

Economics of Cabbage Cultivation and Post-harvest Losses in Phek District of Nagaland

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ABSTRACT

The study was undertaken during 2015-16 on cabbage cultivation in Chizami block, Phek district in Nagaland to identify the economics of production of cabbage and to estimate post harvest losses. With the region being high in altitude, with remote access, and tribal farmers engaged in organic farming, it was crucial to scientifically study the cabbage farming enterprises. Two stage sampling technique was employed to sample farmers from three villages and information were gathered by using a structured interview schedule. From the study it was found that the average yield was 154.27 quintal per hectare, and the total cost per hectare was ₹ 75,615.58. The cost component, cost A for marginal and small farmers was ₹ 51,087.41 and ₹ 55,312.42 per hectare respectively and ₹ 58,365.95 per hectare for medium farmers. Post harvest loss at farmer's field was 17.14 per cent for medium farmers and the losses for small and marginal farmers were lower at 14.20 and 11.94 per cent respectively. The ratio of return per rupee invested (RPR) ranged from 1.75 in medium to 1.96 with marginal farmers. In case of post-harvest loss of cabbage, a purposive sampling of 10 retailers and 5 wholesalers revealed the loss percentage at 25.37 per cent at retail level and 15.86 per cent at wholesalers point. Major constraints faced by farmers were lack of knowledge about plant protection measures, storage facilities and limited working capital. Traders of cabbage and other vegetables in the block reported lack of cold storage facilities, transportation facility and improper handling of produce as the major constraints.

Keywords: Tribes, cabbage, yield, post-harvest loss, cost concept, return, constraints

In Indian agriculture, vegetable is an important component as traditionally a significant population is vegetable-liking or many being strictly vegetarian. The soil and agro-climatic conditions in India is very suitable for growing varieties of fruits and vegetables throughout the year. Apart from fruits, vegetables are the only protective food supplying all the nutrients and crude-fibres. The statistics shows that area under vegetable cultivation in the country has increased from 5593 thousand hectares in 1991-92 to 8495 thousand hectares in 2010-11 and the demand of vegetables is expected to be 225 million tonnes by 2020 and 350 million tonnes by 2030 (IIVR 2013). Regarding cabbage cultivation, India ranked second in the world in 2016 with an area of 386 thousand hectares and production was 8585 thousand metric tonnes (Statistical Handbook

of Nagaland, 2015). The fresh cabbage leaves possess chemical composition which are water, proteins, vitamins A, B1, B2, C, and vital minerals like calcium, sodium, potassium, phosphorus, fibre, carbohydrates etc.

Table 1: State-wise area, production and productivity of cabbage in India (2014-15)

State	Area (000' ha)	Production (000' t)	Productivity (t/ha)
Andaman and Nicobar Islands	0.1	0.7	6.7
Andhra Pradesh	1.8	34.5	19.0
Arunachal Pradesh	0.5	12.0	24.0
Assam	32.2	673.4	20.9
Bihar	39.0	695.3	17.8
Chhattisgarh	19.5	0.7	18.4

Gujarat	30.0	695.3	21.8
Haryana	16.7	256.2	15.4
Himachal Pradesh	4.4	149.7	34.1
Jammu and Kashmir	2.5	73.2	29.4
Jharkhand	30.5	476.0	15.6
Karnataka	10.4	216.6	20.8
Kerala	1.0	14.3	14.4
Madhya Pradesh	20.5	606.0	29.6
Maharashtra	8.9	180.6	20.4
Manipur	7.6	90.7	11.9
West Bengal	78.6	2207.2	28.1
Uttarakhand	6.4	75.0	11.7
Nagaland	8.1	162.0	20.0
Odisha	40.7	1143.9	28.1
Punjab	5.6	97.8	17.6
Rajasthan	3.3	19.0	5.8
Sikkim	1.2	7.3	6.1
Tamil Nadu	1.1	62.7	55.9
Telangana	3.9	58.7	15.0
Uttar Pradesh	2.4	82.1	34.9
India	385.6	8584.8	22.3

Source: Ministry of Agriculture and Farmers Welfare, Govt. of India, 2014-15

Table 2: District-wise area, production and productivity of cabbage in Nagaland (2015)

District	Area (000' ha)	Production (000' t)	Productivity (t/ha)
Kohima	0.778	15.137	19.456
Wokha	0.769	15.053	19.575
Zunheboto	0.649	13.857	21.351
Phek	1.281	20.177	15.751
Dimapur	0.723	14.595	20.187
Peren	0.704	14.405	20.462
Tuensang	0.674	14.104	20.926
Mon	0.598	13.347	22.319
Kiphire	0.625	13.600	21.760
Mokokchung	0.702	14.387	20.494
Longleng	0.597	13.338	22.342
Nagaland	8.1	162.0	20.0

Source: Ministry of Agriculture and Farmers Welfare, Govt. of India, 2014-15

Cabbage (*Brassica oleracea var capitata* L) belongs to the family *Cruciferae* and is one of the oldest cultivated and most popular temperate vegetables. However, the extremely perishable nature of the vegetables push the producers to face problems in marketability. At various stages of post harvest

activities, a large proportion of about 25% of vegetables are lost or spoiled (Sharma and Singh, 2011).

The importance of vegetables in India's growing economy is well acknowledged with the rising domestic demand and rise in per capital income, their increasing export potential and their potential for providing food security and livelihood opportunities to the rural people. However, the vegetables face tremendous uncertainties in production, storage and marketing on several counts. At various stages of post harvest activities, a large proportion of vegetables get spoilt.

The current study on economics of cabbage cultivation and post-harvest losses was done in Chizami block, Phek district of Nagaland during the year 2015-16. The north eastern state of Nagaland is a hilly region with sparse population distribution faced with immense challenges on account of weather, low per capita income, poor infrastructure, regular blockades and poor market set up.

Phek district is the highest altitude region of the state with great potential for growing various horticultural crops, vegetables and fruits. The local Chakhesang and Pochury tribes of the district organically cultivate many vegetables and fruits and cabbage cultivation has a major role in sustainable livelihood of the region. The major vegetables and fruits produced in the district were potato (12890 t); tapioca (2830 t); colocasia (5320); pineapple (9189 t); cabbage (20177 t); chilli (4123 t); papaya (1651 t) and banana (9867 t) during 2013-14 (Statistical Handbook of Nagaland, 2014).

Recent reports of poor marketing facility for cabbage growers that lead to widely fluctuating prices of the produce and resulting in farmer's agitation justifies a thorough study and policy formulation. The district-wise area and production of cabbage in Nagaland is presented in Table 2. With this view, an effort has been made in this study to examine the economics of cabbage cultivation and post harvest losses in Phek district of Nagaland.

Database and Methodology

The study on economics of cabbage cultivation was conducted in Chizami block of Phek district in 2015-16. Two stage sampling technique was used to obtain representative sample of 3 villages

and 15 randomly selected cabbage farmers from each sample village. Altogether 45 farmers for studying economics and 5 wholesalers and 10 retailers were selected purposively from the block for studying post harvest losses. Three villages from Chizami block were Zhavame, Tsüpfüme and Zelome. The respondents were interviewed using structured interview schedule. The farmers sampled were categorized into different farm size groups, marginal (< 1 ha), small (1 – 2 ha) and medium farmers (2 – 5 ha).

The cost of cultivation of cabbage was estimated by using different cost concepts such as farm management cost concept, cost in terms of variable cost and fixed cost (Meena *et al.* 2016 and Sureshkumar *et al.* 2014). Different farm management cost concepts have been described as follows:

Cost A_1 = Actual paid out cost incurred by farmer that includes both cash and kind expenditure involving (i) Human labour a) Hired labour and b) Hired bullock (ii) Planting material viz., seed (iii) Transportation cost (iv) Interest on working capital

Cost A_2 = Cost A_1 + Rent paid for leased-in land.

Cost B_1 = Cost A_2 + Interest on owned capital assets excluding land.

Cost B_2 = Cost B_1 + Rental value of owned land and of leased 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 = 10 per cent over and above Cost C_2 on account of managerial function

Cost of production = (Cost of cultivation/ha)/ (Quantity of main product (q)/ha)

The value of the farm produce is discussed below as returns income (₹/ha) from the cabbage farm enterprises assuming full marketable surplus at field level.

(a) Gross income (₹/ha) (GI) = ($Q_m \times P_m$)

where, Q_m = Quantity of main product (q/ha); and P_m = Price of main product (₹/q)

(b) Returns over variable cost (RVC) = Gross income – Cost A_1

(c) Farm business income (FBI) = Gross income – Cost A_2

(d) Family labour income (FLI) = Gross income – Cost B_2

(e) Net income (NI) = Gross income – Cost C_2

(f) Returns to management (RTM) = Gross income – Cost C_3

(g) Returns per rupee (RPR) = (Gross income/ha)/ (Cost C_2 /ha)

For the assessment of post-harvest losses, Egyir method (2008) was used to evaluate the losses incurred in cabbage cultivation. Egyir *et al.* (2008) method of estimating post harvest losses was:

$$\%TQ_L = Q/TQ \times 100$$

Where, $\%TQ_L$ = percentage post harvest loss; Q= mean quantity lost; TQ = Total quantity produced

RESULTS AND DISCUSSION

Table 3 presents the distribution of sample respondents by size of land holding. Table- 4 shows the cost of cultivation across various categories of cabbage farmers in Chizami block. It was observed that the average cost of cultivation per hectare was ₹ 75,615.58 (Table 4). Amongst all the inputs items, the transportation cost constituted the highest (32.49%) followed by hired human labour (26.87%), family labour (23.33%), planting material (7.51 %) and interest on working capital (5.76%) respectively. Out of the total cost, share of variable cost and fixed cost was found to be 95.96 per cent and 4.04 per cent respectively. Among fixed cost, depreciation of implements was the most important cost item. It is also found that per hectare cost of production of cabbage were ₹ 73,469.45, ₹ 75,408.90 and ₹ 77,967.47 for marginal, small and medium farms respectively.

Table 3: Distribution of sample respondents by size of holding (ha)

Farm size holding group	Land holding size (ha)	No. of selected farmers	Average yield (q/ha)
Marginal	Less than 1.00	18	158.33
Small	1.01-2.00	21	154.49
Medium	2.01 – 5.00	6	150.00
Overall	—	45	154.27

Table 4: Cost of cultivation of cabbage by size of holding

(in ₹/ha)

Sl. No.	Particulars	Farm Size Group			
		Marginal	Small	Medium	Weighted Average
Variable Costs (₹/ha)					
1	Transportation Cost	21280.27 (28.96)	24550.15 (32.56)	27880.08 (35.76)	24570.17 (32.49)
2.(a)	Hired Labour	20101.76 (27.36)	20782.71 (27.56)	20065.68 (31.50)	20316.72 (26.87)
2.(b)	Family Labour	19286.89 (26.25)	17043.01 (22.60)	16590.13 (21.28)	17640.01 (23.33)
3	Planting material	5482.98 (7.46)	5638.23 (7.48)	5922.83 (7.59)	5681.35 (7.51)
4	Interest on working capital	4222.40 (5.75)	4341.33 (5.75)	4497.36 (5.77)	4353.72 (5.76)
	Total Variable Costs (TVC)	70374.40 (95.78)	72355.43 (95.95)	74956.08 (96.14)	72561.94 (95.96)
Fixed Costs (₹/ha)					
1	Depreciation on fixed assets	2920.80 (3.98)	2880.63 (3.82)	2840.93 (3.64)	2880.79 (3.81)
2	Interest on fixed assets	175.25 (0.24)	172.84 (0.23)	170.46 (0.22)	172.85 (0.23)
	Total Fixed Cost (TFC)	3096.05 (4.22)	3053.47 (4.05)	3011.39 (3.86)	3053.64 (4.04)
	Total Cost (TVC+TFC)	73469.45 (100.00)	75408.90 (100.00)	77967.47 (100.00)	75615.58 (100.00)

Note: Figure in the parenthesis indicates percentage in total

Table 5: Different cost concepts of cabbage by size of holding (₹ /ha)

Sl. No.	Particulars	Farm Size Holding Group			
		Marginal	Small	Medium	Weighted average
1	Cost A ₁	54008.21	58193.05	61206.88	57802.75
2	Cost A ₂	54008.21	58193.05	61206.88	57802.75
3	Cost B ₁	54183.46	58365.89	61377.34	57975.60
4	Cost B ₂	54183.46	58365.89	61377.34	57975.60
5	Cost C ₁	73470.35	75408.90	77967.47	75615.61
6	Cost C ₂	73470.35	75408.90	77967.47	75615.61
7	Cost C ₃	80817.39	82949.79	85764.22	83177.13

It was observed that Cost A₁ was ₹ 54008.21 in marginal, ₹ 58193.05 in small and ₹ 61206.88 in medium farms (Table 5). The cost A was found out to be the highest in medium and lowest in marginal. However, Cost A₂ is same as Cost A₁ because the practice of leased-in land is not common in Phek. The cost B₁ with the inclusion of interest of own capital asset (excluding land) to Cost A was found to be highest in medium (₹ 61377.34) and lowest in marginal (₹ 54183.46) farm. Cost B for small was ₹ 58365.89 and the average Cost B was ₹ 57975.60 per hectare. Component of cost B₂ that included rental value of own land, though relevant for the study, was not taken into account because of land holding in this region is village or community based and is unique. The Cost C₁ per hectare was addition of imputed value of family labour to cost B, resulting in ₹ 73470.35, ₹ 75408.90 and ₹ 77967.47 per hectare

for marginal, small and medium farms respectively. Cost C₂ was same as cost C₁ owing to Cost B₁ and Cost B₂. The Cost C₃ included managerial function performed by the farmers over Cost C₂ (@10%). For marginal, small and medium farms cost C₃ was ₹ 80817.39, ₹ 82949.79 and ₹ 85764.22 per hectare respectively. From Table 4, it was observed that variable cost was maximum (~70%) and other costs were nominal and limited to about 30% of the total cost.

Average yield of cabbage per hectare was found to be 158.33 q, 154.49 q and 150 q for marginal, small and medium farms respectively (Table 6). The market price of cabbage in the study area was on an average of ₹ 1,000 per quintal. The RVC and FBI were observed to be ₹ 104321.79, ₹ 96296.95 and ₹ 88793.12 per hectare for marginal, small and medium farms respectively. The family labour

Table 6: Yield (q/ha) and income (₹ /ha) by size of holding

Sl. No.	Particulars	Farm Size Holding Group			
		Marginal	Small	Medium	Weighted average
1	Yield (q/ha)	158.33	154.49	150.00	154.27
2	GI	158330.00	154490.00	150000.00	154270.00
3	RVC	104321.79	96296.95	88793.12	96467.25
4	FBI	104321.79	96296.95	88793.12	96467.25
5	FLI	104146.54	96124.11	88622.66	96294.40
6	Net Income	84859.65	79081.10	72032.53	78654.39
7	RTM	77512.61	71540.21	64235.78	71092.87

Table 7: Net returns by size of holding (₹ /ha)

Sl. No.	Particulars	Farm Size Holding Group			
		Marginal	Small	Medium	Weighted average
1	Cost A ₁	104321.79	96296.95	88793.12	96467.25
2	Cost A ₂	104321.79	96296.95	88793.12	96467.25
3	Cost B ₁	104146.54	96124.11	88622.66	96294.40
4	Cost B ₂	104146.54	96124.11	88622.66	96294.40
5	Cost C ₁	84859.65	79081.10	72032.53	78654.39
6	Cost C ₂	84859.65	79081.10	72032.53	78654.39
7	Cost C ₃	77512.61	71540.21	64235.78	71092.87

Table 8: Cost of production of cabbage by size of holdings (₹ /quintal)

Sl. No.	Particulars	Farm Size Holding Group			
		Marginal	Small	Medium	Weighted average
1	Cost A ₁	341.11	376.68	408.05	374.69
2	Cost A ₂	341.11	376.68	408.05	374.69
3.	Cost B ₁	342.22	377.80	409.18	375.81
4	Cost B ₂	342.22	377.80	409.18	375.81
5	Cost C ₁	464.03	488.12	519.78	490.15
6	Cost C ₂	464.03	488.12	519.78	490.15
7	Cost C ₃	510.44	536.93	571.76	539.17

income per hectare was ₹ 104146.54, ₹ 96124.11 and ₹ 88622.66 for marginal, small and medium farms respectively. This shows that all the group of farmer had utilized more hired labour than that of owned family labour for the cultivation of cabbage; however the proportion of family labour to total labour cost was 0.490, 0.451 and 0.453 for marginal, small and medium farms respectively. The net income per hectare was highest in marginal (₹ 84859.65) and lowest in medium (₹ 72032.53) farms. The net return for small farms was ₹ 79081.10.

Net returns per hectare over different cost components for three land holding sizes are presented in Table 7. Similarly, the cost of production

of cabbage in Phek district has been computed and presented in Table 8. Marginal farmers were observed to be producing cabbage at a cost of ₹ 510.44 per quintal, whereas it was ₹ 571 for medium farmers group.

Table 9 presents the return per rupee (RPR) of investment in cabbage cultivation. The ratio (RPR) ranged from 1.75 in medium to 1.96 with marginal farms. The benefit cost ratio over variable cost per hectare was 2.16, 2.05 and 1.92 for marginal, small and medium farms respectively.

The level of spoilage reported by the farmers, retailers and wholesalers is shown in Table 10. The total estimated losses at each farm size categories

Table 9: Returns per rupee (RPR) of investment in cabbage cultivation

Sl. No.	Particulars	Farm Size holding Group			
		Marginal	Small	Medium	Weighted average
1	Cost A ₁	2.93	2.65	2.45	2.67
2	Cost A ₂	2.93	2.65	2.45	2.67
3	Cost B ₁	2.92	2.65	2.44	2.66
4	Cost B ₂	2.92	2.65	2.44	2.66
5	Cost C ₁	2.16	2.05	1.92	2.04
6	Cost C ₂	2.16	2.05	1.92	2.04
7	Cost C ₃	1.96	1.86	1.75	1.85

Table 10: Post harvest losses at farmer's field and market level

Sl. No.	Particulars	Quantity produced/procured (q)	Estimated loss (q)	Cost (₹/q)	Loss (%)
1	Marginal	1531.05	182.74	1000	11.94
2	Small	2101.10	298.43	1000	14.20
3	Medium	2285.00	391.65	1000	17.14
	Overall	5917.15	872.82	1000	14.55
1	Wholesalers	1190.00	188.75	1500	15.86
2	Retailers	26.80	6.80	2000	25.37
	Overall	1216.80	195.60	3500	16.30

were 182.74 q, 298.43 q and 391.65 q in case of marginal, small and medium farms respectively. This indicates average loss for marginal, small and medium farms, which were 10.15 quintals, 14.15 q and 65.27 q respectively. According to the perception of the farmers, the magnitude of losses depend on the condition of produce at harvest, travelling distance and condition of road. At market level losses total quantity of cabbage procured, quantity loss and percentage loss incurred by the wholesalers and retailers were 188.75 q and 6.8 q respectively (Table 10). The average loss was found to be 25.37% and 15.86% at the retailer and wholesaler levels. However, Singh *et al.* (2013) found comparatively lower losses at the rate of 1.27%, 7.75% and 4.21% at farm, wholesaler and retailers levels respectively in Varanasi district (U.P.) during 2012.

Some of the problems prevailed in the study area were lack of knowledge about plant protection measures (97.77%); lack of storage facilities (93.33%); lack of working capital (68.88%); lack of knowledge about application of fertilizers (64.44%) and lack of technical knowledge (62.22%).

In the market, sample traders reported lack of cold storage facilities (84.66%); poor transportation facility (68.88%) and improper handling (64.44%) as the major constraints in marketing of cabbage.

Other problems were related to lack of processing, packaging facilities etc, local market capacity, cartelisation of wholesalers at Dimapur city, which is the commercial hub of the state as well as the gateway to other states and districts. Notwithstanding multiple taxation and logistics bottleneck were viewed as grave challenges faced by the traders in this region for a good and peaceful life.

CONCLUSION

The study on cabbage production economics and post harvest losses in Phek district, a high altitude region in the state of Nagaland, during 2015-16 throws significant information about the cost of cultivation, income of farmers and the problems in managing losses. While cost A₁ was significant, cost component of total cost for marginal and small farmers was ₹ 54,008.21 and ₹ 58,193.05 per hectare respectively, and ₹ 61,206.88 per hectare for medium farmers. Cost C₁ which had imputed value of family labour component at ₹ 73,470.35 and ₹ 75,408.90 added more heavily on small and marginal farmers respectively, compared to ₹ 77,967.47 for medium farmers. This indicates economy of scale works along with increasing operational land size. Cost B was insignificant

compared to other two cost components indicating less capital intensive assets creation and lower land value realization. This finding is corroborated by the findings of Nandeswar *et al.* (2013) who observed Cost A to be the prime cost component for all the vegetables under study. They observed per hectare cost of cultivation, Cost A was at ₹ 19,268.41 and Cost C was ₹ 64,896.50 and gross return per hectare was 93,162.92, coming from an average production of 125.78 quintal of vegetables per hectare. Hired labour and transportation cost were identified as the major cash expenditure component of cabbage cultivation, but no alternative to it is suggested as it is imperative in this remote locality. Productivity of 154.27 q/ha for cabbage was comparatively low in study region comparing to the national average of 223 q/ha, which emerged as a major concern for small and medium farms. From the study the Cost A component RPR at 2.67 was observed to be high for cabbage cultivation indicating to be economically efficient for a hilly and remote region.

Amount of losses at different levels of production and marketing was estimated to be ₹ 1, 97,280 for all 45 sample farms and ₹ 60,840 for 10 marketers. Thus, about 35.05% of total cabbage is estimated as 'loss' in market each year due to the postharvest and inefficient marketing in Phek district. Various measures viz., plant protection measures to control diseases and insect pest incidence, storage facilities, farmer's organization to tackle the marketing problems and price fluctuation, infrastructure, market regulation etc., were considered very crucial to check losses and price stabilization. It was observed from the study that co-operative marketing could be encouraged for efficient selling of the produce. Also, harvesting of cabbage at proper maturity coupled with better handling of produce and suitable packaging plays a vital role in reducing post harvest losses for distant markets.

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