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Cost-benefit Analysis of Organic Agriculture: A Case Study of Ashapuri Village Development Committee, Kavrepalanchok

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Abstract

This paper presents the cost-benefit analysis of an organic agriculture in Ashapuri village development committee of Kavrepalanchowk District, Nepal. We utilize the informal interview method of data collection and standard cost-benefit technique to assess the financial viability of the three organic crops namely Shiitake Mushroom, Broccoli, and Spinach. We document that Shiitake Mushroom and Broccoli are financially viable but that of Spinach is not. We then argue for a need for further study to justify our finding and to determine its policy implication.

Introduction

Organic agriculture (OA) is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. OA combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved (IFOAM, 2008). It is the fastest growing food sector with an annual global growth rate of 15-20 percent for the last ten years vis-à-vis 4-5 percent per year of overall food industry. The organic food supply chain is a consumer driven sector, with a market value of US$ 40 billion. Organic production at present covers more than 31 million hectares (IFOAM, 2008).

The history of OA in Nepal started from the very beginning of traditional farming system, but in commercial scales it was initiated in 1989 under the leadership of Lotus Organic Farm established by Mrs. Judith Chase. NPG a national level network on sustainable agriculture since 1992 has also been facilitating process for OA promotion[‡‡‡]. Thapa (n.d.) argues that the geographical and biodiversity are ideally suited for the organic agriculture in Nepal.

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On this see, Thapa (n.d.)

The organic farm situated in Asapuri Village Development Committee (VDC) provides typical instance of OA in Nepal. The farm has an area of approximately five hectares of land and is owned and managed by three young graduates and uses local manpower and locally available irrigation facilities for production of organic vegetables. The Asapuri VDC has a total population of 5,566 at present and is at a distance of seven kilometers from the Banepa Town (Arniko Highway) being accessible by local transport. [§§§] The farm has been producing organic vegetables for the last five years and grows Cauliflower, Broccoli, Shiitake Mushroom, Radish and Spinach as the major products.

Against this background, the paper assesses the financial viability of the existing farm project for three products- Shiitake Mushroom, Broccoli and Spinach applying the cost-benefit technique.

Data and Methodology

The data for the study were obtained using informal interview method. For this purpose, a team of twelve researchers were divided into three groups and each group was assigned one crop namely Shiitake Mushroom, Broccoli and Spinach. The raw data obtained were processed and tabulated for carrying out the financial analysis.

For the purpose of financial analysis, standard cost-benefit technique had been utilized. These included Net Present Value, Internal Rate of return (IRR), Benefit-Cost Ratio (BCR) and Sensitivity analysis. The following assumptions were made for the purpose of carrying out financial analysis.

a) The annual benefit is expected to grow at the rate of 10 percent owing to the increasing awareness of and in effect the market demands for the organic vegetables. Accordingly, the annual cost is assumed to grow at the rate of 5 percent as the result of increase in price of the raw materials.

b) The project life is assumed to be consisting of five years and all capital costs will be incurred only in the first year of the project life.

c) The tomato is assumed to be grown along with the main crop spinach. Further, it is assumed that the plantation of spinach is done five times annually whereas the same for the tomato is three times.

Vegetable Crops for the Study

Shiitake Mushroom

Shiitake (*Lentinula edodes*) is an edible mushroom native to East Asia, which is cultivated and consumed in many Asian countries, as well as being dried and exported to many countries around the world. It is a feature of many Asian cuisines including Chinese, Japanese, Korean and Thai. Shiitake mushrooms have been researched for

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§§§ The proportion of male and female is 0.5. This constitutes 1.44 percent of total population of Kavrepalanchok district. See, CBS (2001).

their medicinal benefits, most notably their anti-tumor properties in laboratory mice. These studies have also identified the *polysaccharide lentinan*, a (1-3) β-D-glucan, as the active compound responsible for the anti-tumor effects.[****]

Broccoli

Broccoli is a plant of the Cabbage family, *Brassicaceae* (formerly Cruciferae). It is classified as the *Italica Cultivar Group* of the species *Brassica oleracea.* Broccoli possesses abundant fleshy flower heads, usually green in color, arranged in a tree-like fashion on branches sprouting from a thick, edible stalk. The large mass of flower heads is surrounded by leaves. Broccoli most closely resembles cauliflower, which is a different cultivar group of the same species, but broccoli is green rather than white.[††††] Broccoli is a cool-weather crop that does poorly in hot summer weather. Broccoli grows best when exposed to an average daily temperature between 65 and 75 degrees Fahrenheit (18-23 degrees celsius). Broccoli is high in vitamin C and soluble fiber and contains multiple nutrients with potent anti-cancer properties including *diindolylmethane* and *selenium.*

Spinach

Spinach (*Spinacia oleracea*) is a flowering plant in the family of Amaranthaceae. It is native to central and southwestern Asia. It is an annual plant (rarely biennial), which grows to a height of up to 30 cm. Spinach may survive over winter in temperate regions. The leaves are alternate, simple, ovate to triangular-based, very variable in size from about 2-30 cm long and 1-15 cm broad, with larger leaves at the base of the plant and small leaves higher on the flowering stem. The flowers are inconspicuous, yellow-green, 3-4 mm diameter, maturing into a small hard dry lumpy fruit cluster 5-10 mm across containing several seeds. Primitive forms of spinach are found in Nepal and that is probably where the plant was first domesticated. Spinach is known as a rich source of iron and calcium.[‡‡‡‡]

Financial Analysis of the Vegetable crops

This section consists of two parts. The first part provides a brief overview of cost-benefit technique and the second part deals with the findings of the financial analysis.

Cost -Benefit Techniques

Payback Period

The payback period is the length of the time required to recover the initial capital outlay of the project. The decision rule associated with the Payback Period when

**** See, http://en.wikipedia.org/wiki/Shiitake

†††† See, http://en.wikipedia.org/wiki/Broccoli.

‡‡‡‡ http://en.wikipedia.org/wiki/Spinach

projects are independent is: accept all projects with a payback period shorter than the benchmark payback period. For mutually exclusive projects the project with the shorter period is chosen as the desirable project. As an investment criterion the difficulty with payback period is that it doesn't considers cash flow after the payback period. However as Gitinger (1982) argues it is the most common , rough means of choosing among the investments in business enterprises , especially when choice entails a high degree of risk.

Net Present Value (NPV) or Net Present Worth (NPW)

It is the present worth of benefit (cash inflow) stream less the present worth of the cost cash outflow (streams) or the present worth of the net benefits (cash flow). It is expressed as

$$NPV = \frac{B_1 - C_1}{(1+r)^1} + \frac{B_2 - C_2}{(1+r)^2} + \cdots + \frac{B_n - C_n}{(1+r)^n} \quad (1)$$

$$= \sum_{t=1}^{n} \frac{B_t - C_t}{(1+r)^t}$$

$$= \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t}$$

where, B_t is the benefit delivered by the project in t years time

C_t is the cost incurred by the project in t years time

$B_t - C_t$ (CF_t) is the net benefit (cash flow) in t years time

r is the discount rate

t is the life of the project

The decision rule associated with the Net Present Value is to select all the projects (in case of independent) with a zero or greater at the opportunity cost of the capital whereas for mutually exclusive projects the selection criterion is to choose the project with the greatest NPV. The NPV as a decision rule has some limitations. First, it is expressed in absolute terms rather than relative terms and hence cannot be used to rank the independent projects. The second is that in case of mutually exclusive projects with different lives, NPV is biased in favor of long duration projects.

Internal Rate of Return (IRR)

The internal rate of return of an investment opportunity is the rate of return which equates the present value of benefits and costs. Put another way, it is the discount rate that is just high enough to bring down the present value of benefits to the present value of costs. Gitinger (1982) defines IRR as the maximum interest that a project could pay for the resources used if the project is to recover its investment and operating costs and stills break even. The equation for calculating the internal rate of return is

$$\frac{B_1 - C_1}{(1+IRR)^1} + \frac{B_2 - C_2}{(1+IRR)^2} + \cdots\cdots\cdots + \frac{B_n - C_n}{(1+IRR)^n} = 0 \quad \textbf{(2)}$$

$$\sum_{t=1}^{n} \frac{B_t - C_t}{(1+IRR)^t} = 0$$

$$\sum_{t=1}^{n} \frac{CF_t}{(1+IRR)^t} = 0$$

where, the notations used are as similar to Equation 1, with the exception *IRR* which refers to the Internal Rate of Return

The decision rule associated with the internal rate of return when projects are independent is: accept all projects with an internal rate of return equal to or higher than the discount rate—or 'hurdle rate', as it is sometimes termed—and reject the rest. However in case of mutually exclusive projects the IRR can lead to erroneous investment choice.[§§§§] Even in the case of independent projects, IRR may give incorrect ranking in that it can tell only in general way and not precisely that one project is better that another. For instance, with the discount rate at 10 percent, whether the project with 25 percent economic rate of return contributes relatively more to national income than the project with economic rate of return of 15 percent, it is not known with certainty, albeit both are preferable as economic rate of return is greater than opportunity cost of capital.

Alternatively, IRR can be also expressed as, [*****]

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§§§§ This can be avoided by using the NPW criterion or by considering the IRR on the incremental cash flow.

***** $$IRR = LDR + \frac{HDR - LDR}{NPV_{HDR} - NPV_{LDR}}(0 - NPV_{LDR})$$

$$\text{or: } = LDR + \frac{HDR - LDR}{NPV_{LDR} - NPV_{HDR}}(NPV_{LDR})$$

$$= r_1 + \frac{r_2 - r_1}{NPV_{r_1} - NPV_{r_2}}\left(NPV_{r_1}\right)$$

Where, *LDR* refers to the lower discount rate and *HDR* refers to the higher discount rate.

$$IRR = r_1 + \frac{NPV_{r_1}}{NPV_{r_1} - NPV_{r_2}}\left(r_2 - r_1\right)$$

Benefit-Cost Ratio (BCR)

It is the present worth of benefit stream divided by the present worth of the cost streams. It can be expressed as

$$\text{BCR} = \frac{\sum_{t=1}^{n} \frac{B_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+r)^t}} \qquad (3)$$

Where, the notations used are as similar to Equation **1**

The decision rule for the BCR is to accept all independent projects with a BCR of 1 or greater at the opportunity cost of the capital. In case of mutually exclusive projects the BCR can lead to erroneous investment choice and hence the use of NPV is sought in such case. As for IRR, in the case of independent projects, BCR may give incorrect ranking. However BCR can be used to make a quick estimate of how much the cost would rise before the project become economically unattractive. For instance, if BCR is 1.62 we can tell by inspection that costs could rise by 62 percent before the BCR ratio would be driven to 1. By taking the reciprocal of BCR and subtracting it from 1, we can estimate by how much the benefit could fall before the project becomes economically unattractive. Thus for our example this is 38 percent {[1-(1/1.62)]*100} before the BCR fall down to It is thus a quick means of estimating two "switching values". It should be noted that the BCR computed using equation 3 yields aggregate ratio. For netted ratio the equation, assuming that initial financing is required during the first *m* periods, while inflows, net of additional costs, accrue in each successive period, is ; (Schwab and Lusztig,1969).

$$\text{Netted BCR} = \frac{\sum_{t=m}^{n+1} \frac{B_t - C_t}{(1+r)^t}}{\sum_{t=1}^{m} \frac{C_t}{(1+r)^t}}$$

Net Benefit – Investment Ratio

It is a form of the BCR and is computed as the present worth of the net benefits divided by the present worth of the investment. It is expressed as:

$$\text{Net Benefit- Investment Ratio (N/K)} = \frac{\sum_{t=O}^{n} \frac{N_t}{(1+r)^t}}{\sum_{t=O}^{n} \frac{K_t}{(1+r)^t}} \qquad \textbf{(4)}$$

where, N_t is the net benefit in t years time after the project has turned positive and K_t is the net benefit in initial years when stream is negative. The decision rule for the Net Benefit- Investment Ratio is to accept all independent projects with an N/K of 1 or greater at the opportunity cost of the capital-in order, beginning with the largest ratio value and proceeding until available investment funds are exhausted. In case of mutually exclusive projects the N/K like the BCR can lead to erroneous investment choice and hence the use of NPV is more desirable in such case. The Net Benefit-Investment Ratio can be used to rank the projects in case when capital is rationed because of lack of sufficient funds to undertake the all the projects. However it cannot be used for dynamic optimization-optimizing project investment over time. Like BCR, Net Benefit- Investment Ratio also provides a quick means of estimating two "switching values".

The paper however utilizes the NPV, BCR and IRR as the standard technique of the financial analysis along with the sensitivity analysis.

Financial Analysis and Findings

The financial analysis of the three farm products viz Shiitake Mushroom, Broccoli and Spinach has been provided in Appendix 1, 2 and 3 respectively and are summarized in Table 1.

Table 1: NPV, IRR and BCR of Vegetable Crops

Cost Benefit Techniques	Vegetable Crops		
	Shiitake Mushroom	Broccoli	Spinach
Net Present Value (NPV)	699111.23	175411.8	-656617.36
Internal Rate of Return (IRR)	98 %	25 %	-
Benefit-Cost Ratio (BCR)	2.42	1.20	0.13

The analysis of NPV, BCR and IRR of vegetable crops reveals that Shiitake Mushroom and Broccoli are both financially viable to produce but that of Spinach is not financially viable. The sensitivity analysis shows that even in the case of decrease in selling price (revenue) and increase in price of seeds (Shiitake Mushroom) and labor (Broccoli) respectively by the magnitude of 10 percent, Shiitake Mushroom and Broccoli remain financially viable. In addition, Table 2 also reveals that decrease in selling price of Shiitake Mushroom by 10 percent results in a decrease of 17 percent in the net present value. Moreover the switching value of 58.7 percent shows that a decrease of 58.7 percent in the selling price will cause the net present value to become zero. Corresponding figures for the Broccoli are respectively 5.9 and 16.8 percent. The similar interpretation holds incase of increase in price of seeds (Shiitake Mushroom) and labor (Broccoli).

Table 2: Sensitivity Result of Shiitake Mushroom, Broccoli, and Spinach

	Price		NPV		Sensitivity Indicator	Switching Value (%)
	Price (P_0)	Price (P_1)	NPV_0	NPV_1	SI	SV(%)
Scenario 1: 10 % decrease in selling price (Revenue)						
Shiitake Mushroom	400	360	699111	580103	1.7	58.7
Broccoli	70	63	175412	71280	5.9	16.8
Spinach	-	-	-	-	-	-
Scenario 2: 10 % increase in price of seeds for Shiitake Mushroom and labor for Broccoli						
Shiitake Mushroom	1000	1100	699111	680245	0.27	370.6
Broccoli	15	16.5	175412	141452	1.94	51.7
Spinach	-	-	-	-	-	-

Conclusions and Recommendations

In this study we apply the standard cost-benefit technique to assess the financial viability of the existing farm project for three products- Shiitake Mushroom, Broccoli and Spinach. The results of our study show that Shiitake Mushroom and Broccoli are financially viable but that of Spinach is not financially viable both under normal condition and under the two assumed scenarios- decrease in selling price (revenue) and increase in price of seeds (Shiitake Mushroom) and labor (Broccoli) respectively by the magnitude of 10 percent.

Although the study is based on the organic farm situated in Asapuri Village Development committee (VDC) of Kavrepalanchok District, Nepal, the cost benefit techniques applied are standard and can be used to replicate the findings made in this paper by focusing on the other organic farms. In other words, there is a need for further study to justify the present findings and to determine its policy implications.

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Annex 1: Detailed Costs Breakdown of Shiitake Mushroom

Details	Unit	Qty	Rate	Total	Year					
					0	1	2	3	4	5
Capital cost					235000	0	0	0	0	0
Land and site development	Ropani	1	110000	110000						
Irrigation structure	Lump sum			25000						
Shed construction	no	1	10000	90000						
Preliminary expenses	Lump sum			10000						
Annual costs					0	-73500	-77175	-81034	-85085	-89340
Labor	No per hour per day	2	15	9000						
Fertilizer	bottle	25	100	2500						
Seeds	packet	50	1000	50000						
Other (communication)	Lump sum			12000						
Annual Benefit					0	288000	316800	348480	383328	421661
Mushroom	Kg	720	400	288000						
Net benefits (cash flow)					-235000	214500	239625	267446	298243	332321
Discount rate			10%							
Financial Net Present Value			699,111.23							
Financial Internal Rate of Return			98%							
Financial Benefit Cost Ratio			2.42							
Payback Period			1.04							

Annex 2: Detailed Costs Breakdown of Broccoli

Details	Unit	Qty	Rate	Total	Year					
					0	1	2	3	4	5
Capital cost					-415000	0	0	0	0	0
Land and site development	Ropani	3	110000	330000						
Irrigation structure	Lump sum			25000						
Shed construction	No	5	10000	50000						
Preliminary expenses	Lump sum			10000						
Annual costs					0	-129500	-135975	-142774	-149912	-157408
Labor	no per hour per day	20	15	90000						
Fertilizer	Bottle	25	100	2500						
Hybrid Seeds	Packet	25	1000	25000						
Other (communication)	Lump sum			12000						
Annual Benefit					0	252000	277200	304920	335412	368953
Broccoli	Kg	3600	70	252000						
Net benefits (cash flow)					-415000	122500	141225	162146	185500	211545
Discount rate			10%							
Financial Net Present Value			175,411.8							
Financial Internal Rate of Return			25%							
Financial Benefit Cost Ratio			1.20							
Payback Period			2.93							

Annex 3: Detailed Costs Breakdown of Spinach

Details	**Unit**	**Qty**	**Rate**	**Total**	**Year**					
					0	1	2	3	4	5
Capital cost					-455000	0	0	0	0	0
Land and site development	Ropani	3	110000	330000						
Irrigation structure	Lump sum			25000						
Shed construction	No	9	10000	90000						
Preliminary expenses	Lump sum			10000						
Annual costs	no per hour				0	-91500	-96075	-100879	-105923	-111219
Labor	per day	6	15	27000						
Fertilizer	Bottle	25	100	2500						
Seeds	Packet	50	1000	50000						
Other (communication)	Lump sum			12000						
Annual Benefit					0	24750	27225	29948	32942	36236
Spinach	Kg	75	240	18000						
Tomato	Kg	135	50	6750						
Net benefits (cash flow)					-455000	-66750	-68850	-70931	-72980	-74982
Discount rate			10%							
Financial Net Present Value			656,617.36							
Financial Internal Rate of Return			-							
Financial Benefit Cost Ratio			0.13							
Payback Period			-							