International Journal of Bio-resource and Stress Management https://pphouse.org/ijbsm.php

Crossref

IJBSM July 2022, 13(7):702-708 Print ISSN 0976-3988 Online ISSN 0976-4038 **Article** AR3004

Research Article *Social Science*

DOI: HTTPS://DOI.ORG/10.23910/1.2022.3004

Profitability, Resource Use Efficiency and Marketing of Potato in East Siang Districts of Arunachal Pradesh, India

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ABSTRACT

The present study was undertaken with a sample size of 90 potato growers of East Siang district of Arunachal Pradesh State, India through stratified random sampling during 2019–20. The cost of cultivation was estimated based on cost concept. Cobb-Douglas production function was used as the better fit over linear form to find out the resource use efficiency of each variable input in potato production process. It was revealed that the total cost of cultivation on small, medium and large farms were ₹ 41604, ₹ 44150 and ₹ 44608 ha^{-1} respectively. Potato cultivation is highly labour intensive, as human labour contributes about 30% in Cost C_3 (total cost). The gross return varied between ₹ 179914 ha^{-1} on large farms and ₹ 117927 ha^{-1} on small farms. The benefit-cost ratio varied between 3.16 to 5.63. There were many problems related to recurrent price fluctuation, high marketing, storage and transportation costs, inadequate storage facilities and lack of competitive marketing. For resource-use efficiency, the ratios of MVP to MFC were greater than one for human labour showing significant under-utilization of this resource and possibility of additional use to achieve the optimal level. Adoption of new production technology with sustained resources utilization can help farmers in minimizing the cost of production. In Arunachal Pradesh, the potato production and marketing can be improved by constructing the cold storage units in rural areas near production points, improving the market intelligence services and to make availability of the reliable information on processing and value addition, through small scale industries, FPOs and cooperatives.

KEYWORDS: Arunachal Pradesh, marketing, potato, profitability, resource use efficiency

***Citation* (VANCOUVER):** Hatai, Profitability, Resource Use Efficiency and Marketing of Potato in East Siang Districts of Arunachal Pradesh, India. *International Journal of Bio-resource and Stress Management,* 2022; 13(7), 702-708. HTTPS://DOI.ORG/10.23910/1.2022.3004.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

RECEIVED on 03rd April 2022 RECEIVED in revised form on 29th June 2022 ACCEPTED in final form on 24th July 2022 PUBLISHED on 31st July 2022

1. INTRODUCTION

Potato is designated as "Food for Future" by FAO because of its high productivity and nutritive value. Potato has been historically the most important vegetable and continues to receive the same status as on date. Potato (*Solanum tuberosum*) possesses all the virtues to be a potential food crop. It produces substantially more edible energy, protein and dry matter per unit area and time than many other crops. Potato is now the world's third most important food crop in terms of human consumption, after wheat and rice. Potato tubers constitute a highly nutritious, wholesome food. Potato plays a very important role in Indian agriculture as it alone contributes about 21% of the area 26% of production under vegetable crops in India. Potatoes are a good source of energy, minerals, proteins, fats and vitamins (Ekin, 2011,Drewnowski and Rehm, 2013, King and Slavin, 2013). FAO declared potato as the crop to address future global food security and poverty alleviation during 2008. Potato is currently grown on an estimated 20 mha of farmland globally, and the potato production worldwide stands for 366 mt(Anonymous, 2020). India produced 48.6 mt of potato and ranked second in the world, only after China(99.2 mt). The productivity in India is higher than in China and Russia, the third largest potato producer (Anonymous, 2008).

Potato is a food security crop in the current global food system (Devauxetal., 2021, Haverkort and Struik,2015). Sustainable potato production and efficient use of resources will require adjustments and redesigns of the current cropping and processing systems (Andrivon, 2017). Potato is a profitable enterprise in spite of high capital requirement (Verma and Rajput, 2002). Cultivation of high yielding variety is more profitable for potato growers (Singh and Kishore, 1997). Unless prices are fixed above production costs, it may not be possible to meaningfully improve potato production (Naik and Patnaik, 1986).

Potato is a high yield potential and nutritionally superior crop(Kochetal., 2020). It could help in banishing hunger, malnutrition, more specifically in the developing and under developed countries. Its cultivation is one of the alternatives for the diversification of agriculture and development of agro-processing industries. Potato plays a significant role in the agriculture economy (Sinha and Singh, 2019). In Arunachal Pradesh, Potato is one of the important vegetable crops covering an area of 6200 ha. with a production of 44950 mt (2019-20). In East Siang district, it occupies an area of 790 ha with 16.28 per cent of state production (2018-19).

Sustainable agri-food system includes productivity, agricultural income, human wellbeing and environmental sustainability (Smith et al., 2017, Wu et al., 2018). Adoption of new production technology with sustained resources utilization can help farmers in minimizing the cost of production of potato. The value chain fragmentation, price volatility, quality and quantity losses and low levels of processing that characterize the market for horticultural crops in India (Gulati et. al., 2022). New paradigm and challenges are needed for potato growers of Arunachal Pradesh in solving the problems like recurrent price fluctuation, high marketing, storage and transportation cost, non-availability of adequate storage facilities, post-harvest losses and lack of competitive marketing system. In keeping with the preferences of consumers, a greater variety of appealing potato products have been developed, including potato steamed bread, potato noodles and flour (Su and Wang, 2019). Keeping the view of importance of State's economy, this effort has been made for which the main objectives of the study are profitability, resource use efficiency and marketing of potato in East Siang Districts of Arunachal Pradesh.

2. MATERIALS AND METHODS

The present study was undertaken with a sample of 90 potato growers comprising 40 small (<2 ha), 30 medium (2–4 ha) and 20 large (>4 ha) farmers from twelve villages of three CD blocks namely, Paighat, Mebo, and Ruksin of East Siang district, Arunachal Pradesh, India through stratified random sampling method. Besides, 12 traders and 18 retailers in Pasighat market were also randomly chosen. Data pertaining to the agricultural year 2019–20 was considered with specific objectives. On the basis of the different cost concepts of CACP, Govt. of India (Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1, Cost C_2,Cost C_2 and Cost C_3), the cost of cultivation has been estimated. The net returns over different cost concepts have been estimated as the difference between the gross return and particular cost. The benefit-cost ratios over different cost concepts were calculated by dividing the gross return by a particular cost., Simple percentage, average, percentage of multiple responses for constraints faced by potato growers and appropriate formulae as per methodology was used to analyze the collected primary data.

2.1. Cost concepts

To work out the costs and returns of potato production, cost concept recommended by the Commission for Agricultural Costs and Prices (CACP) was used *viz.*, Cost A_1, Cost A_2, Cost B_1, Cost B_2, Cost C_1, Cost C_2 and Cost C_3wasused.

Cost A_1 :Value of hired human labour+Attached labour, Value of owned and hired bullock labour+charges on owned and hired machinery+Value of seed (both farm produced and purchased)+Value of owned and purchased manures+value of fertilizers+value of plant protection chemicals used+

depreciations+ repairs and maintenance of farm machinery and farm implements and farm buildings+land revenue, cesses+interest on working capital.

Cost A_2 :Cost A_1+Rent paid on leased in land.

Cost B_1 : Cost A_2+Imputed interest on owned fixed capital excluding land.

Cost B_2 :Cost B_1+Rental value of owned land (less land revenue) and 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 % of Cost C_2 as management of cost

2.2. Cobb–Douglas production function

Based on the significance of the results, the Cobb-Douglas production function was used as the better fit over linear form to find out the resource use efficiency of each variable input in potato production process:

$Y=a\pi x^{bi}e^{ui}$……(1)

Where, Y=Yield of potato in quintals ha^{-1}

a=intercept

Π=multiplication symbol

X_1=Hired human labour in man days ha^{-1}

X_2=Seed in ₹ ha^{-1}

X_3=Fertilizers in ₹ ha^{-1}

X_4=Plant protection measures in ₹ ha^{-1}

X_5=Irrigation in ₹ ha^{-1}

u=Error term or disturbance term

b_i=Regression coefficient of the i^{th} variable

e=Napier base i.e. 2.718

On the basis of marginal value productivity (MVP), the resource use efficiency was judged. It is imperative to study efficient resource allocation in agricultural production from the viewpoint of the national use of scarce resources and maximization of farm income. The MVP of the i^{th} input was worked out by using the following formula:

$MVP=b_i (\bar{Y}/\bar{X}_i)P_y$……(2)

Where, Y=Geometric mean of yield of potato ha^{-1}

X_i=Geometric mean level of i^{th} resources

b_i=Production elasticity of i^{th} input

P_y=Price of the product

2.3. Marketing costs

These include all the marketing charges from local assembling to retailing in the marketing process. Marketing costs limit the income of the farmers, affect the cost of living of consumers and define the margins and profits of the marketing agencies.

The total cost incurred on marketing either in cash or in kind by the producer, seller and by the various intermediaries involved in the sale and purchase of the commodity reaches the ultimate consumer.

$C=CF++CM_1+CM_2+CM_3+…..++CM_n$

Where, C = Total cost of marketing of commodity

CF=Cost paid by the producer

CM_i=Cost incurred by the ith middleman in the process of buying and selling the product.

3. RESULTS AND DISCUSSION

3.1. Cost of cultivation of potato

The total cost of cultivation (C_3) was highest on large farms (Table 1). It was due to use of more inputs and higher expenses on labour, seed material, fertilizer and plant protection measures by contract potato cultivations. The total cost of cultivation on small, medium and large farms were ₹ 41604, ₹ 44150 and ₹ 44608 ha^{-1} respectively. Potato cultivation is highly labour intensive, as human labour contributes about 30%. The gross return varied between ₹ 179914 ha^{-1} on large farms and ₹ 117927 ha^{-1} on small farms (Table 2). The productivity and average price received by large farmers were also the highest. The net return in potato cultivation over Cost C_2 was ₹ 32432 and ₹ 28499 over Cost C_3. The benefit cost ratio varied between 3.16–5.63, while it was 3.57–5.35 on overall farm category wise estimation.

3.2. Resource use efficiency

It was observed that on all categories of farm sizes the ratios of MVP to MFC were greater than one for human labour showing significant under-utilization of this resource and possibility of additional use to achieve the optimal level (Table 3). This indicates that by spending an extra rupee on human labour the farmer, on average, will be able to generate additional returns worth ₹ 2.46. In the case of medium farms, the MVP:MFC ratio for fertilizer use was less than unity implying its uneconomic use. The ratios were negative for seed and plant protection on large farms suggesting curtailing their excessive use. Over all, the uses of variable inputs were being expanded to generate higher level of returns.

3.3. Marketing of potato

About 35% of produce was directly sold to the retailer by potato growers. The small farmers sold about 6% of potato to the processor directly (Table 4). The processing units used to make papad, chips, flakes and potato floor etc. in small units for local consumption. The disposal of potato through wholesalers were accounted for about 75, 57, 45% of production on small, medium and large farms in the

Table 1: Farm category-wise cost of cultivation of potato in East Siang District of Arunachal Pradesh (` ha^{-1})

Cost items	Small	Medium	Large	Overall
1. Human labour				
a. Hired	7625 (18.33)	8872 (20.10)	10204 (22.88)	8817 (20.38)
b. Family	5748 (1381)	4682 (10.60)	3012 (6.75)	4552 (10.52)
2. Machine labour	2862 (6.88)	2540 (5.75)	2484 (5.57)	2650 (6.12)
3. Seed (Vegetative Planting Material)	4595 (11.04)	4721 (10.69)	5272 (11.82)	4854 (11.22)
4.FYM	387 (0.93)	305 (0.69)	312 (0.70)	340 (0.78)
5. Fertilizers	4426 (10.64)	4985 (11.29)	4601 (10.31)	4633 (10.71)
6. Plant protection	4850 (11.66)	5696 (12.90)	5876 (13.17)	5417 (12.52)
7. Irrigation	542 (1.30)	628 (1.42)	705 (1.58)	619 (1.43)
8. Interest on working capital	1402 (3.37)	1684 (3.82)	1842 (4.13)	1624 (3.75)
9. Mis.expenditure	16 (0.04)	18 (0.04)	22 (0.04)	18 (0.04)
10.Rental value of owned land	4864 (11.69)	5072 (11.49)	5162 (11.57)	5018 (11.60)
11. Rent paid for leased in land	125 (0.30)	465 (1.05)	524 (1.17)	348 (0.80)
12. Land, revenue cesses and taxes	-	-	-	-
13. Depreciation on farm implements and farm building	72 (0.17)	77 (0.17)	87 (0.19)	78 (0.18)
14. Interest on fixed capital	308 (0.74)	392 (0.88)	450 (1.01)	378 (0.87)
Cost A_1	26777 (64.36)	29526 (66.88)	31405 (70.40)	29050 (67.14)
Cost A_2	26902 (64.66)	29991 (67.93)	31929 (71.58)	29398 (67.92)
Cost B_1	27085 (65.10)	29918 (67.76)	31855 (71.41)	29428 (68.01)
Cost B_2	32074 (77.09)	35455 (80.30)	37541 (84.16)	34794 (80.41)
Cost C_1	32833 (78.92)	34600 (78.37)	34867 (78.16)	33980 (78.53)
Cost C_2	37822 (90.91)	40137 (90.91)	40553 (90.91)	39336 (90.91)
Cost C_3	41604 (100.00)	44150 (100.00)	44608 (100.10)	43269 (100.00)

Figures in parentheses indicate the % to the Cost C3; 1 US$= ` 71.27 in January, 2020

marketing channel of Producer-Processor-Wholesaler-Retailer – Consumer.

The price received by the farmer was the highest ₹ 2.54 kg^{-1} when potato was directly sold to consumer and the lowest ₹ 1.50 kg^{-1} for the sale through retailer. The marketing cost incurred by sample potato growers for the sale through wholesaler, processor, consumer and retailer were ₹ 0.88, ₹ 0.82, ₹ 0.40 and ₹ 0.08 kg^{-1} respectively. However, the net price received by the sample farmer was highest when directly sold to consumers (₹ 2.14 kg^{-1}).

3.4. Constraints in production and marketing

About 85% of the farmers were facing the problem of infestation of potato crop by Epilachna beetle and Late Blight diseases (*Phytophthora infestance*). About 60% of potato growers even complained about the high cost of inputs. Overall, about 42% of the farmers were concerned with the poor quality of pesticides and facing the scarcity of labour force during peak period of potato production (<10%). Lack of sufficient number of cold storage capacity in that area compelled the farmers to sell their produce soon after harvest. Low price in the wholesale market, seasonal fluctuation in prices due to irregular supply were unique feature of marketing problem faced by potato growers of the study area (Table 5). Usually, efficient marketing provides higher return to producer and greater satisfaction to the consumer by way of reduction in marketing cost. Farmers experience very difficulties to dispose their produce at remunerative price during the glut situation in the market. High transportation, grading, bagging and storage costs in the retailer market created major marketing problems. Hence, they could sell only small amount of production to retailers. It was observed that large potato growing farmers were more reluctant for direct sale to the consumer due to lack of labour and longer period of requirement for marketing of their produce as compared to medium and small farmers.

Table 2: Farm category-wise estimation of net return and benefit-cost ratio of potato

Particulars	Small	Medium	Large	Overall
Area (ha farm^{-1})	0.56	0.88	1.94	1.10
Yield (kg ha^{-1})	24215	27547	29886	27216
Price (₹ kg^{-1})	4.87	5.95	6.02	5.61
Gross return (₹ ha^{-1})	117927	163905	179914	152682
a. Net returns (₹ ha^{-1}) over				
Cost A_1	37205	43690	49164	42718
Cost A_2	37080	43225	48604	42370
Cost B_1	36897	43298	48714	42340
Cost B_2	31908	37761	43028	36974
Cost C_1	31149	38616	45702	37788
Cost C_2	26160	33079	40016	32432
Cost C_3	22378	29066	35961	28499
b. Benefit-Cost ratio over				
Cost A_1	3.16	3.75	3.65	3.57
Cost A_2	3.18	3.78	3.70	3.60
Cost B_1	3.19	3.78	3.69	3.60
Cost B_2	3.69	4.34	4.18	4.12
Cost C_1	3.78	4.24	3.93	4.04
Cost C_2	4.50	4.95	4.49	4.70
Cost C_3	5.26	5.63	5.00	5.35

1 US$=₹ 71.27

Table 3: The MVP and MFC of important inputs for potato cultivation of sample farms in East Siang District

Particulars	HL	S (PM)	F	PP	I
1. Small					
MVP (₹)	184.62**	6.21**	7.48*	7.82	7.11*
MFC (₹)	60	1.0	1.0	1.0	1.0
MVP/MFC	3.07	6.21	7.48	7.82	7.11
2. Medium					
MVP (₹)	137.88**	1.53	0.72	6.56	-7.29
MFC (₹)	60	1.0	1.0	1.0	1.0
MVP/MFC	2.29	1.53	0.72	6.56	-7.29
3. Large					
MVP (₹)	175.14**	-1.97	1.64	-1.92	1.36
MFC (`)	60	1.0	1.0	1.0	1.0
MVP/MFC	2.91	-1.97	1.64	-1.92	1.36
4. Overall					
MVP (₹)	148.05**	-0.56	1.86*	0.77	1.42
MFC (₹)	60	1.0	1.0	1.0	1.0
MVP/MFC	2.46	-0.56	1.86	0.77	1.42

HL: Human Labour (X_1); S(PM): Seed (Planting Material) (X_2); F: Fertilizer (X_3); PP: Plant Protection (X_4); I: Irrigation (X_5); **: p=0.01%; *: p=0.05%

Table 4: Disposal trend and prices of Potato in different categories of sample farms in East Siang District

Marketing	Small				Medium				Large				Over all			
	Q	PR	MC	NP	Q	PR	MC	NP	Q	PR	MC	NP	Q	PR	MC	NP
Processor	1811 (5.72)	1.44	0.09	1.35	1286 (3.94)	1.52	0.7	1.45	1022 (3.00)	1.57	0.08	1.49	1408 (4.30)	1.50	0.08	1.42
Wholesaler	23750 (75.00)	2.05	0.94	1.11	18672 (57.27)	2.24	0.87	1.37	15248 (44.75)	2.32	0.82	1.50	19562 (59.78)	2.19	0.88	1.31
Retailer	5642 (17.81)	1.92	0.86	1.06	12265 (37.62)	2.01	0.81	1.20	17500 (51.36)	2.14	0.78	1.36	11360 (34.72)	2.02	0.82	1.20
Consumer	467 (1.47)	2.38	0.42	1.96	382 (1.17)	2.56	0.39	2.17	304 (0.89)	2.72	0.37	2.35	390 (1.20)	2.54	0.40	2.14
Total	31670 (100.00)	1.87	0.85	1.02	32605 (100.00)	1.95	0.62	1.33	34074 (100.00)	2.02	0.54	1.48	32720 (100.00)	1.94	0.69	1.25

(Figures in parentheses indicates the proportion of the produce disposed by various agencies); Q: Quantity sold (kg ha^{-1}), PR: Price received by the farmer (₹ kg^{-1}); MC: Marketing cost (₹ kg^{-1}), NP: Net Price received (₹ kg^{-1}); 1 US$= ₹ 71.27

Table 5: Production and marketing constraints faced by sample potato growers in East Siang District (% Multiple response)

Particulars	Small	Medium	Large	Overall
Production constraints				
High infestation by pest & disease	78.53	86.65	94.22	85.92
High cost of inputs	70.02	64.30	55.70	63.72
Scarcity of labour	9.84	5.44	6.12	7.42
Poor quality plant protection chemical	40.76	45.87	42.48	42.70
Marketing constraints				
1. Processor				
Delay in payments	7.25	16.87	24.46	15.55
Rejection of produce	30.42	43.06	57.18	42.71
Compulsory weight cut	20.64	27.74	25.05	24.00
Long weight at the gate	15.45	21.33	26.74	20.78
2. Wholesaler				
Low in the market price	78.14	69.50	62.47	70.61
Congestion in the market	24.62	15.00	18.54	20.02
High marketing cost	16.94	13.66	10.85	14.04
3. Retailer				
High transportation cost	16.72	12.97	9.88	14.10
Handling, bagging and storage cost	10.11	14.25	13.65	12.40
4. Consumer				
Shortage of labour force	6.24	22.62	40.75	22.11
Longer time required	12.44	20.60	24.32	20.20

4. CONCLUSION

The productivity and average price received by large farmers were highest in all categories of farm sizes. The net price received by the sample farmer was highest when directly sold to consumers. Potato production and marketing can be improved by providing adequate short-term credit facilities through PACS, constructing the cold storage units in rural areas, formation of FPOs and by improving the market intelligence services. Potato growers should be educated and encouraged for contract farming in order to hedge risk.

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