ufi.edu/organic_vegetables). Many NGOs are today active in promoting organic agriculture in India. Growing environmental consciousness and fears of health hazards of conventional food has spawned domestic consumption of organic food (Nadia, 2000).

The advances in agricultural research have propelled dramatic changes in farming practices over the last four decades resulting in a loss of natural habitat and species. The conventional agricultural practices have caused: Soil erosion, Decrease in water availability, Increased salinization, Pollution due to fertilizer and pesticides, Genetic erosion, Reduced socio- economic values, Ill effects on environment, Danger to food security, quality and safety of food, and High input costs leading the farmers into a debt trap.

Organic farming requires less financial and external inputs and places more reliance on the natural and human resources on farm, which are abundant in our country. It is clear that presence of inadequate efficiency and productivity levels could be a disincentive for farmers to shift towards organic farming.

As per the available statistics, India's rank in terms of World's Organic Agricultural land was 15 as per 2013 data (Source FIBL and IFOAM Year Book 2015). The total area under organic certification is 5.71million hectare (2015-16). This includes 26% cultivable area with 1.49 million hectare and rest 74% (4.22 million hectare) forest and wild area for collection of minor forest produces. India produced around 1.35 million MT (2015-16) of certified organic products which includes all varieties of food products namely sugarcane, oil seeds, cereals and millets, cotton, pulses, medicinal plants, tea, fruits, spices, dry fruits, vegetables, coffee etc. The production is not limited to the edible sector but also produces organic cotton fibre, functional food products etc.(*http://apeda.gov.in/organic/Organic_Products.htm*).

The State is also known for its excellence in horticultural crops and animal husbandry. Thus, Karnataka is often called as state with "Cafeteria of Crops". In addition, many farmers of the State are pioneers in organic agriculture and have developed many different systems of cultivation through indigenous knowledge base. They have developed their own methods of using organic wastes and developed holistic pest control agents to control pests and diseases.

It is pertinent to mention that there are active farmers' associations involved in organic farming and NGOs promoting this. The awareness of affluent classes and urban societies on use of organic foods is constantly growing in the State as well (Anonymous, 2004).

The aim of this paper is to analyse the comparative economics and resource use efficiency of cucumber in two groups of farms, respectively constituted by organic and inorganic farms.

MATERIAL AND METHODS

The study was conducted in Bengaluru urban and rural district of Karnataka state. For the purpose of analyzing, primary data pertaining to costs, returns and resource use efficiency of organic and inorganic cucumber were collected from the vegetable growers of both the districts through pre structured schedule. As large number of farmers practice the organic cultivation of these vegetables in the district. To compare the costs involved, prices and the returns in organic and inorganic cultivation of cucumber, 45 farmers practicing organic and 45 farmers practicing inorganic cultivation spread over the district of Bengaluru were selected randomly for the study.

The budgeting technique was used to estimate the costs and returns. The following recent farm management cost concepts were used for calculating the cost per acre of each vegetable crop under study [as per Commission on Agriculture Costs and Price (CACP)]. The classification of costs based on Dr. Sen's

Committee report (1979) is as follows. Cost - A1: It included wages of hired human labour, cost of bullock labour, charges of hired machinery, cost of seedlings, value of organic manure and chemical fertilizers, value of plant protection components, interest on working capital, depreciation on farm machinery, implements, equipment's, farm buildings, land revenue etc. Cost - A2: Cost 'A1' plus rent paid for leased in land.

Cost B1- Cost 'A1'or 'A2' plus interest on fixed capital invested in the business excluding the value of the land.

Cost - B2: Cost 'B1' plus rental value of own land.

Cost - C1: Cost 'B1' plus imputed value of family labour.

Cost - C2: Cost 'B2' plus imputed value of family labour.

Cost – C3: Cost 'C2' plus value of management of inputs at 10 per cent of total cost.

Cobb-Douglas form of production function was employed to analyse the resource use efficiency in both organic and inorganic farms.

The general form of the function is $y = axi^{bi}$ where, 'xi' is the variable resource, 'y' is the output, 'a' is a constant and 'bi' estimates the extent of relationship between xi and y and when xi is at different magnitudes. The 'b' co-efficient also represents the elasticity of production in Cobb-Douglas production function analysis.

This type of function allows for either constant or increasing or decreasing returns to scale. It does not allow for total product curve embracing all the three simultaneously. Functions of the following form (1) were fitted for two farming practices.

$$Y = ax_1^{b1}x_2^{b2}x_3^{b3} \ldots\ldots\ldots\ldots x_n^{bn} \quad \ldots (1)$$

On linearization, eq. (1) becomes (2)

$$\log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + \ldots + b_n \log x_n \quad \ldots (2)$$

Production function employed for two farming practices as a whole is given in eq. (3)

$$\text{Log } Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + b_6 \log x_6 + e \quad \ldots (3)$$

where,

Y = Gross returns in Rs./acre

a = Intercept

x_1= Seeds Rs./acre

x_2 = Manures and Tank silt Rs./ acre

x_3 = Bio-fertilizers or Fertilizer Rs./ acre

x_4 = Bio-pesticides or plant protection chemicals Rs./ acre

x_5= Human labour Rs./ acre

x_6= Bullock and machine labour Rs./ acre

$\sum bi$ = return to scale (i = 1 to 6)

e = Error term

Returns to scale :

The returns to scale were estimated directly by getting the sum of 'bi' co-efficients. The returns will be increasing, constant or diminishing based on whether value of summation of 'bi' is greater, equal or less than unity, respectively.

RESULTS AND DISCUSSION

Comparative per acre cost of cultivation and farm management costs of cucumber crop on organic and inorganic farms are presented in the Table 1. Perusal of the table indicated that the total cost of cucumber cultivation on organic farms was more than that of inorganic farms because of increasing costs of organic manures in the study area. The cost of cultivation per acre of cucumber on organic farm was Rs. 3,14,454.75 as against Rs. 2,55,139.91 on inorganic farms. The cost of chemical fertilizers and cost of plant protection chemicals on inorganic farms were the differentiating factors in the cost. In the total cost, variable costs accounted for a major share. The proportion of variable cost was Rs. 1,68,029.95 and Rs. 1,51,607.38 on each organic and inorganic farms, respectively (Table 1) (Robin *et al*., 2000 and Chiara, 2015).

In the case of organic farms, the variable costs mainly comprised of cost of human labour, cost of organic inputs (seedlings, FYM, poultry manure, external soil, green manuring, vermicompost, panchagavya, jeevamrutha, NSKE, biofertlizers and biopesticides, etc.) and cost of bullock and machinery labour which were Rs. 52,600, Rs. 72,313 and Rs. 5500 of the total cost of cultivation, respectively. The expenditure on organic manure found to be an important item in total cost of cultivation on organic farms. The other variable cost items such as interest on the working capital is Rs. 21,916.95 and marketing expenses is Rs. 15,700 were also included in the total cost of cultivation of cucumber in organic cultivation (Naik *et al.*, 2012).

In the cost of cultivation of cucumber in inorganic farms, the variable cost mainly comprised of cost of human labour, cost of manures (FYM and poultry manure) and external soil, cost of bullock and machinery labour, cost of chemical fertilizers and cost of plant protection chemicals which were Rs. 49,380, Rs.11,700, Rs. 4062.50, Rs. 18,550 and Rs. 13,740 of the total cost

of cultivation, respectively. The expenditure on chemical fertilizers and chemical pesticides found to be an important item in the total cost of cultivation on inorganic farms. The other variable cost items such as cost of seedlings, interest on working capital and marketing expenses were found to be Rs. 5200, Rs. 19,774.88, Rs. 14,500 of the total cost of cultivation of cucumber in inorganic cultivation, respectively (Table 1) (Pandey *et al.*, 2006).

The share of fixed cost in total cost of cultivation of Cucumber in organic and inorganic cultivation was 46.56 per cent (Rs. 1,46,424.80) and 40.58 per cent (Rs. 1,03,532.54), respectively and its inclusive of managerial cost of 10 per cent of total cost. Among the items of fixed cost, the rental value of the land had a maximum share in the total cost of cultivation on both organic and inorganic farms (Emily and Jeff, 2012).

The resource use efficiency as a result of Cobb-Douglas production function estimates (Table 2) for organic cucumber have clearly indicated that chosen factors of production have significantly influenced the production of cucumber in organic farming practice. However, there were considerable differences in the extent of influence of different factors on the production of cucumber (Bal *et al.*, 1983).

The value of co-efficients were positive in respect

Table 1 : Costs of cultivation of cucumber crop in organic and inorganic farming (Rs. / acre)

Details		Organic			Inorganic		
		Qty per acre	Cost per unit	Cost per acre	Qty per acre	Cost per unit	Cost per acre
Variable cost				168029.95			151607.38
Human labour				52600			49380
Family	Male (no.)	44	400	17600	44	400	17600
	Female (no.)	22	220	4840	18	220	3960
Hired	Male (no.)	27	400	10800	25	400	10000
	Female (no.)	88	220	19360	81	220	17820
Bullock and machine labour				5500			4062.50
Bullock labour (days)		2	1000	2000	1	1000	1000
Tractor (Hrs)		4	875	3500	3.5	875	3062.50
Inputs				72313			63890
FYM (Tractor loads)		3	3600	10800	2	3600	7200
Poultry manure (Tractor loads)		1	3500	3500	1	3500	3500
Tank silt/ external soil (Tractor loads)		1	1000	1000	1	1000	1000
Seeds		800	6.5	5200	800	6.5	5200
Biofertilizers / chemical fertilizers (qtl)		21.57	1178.16	25413	7.5	2473.33	18550
Biopesticides / chemical pesticides (ltr)		9.5	600	5700	6.95	1976.98	13740
Thread (kg)		50	80	4000	50	80	4000
Wiring (kg)		40	80	3200	40	80	3200
Poles (No's)		750	18	13500	750	10	7500
Marketing expenses (Rs.)				15700			14500
Transportation		8	500	4000	8	500	4000
Loading and unloading		450	10	4500	300	10	3000
Packing material (No's)		450	16	7200	300	20	6000
commission charges @ 3%		0	0	0	1500	3	4500
Interest on working capital (15 %)*				21916.95			19774.88
Fixed cost				146424.80			103532.54
Land and water tax			50	50		50	50
Depreciation on farm machinery and farm buildings				5288			5288
Rental value of land (25% Gross income)*				112500			75000
Managerial cost (10 % of all cost)*				28586.8			23194.54
Costs	Cost A_1 + Imputed value of family labour			173367.95			156945.38
	Total Cost (C_3)			314454.75			255139.91

of manures and tank silt, bio-fertilizers, bio-pesticides and bullock and machine labour, where as the co-efficient for seeds and human labour were negative. Among the variables the co-efficients for manures and tank silt, bio-fertilizers, bio-pesticides and bullock and machine labour were significant at one per cent level, the co-efficient of seeds and human labour was significant at five per cent level.

The co-efficient of multiple determinations (R^2) was 0.99 and the estimated returns to scale were 1.00 and it is equal to unity *viz.*, there was a constant return to scale. It is clearly indicating that the co-efficient of manures and tank silt is found be 0.7073, means as value of this variable is increased by 1%, the output would increase by 0.70%.

The resource use efficiency as a result of Cobb-Douglas production function estimates for cucumber in inorganic farming practice were depicted in Table 3. However, there were considerable differences in the extent of influence of different factors on the production of cucumber in inorganic practice.

It can be observed that the co-efficients for plant protection chemicals and bullock and machine labour were negative and co-efficient for all other resources were positive, among these variables the co-efficient for fertilizers and human labour were significant at five per cent level and the rest of the estimated co-efficients were statistically non-significant (Verma, 2002).

The co-efficient of multiple determinations (R^2) is 0.9951 and the estimated returns to scale were 0.9923 and it is less than unity.

The yield, market price, returns, cost of production and benefit-cost ratios are presented in the Table 4. The per acre average yield of cucumber in organic cultivation (225 q) was comparatively higher than that of inorganic farm (200 q). The average per quintal market price of organic cucumber (Rs. 2000) was found to be higher than that of inorganic tomato (Rs. 1500). Always there will be a premium price for organically produced vegetables.

The return structure is clearly revealed that the gross returns per acre were higher in organic cultivation (Rs.

Table 2: Resource use efficiency in organic cucumber - results of Cobb-Douglas function analysis [Dependent variable: Gross return (Rs./acre]

Sr. No.	Particulars	Parameter	Co-efficients	P - value
1.	Intercept	a	3.5899	2.8780
2.	Seeds Rs./acre	b_1	-0.2241*	0.0436
3.	Manures and Tank silt Rs./ acre	b_2	0.7073**	0.0018
4.	Bio-fertilizers Rs./ acre	b_3	0.6517**	0.0005
5.	Bio-pesticides Rs./ acre	b_4	0.0850**	0.0009
6.	Human labour Rs./ acre	b_5	-0.4123*	0.0448
7.	Bullock and machine labour Rs./ acre	b_6	0.1927**	0.0001
	n = 45	R^2	0.9997	
		Adjusted R^2	0.9996	
		Returns to scale ($\sum b_i$)	1.0004	

Note: * and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 3 : Resource use efficiency in inorganic cucumber - results of Cobb-Douglas function analysis [Dependent variable: Gross return (Rs./acre)]

Sr. No.	Particulars	Parameter	Co-efficients	P - value
1.	Intercept	a	2.1730	0.00005
2.	Seeds Rs./acre	b_1	0.1662^{NS}	0.1846
3.	Manures and Tank silt Rs./ acre	b_2	0.1121^{NS}	0.7842
4.	Fertilizer Rs./ acre	b_3	0.4044*	0.0323
5.	Plant protection chemicals Rs./ acre	b_4	-0.0280^{NS}	0.9302
6.	Human labour Rs./ acre	b_5	0.5746*	0.0262
7.	Bullock and machine labour Rs./ acre	b_6	-0.2370^{NS}	0.1941
	n = 45	R^2	0.9951	
		Adjusted R^2	0.9943	
		Returns to scale ($\sum b_i$)	0.9923	

Note: * and ** indicate significance of values at P=0.05 and 0.01, respectively NS=Non-significant

Table 4 : Yield, market price and returns of organic and inorganic cucumber

Particulars	Cucumber	
	Organic	Inorganic
Yield (q)	225	200
Price / q	2000	1500
Gross Returns	4,50,000	3,00,000
Cost of cultivation [Rs. / acre (C_3 cost)]	314454.75	2,55,139.91
Cost of cultivation [Rs. / acre (cost A_1+ imputed value of family labour)]	173367.95	1,56,945.38
Cost of production [Rs. / q (over C_3 cost)]	1397.58	1275.70
Cost of production [Rs. / q (over cost A_1+ imputed value of family labour)]	770.52	784.73
Net returns (Rs. / Acre) (over C_3 cost)	1,35,545.26	44,860.09
Net returns (Rs. / Acre) (over cost A_1+ imputed value of family labour)	276632.05	1,43,054.63
B:C Ratio (over C_3 cost)	1.43	1.18
B:C Ratio (over cost A_1+ imputed value of family labour)	2.60	1.91

4,50,000) compared to that of inorganic (Rs. 3,00,000) cultivation of cucumber with a positive net return on both the categories of the farms. The net return in organic practice was Rs. 1,35,545.26 and Rs. 44,860.09 in inorganic practice. Though the yield levels on organic farming practice were higher compared to inorganic farming practice, the net returns were higher because of the premium price received and lower cost of cultivation. The B:C ratio was also higher in organic farming (2.60) compared to inorganic farming (1.91). The findings are in conformity with the study conducted by Shrestha *et al.* (2014); Bhardwaj *et al.* (2000) and Patil *et al.* (2010).

The results of the study revealed that the yields on organic farms were found to be higher than inorganic farming practice. Though organic farming gives relatively higher yields and it continuous practice will help to build up the soil fertility. Proper practicing of it will lead to higher net returns to the farmers because of increasing health conscious among urban consumers. The comparative perspective of organic and conventional agriculture, While organic agriculture aims to be environmentally sustainable, it has not yet reached its goals and there are issues that still need to be addressed.

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