Journal of Crop and Weed, 14(2): 33-39 (2018)

An economic viability analysis of pineapple cultivation in Ri Bhoi district of Meghalaya

BALANCE S. SWETT AND B. BERA

Department of Agricultural Economics

Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, West Bengal

Received : 04-02-2018 ; Revised : 09-08-2018 ; Accepted : 16-08-2018

ABSTRACT

Present study conducted on some purposively selected villages of Umling block under Ri Bhoi district of Meghalaya indicates that the average annual total return realized by sample pineapple growers was estimated to be Rs.1,98,766.80 ha^{-1} from an average annual expenditure of Rs 85,412.67. The net present worth, benefit–cost ratio and internal rate of return of the pineapple plantation were calculated to be Rs.5,45,190.73 ha^{-1},1.77 and 38.95 per cent respectively discounted at the rate of 9.25 per cent. Pineapple cultivation provided employment of 207 man-days annually. The adoption of improved package of practices coupled with the development in the infrastructural facilities, particularly in the marketing and processing sector, can boost up the rural economy of this backward region.

***Keywords*:** Benefit-cost ratio, IRR, NPV, prime cost concept, sensitivity analysis

Pineapple (*Ananas comosus*), popular herbaceous perennial tropical fruit grows well in humid tropics and sandy loam soils with an optimum temperature of 22-32^{0}C, up to an elevation 1,100 m and having an annual rainfall of 760-1000 mm. Pineapple is the most important fruit crop in Meghalaya and occupies the fifth position in terms of area accounting 11.31 thousands ha and produces 117.77 thousand tonnes with an average productivity of 10.41 t ha^{-1} claiming 7th and 12th position respectively among pineapple producing states in the country (Saxena *et al*., 2015). During the last decade, the area under pineapple cultivation has increased by 11.7per cent and the total production has been increased by 21.8per cent in the state. The fruit is grown from the plains up to about 1000 m above M.S.L. However, it grows well on the foothills of the state up to 700 m above M.S.L., where the yield is marginally better. In the hills, the crop is grown in the un-terraced slopes, the rows being along the slopes, purely as a rainfed crop. In the mid-hills (800 m above M.S.L.), double-row bed planting with a spacing of 45 × 45 × 75 cm has been found to be optimum on wide-bench terraces, based on the findings of ICAR (Government of Meghalaya, 2014-15). The most prominent pineapple variety grown in the State is Giant Kew, followed by the Queen. In most of the pineapple growing areas of the state, the age-old indigenous cultural practices are still in use. Although the yield is less, these fruits are free from chemical residues as the farmers do not apply any form of chemical fertilizers and pesticides. Traditional pineapple growing areas of Meghalaya have immense potential to be developed into certified organic pineapple producing hubs (Matthew *et al*., 2011).

Ri Bhoi district has the highest area and production among all the districts of Meghalaya covering an area of 3.829 thousand hectares which is 33.32 per cent of the total area of the state during the period 2014-15 and produced 45.40 thousand tonnes constituting 37.39 per cent of the total production of the state with productivity of 11.86 t ha^{-1} which is the third highest in the state after North Garo (18.86 t ha^{-1}) and East Garo Hills (18.44 t ha^{-1}) (Government of Meghalaya, 2014-15). Considering the economic importance of the crop in the region, the present study has been undertaken with the objectives (i) to examine the cost and return structures of pineapple cultivation in Ri Bhoi district of Meghalaya, (ii) to study the financial feasibility of investment in pineapple orchards in the district and (iii) to compare the relative profitability between pineapple and the competing crops.

MATERIALS AND METHODS

The present study is based on primary data collected from the sample farmers belonging to two purposively selected villages of Umling block of Ri Bhoi district of Meghalaya which are also selected purposively. A total of 50 pineapple growers, 25 from each of the two villages are selected following simple random sampling without replacement technique to collect information related to the cost and returns structure using a pre-tested schedule through personal interview method.To measure the cost of cultivation for individual farm, the prime cost concept (Panse and Bokil,1966) has been employed which includes all the variable costs and imputed value of family labour less land revenue and cess. Prime cost of cultivation which is the summation of cost of all variable inputs including family labour minus land revenue and cess is also employed to avoid arbitrariness in estimating imputed rental value of owned land and interest on fixed capital (Mukhopadhyay, 1990). The formal mathematical

Email: balanceswett@gmail.com

statements of discounted measures of project worth are presented as follows:

Net present worth or value (NPW or NPV)

It is simply the present worth of cash flow stream.

NPV = Present value of the benefits - present value of the costs

Internal rate of return

It shows the marginal efficiency of capital or return generating capacity of investment. It is the rate (R) at which the Net Present Worth (NPW) is equal to zero. IRR = Lower discount rate + difference between two discount rates ×

$$\frac{\text{(Present worth of the cash flow at lower discount rate)}}{\text{(absolute difference between the Present worth of the cash flow at two discount rates)}}$$

Benefit cost ratio (B-C Ratio)

This ratio is derived by dividing the present value of benefits by the present value of costs. In fact, this ratio measures the return or benefit per units of cost or investment.

$$\text{B-C ratio} = \frac{\text{Present value of the benefits}}{\text{Present value of the cost}}$$

Average annual return

Average annual return is calculated by dividing the net present value of the pineapple cultivation by annuity factor for the whole life span of the crop.

Payback period

The payback period is the length of time required to recover the initial cash outlay on the project.

$$P = \frac{\text{Investment of the project in rupees}}{\text{Annual cash revenue in rupees}}$$

Simple tabular and percentage method is employed for analysis of data related to the estimation of cost and returns structure to draw meaningful conclusions.

RESULTS AND DISCUSSION

The pineapple cultivation in the study region is carried out in large upland areas or mountains as a mono-crop in jhum abandoned areas without any application of purchased inputs, like insecticides, pesticides, chemical fertilizers, weedicides or growth regulators *etc*. It is a perennial crop with an economic life of 5-7 years, though many of the farmers in the North eastern region cultivate it beyond 12-15 years through crop manipulation and traditional agronomic practices (Darlong *et al., 2006*). But, in the present analysis, the economic life of the plantation has been kept restricted up to 15 years depending on the availability of required information. The farmers of the study region rely fully on locally available farm compost for the supply of nutrients to crops.

Study on the costs and returns structure reveals that the first year, the establishment period accounts for a major share of the total cost amounting ₹1,40,190 ha^{-1} followed by the 9-15 and the 2-8 years of age group with annual average investment to the tune of ₹82,600 ha^{-1} and ₹80,400 ha^{-1}, respectively (Table 1). The average annual cost shows a deceleration trend up to the 8th year and from the 9th year, it moves upward due to the higher cost of maintenance with the aging of the orchard. During first year, the sample farmers have made maximum investment on seedlings which is accounted to be 55 per cent of the total cost. Expenditure towards the payment of human labour appears to be the second highest cost component claiming 34.24 per cent of the total cost. Interest on working capital occupies the third position with a share of 5.42 per cent .The share of compost and miscellaneous in the total cost are accounted to be only 3.57 and 1.78 per cent respectively. From the 2nd up to 8th year, wage payment for human labour is the dominant cost component measuring 56.59 per cent of the average annual expenditure followed by cost of seedlings (26.87%) and subsequently followed by compost (8.71 %). The expenditure on miscellaneous items and interest on working capital are estimated to be 4.55 and 3.29 per cent respectively. Although farmers transplant suckers in the first year, they have to make investment in the subsequent years also because of the fact that every year some suckers die or wilt due to scarcity of water or adverse weather conditions which need to be replaced in every year. In the next sub-period of 9th to 15th year, share of each cost component in the average annual total expenditure is similar to that of previous period, *i.e*., the cost component follow the same pattern as that of the earlier period in terms percentage share in the average annual cost per ha, but with small variations in magnitude. The contribution of human labour to the total cost is observed to be the highest with the share of 54.57 per cent which is marginally lower compared to previous periods, whereas the share of seedling has gone up to 30.87 per cent from 26.87 per cent in the earlier period may be due to increase in the rate of replacement of old plantations by new suckers. The share in total cost was found to be increasing with the age of plants which needs more inputs with the increasing age whereas, the share of land rent was more in initial compared to second and third year and it was due to proportionate cost share increase in other items of total cost with the increase in age of plants (Rymbai *et al*., 2012). The

Table 1: Undiscounted annual average cost of cultivation (₹ ha^{-1} annum^{-1}) of pineapple in Ri Bhoi district of Meghalaya

Age Groups (years)	Seedlings	Compost	Human labour	Interest on working capital	Miscell -aneous	Prime cost annum^{-1}	Total prime cost
1	77100.0 (55.00)	5000.0 (3.57)	48000.0 (34.24)	7594.3 (5.42)	2495.8 (1.78)	140190.0 (100.00)	140190.0
2-8	21600.0 (26.87)	7000.0 (8.71)	45500.0 (56.59)	2645.5 (3.29)	3654.5 (4.55)	80400.0 (100.00)	562800.0
9-15	25500.0 (30.87)	7000.0 (8.47)	45077.5 (54.57)	3006.3 (3.64)	2016.3 (2.44)	82600.0 (100.00)	578200.0
Total Average	**27120.00 (31.75)**	**6866.67 (8.04)**	**45469.50 (53.24)**	**3143.77 (3.68)**	**2812.74 (3.29)**	**85412.67 (100.00)**	**1281190.0**

Note: Figures in parentheses represent the percentage to total

Table 2: Estimation of undiscounted total returns (₹ ha^{-1}) from pineapple cultivation by sample farmers of Ri Bhoi district of Meghalaya

Age group	Main product		By-product		Total return
	Quantity	Value	Quantity	Value	
1	0	0	0	0	0
2	0	0	0	0	0
3	4640	92800	9280	27840	120640
4	6540	130800	13080	39240	170040
5	8110	162200	16220	48660	210860
6	8412	168240	25236	75708	243948
7	9732	194640	29196	87588	282228
8	9,616	192320	28848	86544	278864
9	9194	183880	27582	82746	266626
10	8440	168800	25320	75960	244760
11	8297	165940	16594	49782	215722
12	6240	124800	18720	56160	180960
13	5170	103400	15510	46530	149930
14	4135	82700	12405	37215	119915
15	3826	76520	7652	22956	99476
Average	**7104**	**142080**	**18895.62**	**56686.85**	**198766.8**

contribution of compost to the average annual total cost is found to be the third highest cost component accounting 8.47 per cent and interest on working capital and miscellaneous come next in descending order of their magnitude by claiming 3.64 and 2.44 per cent respectively. Summarily, cost of human labour for performing various cultural operations and the expenditure on seedling are the most dominant cost component in pineapple cultivation in the study region which jointly constitutes about 85 per cent of the total cost of cultivation.

Returns structure of pineapple cultivation shows an increasing trend up to the 7th year after which productivity starts declining to the minimum level of ₹ 99,476 ha^{-1} in the 15th year. The average annual total return realized by the sample farmers is estimated to be ₹ 1,98,766.8 ha^{-1} in which the share from main product i.e, pineapple fruit and by-products *i.e*, suckers used as planting material, are calculated to be ₹ 1,42,080 and ₹ 56,686.85 ha^{-1} respectively (Table 2).

Pineapple being perennial in nature, the flow of costs incurred and returns obtained are estimated by applying techniques of financial appraisal method and are presented in table 3. While static analysis for a given year/period is more appropriate for seasonal and annual crops, perennial crops like rubber require inter-temporal analysis (Rae, 1977). Since the collection of time series data pertaining to single farm holding is difficult, the analysis of the life cycle data was made based on the cross sectional information from rubber holdings of

Table 3: Estimation of discounted costs (₹ ha^{-1}) and returns (₹ ha^{-1}) in cultivation of pineapple in Ri Bhoi district of Meghalaya

Age of orchard	Discounted cost	Discounted return	Discounted net benefit
1	128320.37	0	-128320.37
	(18.13)	(0.00)	
2	67361.72	0	-67361.72
	(9.52)	(0.00)	
3	61658.32	92506.66	30848.33
	(8.71)	(7.38)	(5.66)
4	56437.82	119339.32	62901.5
	(7.98)	(9.53)	(11.54)
5	51659.34	135463.95	83804.61
	(7.30)	(10.81)	(15.37)
6	47285.43	143472.77	96187.33
	(6.68)	(11.45)	(17.64)
7	43281.86	143536.06	100254.2
	(6.12)	(11.46)	(18.39)
8	39617.26	137399.23	97781.96
	(5.60)	(10.97)	(17.94)
9	38878.93	127324.42	88445.5
	(5.49)	(10.16)	(16.22)
10	35587.12	101055.85	65468.74
	(5.03)	(8.07)	(12.01)
11	32574.02	81518.19	48944.17
	(4.60)	(6.51)	(8.98)
12	29816.04	62588.08	32772.04
	(4.21)	(5.00)	(6.01)
13	27291.57	47465.8	20174.23
	(3.86)	(3.79)	(3.70)
14	24980.84	34747.28	9766.44
	(3.53)	(2.77)	(1.79)
15	22865.76	26389.52	3523.77
	(3.23)	(2.11)	(0.65)
Total	**707616.39**	**1252807.12**	**545190.73**
	(100)	**(100)**	**(100)**

Note: Figures in parentheses represent the percentage to total

Table 4: Operation wise distribution of human labour (man days ha^{-1}) for pineapple cultivation by sample farmers in Ri Bhoi district of Meghalaya

Operations	Family labour		Hired labour		Total		Total
	Male	Female	Male	Female	Male	Female	
Land preparation	2	1	38	17	40	18	58
	(5)	(5.56)	(95)	(94.44)	(68.96)	(31.04)	(100)
Planting Suckers	1	1	5	6	6	7	13
	(16.67)	(14.29)	(83.33)	(85.71)	(46.15)	(53.85)	(100)
Compost application	1	2	2	2	3	4	7
	(33.33)	(50)	(66.67)	(50)	(42.86)	(57.14)	(100)
Interculture Operations	1	1	37	31	38	32	70
	(2.63)	(3.13)	(97.37)	(96.87)	(54.29)	(45.71)	(100)
Harvesting	1	2	27	29	28	31	59
	(3.57)	(6.45)	(96.43)	(93.55)	(47.46)	(52.54)	(100)
Total	**6**	**7**	**109**	**85**	**115**	**92**	**207**
					(55.56)	**(44.44)**	**(100)**

Table 5: Economic feasibility and financial viability of investments in pineapple garden, 2016-2017

Parameters	Values
IRR (%)	38.95
B : C	1.77
NPV (₹ ha^{-1})	545190.73
Payback period	4 years 10 months
Average annual net return (₹ ha^{-1})	68637.09

Table 6: Sensitivity analysis for pineapple cultivation in Ri Bhoi district of Meghalaya

Particulars	Percentage	
	10	20
Situation -I: Increase in Cost		
NPV @ 9.25% discount rate	474429.09	403667.45
NPV @11.25% discount rate	391235.13	327679.83
BC ratio @ 9.25 %	1.61	1.48
BC ratio @ 11.25 %	1.56	1.43
IRR (%)	34	30
Average annual net return @9.25% discount rate (₹ ha^{-1})	59728.52	50819.94
Average annual net return @11.25% discount rate (₹ ha^{-1})	55181.26	46217.18
Situation -II: Decrease in Gross Return		
NPV @9.25% discount rate (₹ ha^{-1})	419910.02	294629.31
NPV @11.25% discount rate (₹ ha^{-1})	345756.08	236721.74
BC ratio@ 9.25 %	1.59	1.42
BC ratio@ 11.25 %	1.54	1.37
IRR (%)	34	28
Average annual net return @ 9.25% discount rate (₹ ha^{-1})	52864.81	50819.94
Average annual net return @ 11.25% discount rate (₹ ha^{-1})	48766.73	33388.12

Table 7 : Estimated total cost (₹ ha^{-1}) and total return (₹ ha^{-1}) and net revenue from rice and pineapple cultivation by the sample farmers

Crops	Return (Rice)	Return (Straw)	Total return	Total cost	Net return
Rice	43608.32	17378.76	60987.08	45715.41	15271.68
Pineapple (discounted) at the age of 13th year	—	—	47465.8	27291.57	20174.23

different ages to approximate the entire plantation life cycle (Goswami and Challa, 2007). The costs and returns are discounted at the rate of 9.25 per cent (opportunity cost of capital). It reveals that the discounted cost decreases continuously as expected due to higher initial investment. From third year, after initial two years gestation period, the discounted returns show an increasing trend up to 7th year when the crop reaches the peak bearing period by claiming 11.46 per cent of the total discounted returns and starts declining to attain the lowest level in the 15th years of age. The flow of discounted benefit shows similar trend as that of discounted returns having major share of 18.39 per cent on the 7th year and the least share of 0.65 per cent on the 15th year. The net present worth of the pineapple garden was observed to be ₹ 5,45,190.73 ha^{-1} discounted at the prevailing opportunity cost of capital.

The operational-wise human labour distribution depicted in table 4 discerns that pineapple cultivation requires 207 man days on an average annually calculated over the entire life period in which the participation of male and female labours are accounted to be 55.56 and 44.44 per cent respectively. Intercultural operations has the highest labour absorbing capacity of 70 man days due to huge amount of labour employed in weeding operations, followed by harvesting and land preparation requiring 59 and 58 man days respectively.

Economic feasibility and financial viability of pineapple cultivation

The return out of the investment should generate sufficient income to enable the farmer to continue his farming without losses. To work out the financial feasibility, different criteria have been employed such as benefit-cost ratio (B:C ratio), Net present worth (NPV), internal rate of return (IRR), payback period, average annual return etc (Table 5). It reveals that the net present value of pineapple cultivation representing the series of differences between inflows (costs) and out-flows (returns) shows a positive value of ₹ 5,45,190.73/-. The benefit-cost ratio (BCR) is estimated to be 1.77 indicating benefits which outweigh its cost. The decision rule is that we accept the project if BCR $\geq$ 1, when the cost and benefit streams are discounted at the opportunity cost of capital. Thus, if BCR >1, it implies that pineapple cultivation is profitable, if BCR <1, it implies non-profitability of the investment and if BCR = 1, then the investment breaks even (Gittinger, 1996). IRR is observed to be 38.95 per cent which is much higher than the opportunity cost of the capital, and the payback period is worked out to be 4 years and 10 months and the average annual net return is found out to be ₹ 68,637.09 indicating the farmers has earned high profit from investment in pineapple. All these results indicates that the investment in pineapple being financially feasible and economically viable.

The most common tools used in economic and financial analysis is sensitivity analysis (SA) which enable testing and measurement of the effect of changes in key project variables on the final outcomes of our project, and hence its economic indicators (NPV and IRR). It is frequently used to assess the robustness of projects and their resilience to shock; its outcomes are seldom linked to risk analysis. In other words, the most relevant question at this stage is to know how fluctuation in critical parameters (*e.g.* increases in costs, delays in implementation) will affect project performance, and which of the identified risks is the ones that need close monitoring (IFAD, 2015). It tests percentage increases and decreases in estimated benefits and costs to assess their impact on NPV and IRR, and if the estimated values are still higher than the opportunity cost of the capital, then the investment project is considered viable. This analysis gives us a further understanding of the relationships between input and output variables in the system. Table 6 shows the sensitivity analysis estimated for pineapple cultivation under changed scenario assumed in two discrete situations. The effect of change on financial viability parameters are studied by increasing the flow of costs at 10 and 20 per cent without any change in returns depicted in situation I and under situation II where the flow of returns were decreased by 10 and 20 per cent without any change in cost. Results indicate that the investment on pineapple is viable under both situation since the B:C ratio is more than one, net present values are positive at 9.25 and 11.25 per cent, the internal rate of returns are found to be higher than the opportunity cost of the capital and the average annual net return were profitable in both situations.

Relative profitability between pineapple and the competing crop

Decision regarding choice of cultivation of a crop should be done considering the cost and returns structure, relative profitability and also the availability of investment capital for all the competitive crops. As the study region is characterised by hilly slopes unsuitable for growing seasonal crops, except the low land areas where there is a scope of cultivation of few annual crops, but the scarcity of irrigation water has rendered the area to be mono-cropped *i.e.*, only rice can be taken up in kharif season and that too provides meagre yields resulting rice cultivation non-remunerative. Comparative analysis made between pineapple and the competitive rice crop by selecting 20 rice farmers, 10 from each of the two villages of Umling block following simple random sampling without replacement technique using a pre-tested schedule shows that farmers have earned a net return of ₹15,271.68 ha^{-1} from an investment of ₹ 45,715.41 ha^{-1} which is comparable to the net present value of pineapple cultivation in the 13th year amounting ₹ 20,174.23 ha^{-1} and in the 14th year, it drastically reduced to ₹ 9,766.44 ha^{-1} (Table 7). So the farmers can think of replacement with rice in between 13th and 14th year in the low lying areas, but with great uncertainty or alternatively, they can take the decision to replace the old plantation completely with new one, *i.e.*, the year of replacement of the current plantation may be between 13th and 14th year with existing package of practices.

Pineapple cultivation in Ri Bhoi district of Meghalaya is remunerative in both discounted and undiscounted measures, even the sensitivity results also proves the economic viability and financial feasibility of the investment. But from the qualitative point of view, the product, *i.e.*, pineapple produced indigenously is completely free from chemical residues. So, if the crop is certified as organic and the premium price of organically produced pineapple given as it deserves, then the low yield will be compensated by higher income which will ultimately uplift the living standard of the growers. The other alternative is to increase the productivity of the crop by exploiting the full potentiality of the region following modern crop production

techniques, *i.e*., by applying recommended doses of chemical fertilizers and farm yard manures, plant protection chemicals, chemical growth regulators etc. along with development of marketing facilities supported by credit facilities, establishment of cold storages, development of transport facilities and processing unit, establishment of regulated market or Agricultural Produce Market Committee (APMC) to protect the farmers from the unscrupulous traders practising unfair means. Various government organizations and institutions should come forward with more skill oriented training and awareness programmes exclusively for pineapple growers in the area which would encourage and boost up their confidence in adopting the scientific method of pineapple cultivation (Marak *et al*., 2015). In short, the introduction of suitable agricultural development technology coupled with the development in the infrastructure facilities of the area can help the farmers in adopting the modern pineapple cultivation technology more efficiently and at same time, ensure remunerative prices to growers of pineapple for their produce.

REFERENCES

Darlong, V.T., Hmar, M., Thingreiphi, N.G., Iboyaima M.M., Khanikar, M. and Chakraborty, A. 2006. Package of Organic Practices from Assam, Manipur, Meghalaya and Nagaland for Arecanut, Ginger, Large Cardamom, Passion Fruit and Pineapple. North Eastern Region Community Resource Management Project (NERCORMP). Shillong, pp. 102-15.

Gittinger, J.P. 1996. *Economic Analysis of Agricultural Project*. John Hopkins University Press, Baltimore, 2nd edition, completely revised and expanded.

Goswami, S.N. and Challa, O. 2007. Economic analysis of smallholder rubber plantations in West Garo Hills district of Meghalaya. *Indian J. Agric. Eco*., **62** : 649-63.

Government of Meghalaya 2014-15. *State Level Crop Statistics Report on Kharif Crops*. Directorate of Economics and Statistics, Meghalaya.

IFAD. 2015. Economic and Financial Analysis of rural investment projects, IFDA'S Internal Guidelines, Rome.

Marak, B.R., Bandyopadhyay, A.K. and Lahiri , B. 2015. Adoption of Pineapple Production Technology in West Garo Hills District of Meghalaya. *Indian Res. J. Ext. Edu.*, **15**: 56-59.

Matthew, B., Periera, L.S. and Suresh, C.P. 2011. Pineapple production in Meghalaya (India)-indigenous cultural practices and status. *Acta Hort.*, **902**: 275-80.

Mukhopadhyay, A. 1990. *Crops Costs and Variations – An Investigation Based on Farm Management Studies in India*. Mittal Publications. New Delhi.

Panse,V.G. and Bokil, S.D. 1966. Costs of Cultivation of Some Indian Field Crops. New Delhi. I.C.A.R.

Rae, A.N. 1977. Crop Management Economics, Clowes Ltd. London, pp. 265-68.

Rymbai, D., Singh, R., Feroze, S. M. and Bardoloi, R. 2012. Benefit-Cost Ratio Analysis of Pineapple Orchard in Meghalaya. *Indian J. Hill Farm.*, **25** : 9-12.

Saxena, M., Bhattarcharya, S., Maholtra, S.K., Bhawna, K.M., Singh, R. and Gilotra, P. 2015. *Horticultural Statistics at a Glance*.National Horticultural Board. Gurgaon, Haryana, pp. 189-36.