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COMPARATIVE COST AND RETURN ANALYSIS OF EIGHT MAJOR VEGETABLES IN CHAR LAND ECOSYSTEM OF BANGLADESH

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ABSTRACT

Bangladesh has tremendous opportunities to harness the potential of the agriculture sector like in vegetable sector which is contributing to our export sector too. Thus, the main focus of this study is to assess the financial profitability of selected eight major vegetables. The cost and return scenario of eight major vegetables that most of the farmers cultivate in the char land area such as brinjal, tomato, chili, bitter gourd, pumpkin, okra, bottle gourd, and amaranth were done for the study. Study areas were chosen in the districts of Mymensingh, Jamalpur, and Sherpur in Bangladesh following a simple random sampling procedure where 240 farmers were surveyed. The results show that the highest and lowest net return found for bottle gourd and okra, were Tk. 195,118 ha^{-1} and Tk. 32,894 ha^{-1}, respectively. Further, in terms of gross return, bottle gourd production is the most profitable but in terms of net return both the brinjal and tomato are in the same position. The benefit-cost ratio (BCR) was the highest (1.98) for bottle gourd followed by tomato (1.96). Among the cost items, labor cost occupies more than half of the total cost which proves that vegetable production is labor-intensive cultivation. The ranking by variable and total cost revealed that farmers frequently choose the lowest-cost production method and the okra is the most preferred product in that method. However, a ranking of the probability of all vegetables was also done. This ranking will help farmers to take their decision according to their resource availability.

Keywords: Vegetable production; Profitability; Benefit Cost Ratio; Char land; Bangladesh.

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INTRODUCTION

Bangladesh is one of the predominantly agro-based developing countries in the world where agriculture has been the core sector of Bangladesh's economy and rural people depend on it for their livelihood directly or indirectly (Islam et al., 2020). By reducing poverty and guaranteeing food security, the sector is the backbone of our economy. The sector has however remained resilient in terms of profitability and productivity despite the ever-increasing population, which is expected to increase from 147.6 million in 2010 to 164.7 million in 2020 (The Daily Star, 2022). The exports and imports of vegetable products were 21,800 and 6,16,037 Million Tk. in the year 2020-21, respectively (BBS, 2022). As Bangladesh is the third largest vegetables producing country in the world (Maruf et al., 2021), the country needs to utilize the enormous scope for exporting vegetables to the mainstream export market by fulfilling import country/foreign buyers' requirements (Bangladesh Foreign Trade Institute, 2016).

Bangladesh's climate is exceptional for growing vegetables. Rabi (winter from October to March) and Kharif (hot, humid season from April to October) are the two separate seasons that make up the entire year because of the comparatively low temperatures, high humidity, and abundant rainfall most vegetable crops can be grown (Mostofa et al., 2010). Because of economic expansion, growing incomes, and urbanization, food demand in Bangladesh and around the world is fast changing. Traditional commodities are being replaced by high-value food commodities such as fruits, vegetables, spices, and fish (Zaman et al., 2010), Bangladesh is no exception. There are plenty of winter and summer vegetables that are grown by Bangladesh gardeners such as cabbage, cauliflower, tomato, brinjal, pumpkin, bitter gourd, spin gourd, ribbed gourd, ash gourd, okra, etc. Some major vegetables such as brinjal, pumpkin, okra, and red amaranth are found to grow in both seasons. Vegetables are important sources of vitamins, and minerals and are associated with a lower risk of cardiovascular disease in humans (Hasan, 2021). Apart from nutritional value, it has an important share of the agricultural GDP, about 9.71%, helps to employment generation, increases income, and reduces poverty as well (Islam et al., 2020), (Chanda et al., 2020). Thus, the economic benefit of vegetable cultivation should be explored particularly focusing on the farmer's viewpoint.

The profitability of a crop is influenced by yield, product price, input costs, and the farmer's managerial skills. Evidently, change in any of the aforementioned variables affects profitability (Chowdhuri et al., 2014). The right intercrops, regional food customs, and market demands are crucial for maximizing profit (Uddin et al., 2009). One of the key elements that farmers consider when allocating land for the growing of vegetables is price. Since wholesale and retail prices occasionally do not reflect the actual price that farmers receive, it is anticipated that the risks associated with yield and price changes will serve as dissuading considerations for areas planted with different vegetables within a specific season (Mostofa et al., 2010). However, many

economic studies such as Uddin et al. (2009), Akter et al. (2011), Chowdhuri et al. (2014), Islam et al., 2020 have so far been reported about single, double or triple vegetable cultivation along with their cost and return but there is no framework for eight vegetables. Therefore, the present study aims to observe the actual financial benefits of vegetable cultivation of char land people in some selected areas of Bangladesh. For this reason, cost and return analyses are done for the main eight vegetables, i.e., brinjal, tomato, chili, bitter gourd, pumpkin, okra, bottle gourd, and amaranth. The findings of the study may be useful for the researcher, policy-maker, and government representatives as they contribute to the extensive cultivation of vegetables.

MATERIALS AND METHODS

The current study was conducted in three districts of Bangladesh: Mymensingh, Jamalpur, and Sherpur. A total of 240 farmers, 80 sample from each district, were interviewed following the simple random sampling technique using a semi-structured interview schedule. Pre-testing with 10 farmers and a few Focus Group Discussions (FGDs) were done before constructing the interview schedule to learn about farmers' general perceptions and knowledge of vegetable production. Microsoft Excel (Microsoft Corporation) allowed data cleaning, while STATA 16 (StataCorp LLC, Texas, USA) facilitated data analysis.

A cost-return analysis namely gross return, gross margin, net return, and benefit-cost ratio (undiscounted) were done for major eight vegetables (Brinjal, Tomato, Chili, Bitter gourd, Sweet gourd, Bottle gourd, Okra, and Amaranth).

$$GRi=\sum_{i=1}^{n} QmiPmi + \sum_{i=1}^{n} QbiPbi$$

Where,

GRi = Gross return from ith product (Tk/ha)

Qmi = Quantity of the ith main product (kg/ha)

Pmi = Average price of the ith main product (Tk/kg)

Qbi = Quantity of the ith by product (kg/ha)

Pbi = Average price of the ith by product (Tk/kg)

i = 1,2,3, … n

$$GMi = Py.Y - \sum_{i=1}^{n} (Pxi\ Xi)$$

Where,

GMi = Gross margin for ith product (Tk/ha)

Py = Per unit price of the product (Tk/kg)

Y = Quantity of the product per hectare (kg)

Pxi = Per unit price of ith inputs (Tk)

Xi = Quantity of the ith inputs per hectare (Kg)

i = 1,2,3, …, n (number of inputs).

$$\pi = Py.Y - \sum_{i=1}^{n} (Pxi\ Xi) - FC$$

Where,

π = Net return (Tk/ha)

Py = Per unit price of the product (Tk/kg)

Y = Quantity of the product per hectare (kg)

Pxi = Per unit price of ith inputs (Tk)

Xi = Quantity of the ith inputs per hectare (Kg)

FC= Fixed cost

i = 1,2,3, …, n (number of inputs).

$$BCR = GR \div GC$$

Where,

GR = Gross return; and

GC = Gross cost (i.e., TFC + TVC).

If BCR>1, the production is economically profitable, otherwise not.

RESULTS AND DISCUSSION

Cost structure of vegetable production

Variable costs are those costs that directly vary with the volume of production. Fixed costs, on the other hand, do not vary with the change in volume of production. For calculating the total per hectare total production cost of eight vegetables, these costs are taken into consideration. Human labor cost is one of the most important costs and the sources of supply of human labor in the research areas were both i) hired labor and ii) family labor were measured in terms of man-day which consisted of eight (08) hours of work by an adult male.

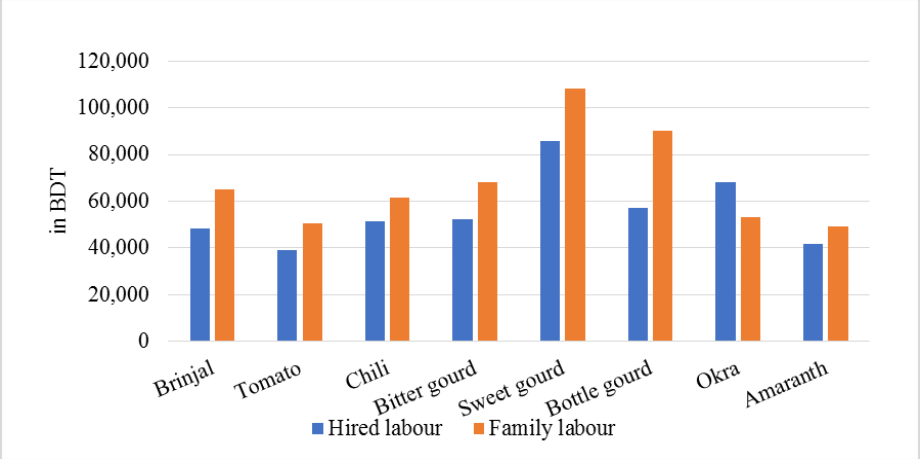

Figure 1. Comparison of hired labor and family labor costs

Figure 1 reveals that family labor plays more significant role than hired labor. The highest hired and family labour cost per hectare of the area was for sweet gourd production where total hired labor cost was estimated at Tk. 85,892/- per hectare of which 55% was for male labor and 45% was for female labor and total family labor cost was estimated at Tk. 108,324/- per hectare of which 70% was for male labor and 30% was for female labor. Additionally, Table 1 reveals that the two highest tillage costs were Tk. 13,011/- ha^{-1} and Tk. 12392/- ha^{-1} for brinjal and bitter gourd production, respectively and Tk. 9302/- per hectare for amaranth production showed the lowest tillage cost. The brinjal seed was costly of Tk. 14,665/- per hectare while the cheapest was amaranth seeds at Tk. 1,895/- per hectare. Among these cultivations, per hectare cost of fertilizers was more in brinjal production than others. Farmers also use a small amount of manure in addition to fertilizers in their fields. Per hectare cost of pesticides for brinjal production was highest at Tk. 13,782/- ha^{-1} and lowest for amaranth at Tk. 1355/- ha^{-1}. Timely irrigation is a very important factor for crop cultivation. As the study area is situated in the riverine zone of Bangladesh, there is plenty of water for crop cultivation. The lease value of land varied from one place to another depending on location, soil fertility, the topography of the soil, distance from the sources of water, etc. For bitter gourd, it was a little bit higher (Tk. 23,254/- ha^{-1}) than others as it takes more time (around 4 months) to be harvested. The lowest (Tk. 15,718/- ha^{-1}) lease value for amaranth takes less time to be harvested than the other vegetables. Total cost was calculated by adding up total variable cost and total fixed cost. The highest total cost was found at Tk. 208,860/- for bitter gourd and okra closely followed by brinjal production cost of Tk. 208,855/-. The lowest total cost was Tk. 134,066/- for amaranth production.

Share of cost items in the total cost

Akter et al. (2011), and Islam et al. (2020) revealed the share of labor, seeds, fertilizers, cow dung, insecticides, and miscellaneous cost in total cost. The present study reveals that vegetable production is labor-intensive cultivation and more than half of the cost share occupies by the labor cost for all vegetables. The two highest share of labor cost was estimated at 78% and 74% for sweet gourd and bottle gourd respectively. For amaranth and okra, it was found 59% of the total cost and 58% for chili and bitter gourd. The other two significant cost items were land use cost and fertilizer cost.

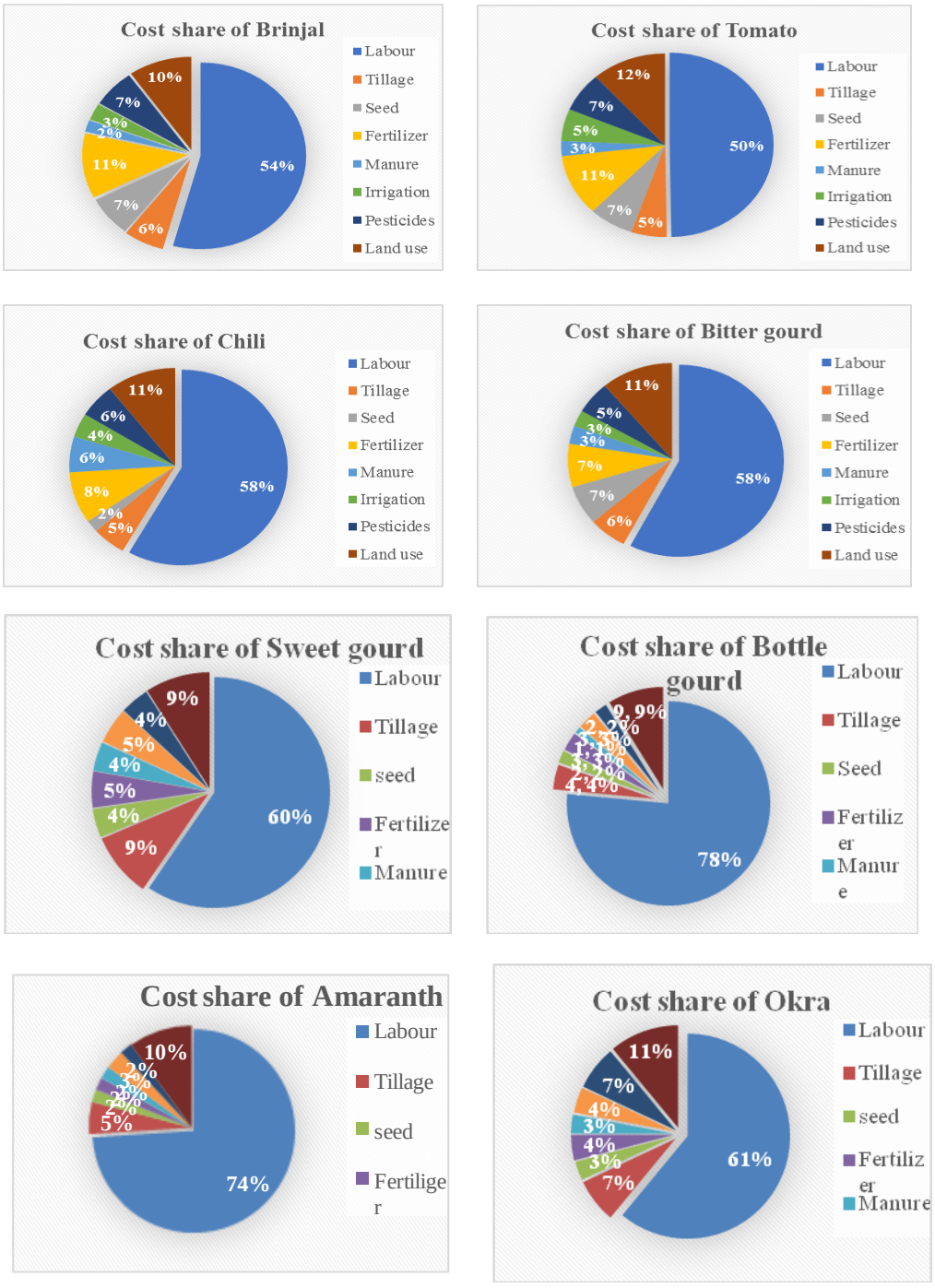

Figure 2. Share of different cost items in total cost for selected vegetable

From Figure 2, the share of land use cost which is lease value in most cases occupied 10-12% of the total cost. Tillage cost is almost the same (5-6%) for all the vegetables. The share of seed cost was insignificant in case of chili, sweet gourd, bottle gourd, okra, and amaranth production (2%). Share of irrigation cost occupied 3-6% of the total cost implies that irrigation is not a very big issue for the farmers in the char land area. So, it can be concluded that as labor cost is the most significant cost item for vegetable production; availability of labor is a big concern here and family labor is a great support to overcome this problem.

Return from vegetable cultivation

Per hectare production of brinjal was found at 15,244 kg where the average price was Tk. 25/- per kg. Thus, the gross return for brinjal was estimated at Tk. 381,100/-. In this way, the maximum gross return was found for bottle gourd (Tk. 393,882/-) and the minimum gross return was found for amaranth (Tk. 181,842/-). The argument for using gross margin analysis is that the farmers are more interested to know their return over variable costs. The analysis reveals that the gross margin and net return of all the vegetables are positive. So, the production of these eight vegetables at least covers the variable costs of the production and production was profitable. Therefore, it can be said that farmers are interested to cultivate vegetables in the study areas. Per hectare net return for bottle gourd, tomato, and brinjal was higher at Tk. 195,118/-, Tk. 172,775/- and Tk. 172,245/-, respectively than others in full cost basis. BCR of brinjal, tomato, chili, bitter gourd, sweet gourd, bottle gourd, okra, and amaranth were found at 1.82, 1.96, 1.65, 1.6, 1.41, 1.98, 1.16, and 1.36, respectively. The results imply that brinjal farmers received Tk. 1.82 in return from investing Tk. 1.00 in brinjal production. The same explanation is applied to other vegetables also.

Table 1. Per hectare cost and return of major vegetables

Item	Brinjal	% of gross Cost	Tomato	% of gross Cost	Chili	% of gross Cost	Bitter gourd	%of gross Cost	Sweet gourd	% of gross Cost	Bottle gourd	% of gross Cost	Okra	% of gross Cost	Amara-nth	%of gross Cost
Gross Return																
Main Product	381100		352,044		320,758		333,725		348,090		393,882		241,754		181,842	
A. Gross Return	381100		352,044		320,758		333,725		348,090		393,882		241,754		181,842	
Variable Cost																
Hired Labour (male)	40950	19.6	32680	18.22	39480	20.3	40,500	19.39	47564	19.21	46799	23.54	53,857	25.79	33583	25.05
Hired Labour (female)	7250	3.47	6235	3.48	12000	6.17	11,750	5.63	38328	15.48	10399	5.23	14,144	6.77	8291	6.18
Tillage	13011	6.23	9958	5.55	10000	5.14	12392	5.93	9337	3.77	9613	4.84	9342	4.47	9302	6.94
Seed/Seedlings	14655	7.01	12480	6.96	3891	2	13850	6.63	3681	1.49	3200	1.61	3847	1.84	1895	1.41
Urea	5605	2.68	4460	2.49	4712	2.42	3173	1.51	2025	0.82	1303	0.66	1359	0.65	1875	1.40
TSP	7952	3.8	5157	2.88	4225	2.17	3476	1.66	2244	0.91	1738	0.87	1845	0.88	2181	1.63
MOP	4142	1.98	4140	2.31	3020	1.55	3276	1.56	1127	0.46	851	0.43	1156	0.55	765	0.57
DAP	5829	2.79	5460	3.05	4676	2.4	5408	2.59	1773	0.72	1824	0.92	1872	0.90	1495	1.11
Manure	4225	2.02	4720	2.63	11557	5.94	6442	3.08	1997	0.81	3296	1.66	2608	1.25	4423	3.30
Irrigation	6123	2.93	10036	5.59	7718	3.96	5675	2.72	6450	2.61	4370	2.20	4814	2.30	3794	2.83

Item	Brinjal	% of gross Cost	Tomato	% of gross Cost	Chili	% of gross Cost	Bitter gourd	%of gross Cost	Sweet gourd	% of gross Cost	Bottle gourd	% of gross Cost	Okra	% of gross Cost	Amara-nth	%of gross Cost
Pesticides/Insecticide	13782	6.59	12446	6.94	10944	5.62	11464	5.49	4532	1.83	3322	1.67	4353	2.08	1355	1.01
B. Total Variable Costs	123,524	59.14	107,772	60.12	112,223	57.7	117,406	56.21	119,057	48.09	86,716	43.63	117,406	56.21	68,958	51.44
Family Labour (male)	53550	25.63	39130	21.82	51240	26.34	56,700	27.15	78420	31.67	75084	37.78	37,082	17.75	35548	26.52
Family Labour (female)	11500	5.5	11610	6.48	10500	5.39	11,500	5.51	29904	12.08	16007	8.05	16,251	7.78	13842	10.32
Lease Value of Land	20281	9.71	20760	11.58	20514	10.54	23,254	11.13	20209	8.16	20958	10.54	19461	9.32	15718	11.72
C. Total Fixed Cost	85,331	40.85	71,500	39.88	82,254	42.29	91,454	43.79	128,533	51.91	112,049	56.37	91,454	43.79	65,108	48.56
D. Gross Cost (B+C)	208,855	100	179,272	100	194,477	100	208,860	100	247,590	100	198,765	100	208,860	100	134,066	100
E. Gross Margin (A-B)	257,576		244,272		208,535		216,318		229,033		307,167		124,348		112,884	
F. Net Return (A-D)	172,245		172,772		126,281		124,865		100,500		195,118		32,894		47,776	
G. BCR (Undiscounted)	1.82		1.96		1.65		1.6		1.41		1.98		1.16		1.36	

Chowdhuri et al. (2014) revealed that cabbage cultivation was more profitable than brinjal and country bean as per hectare yield, gross returns, gross margin, net return, and benefit-cost ratio were higher than others. Islam et al. (2020) resulted that cauliflower and cabbage production was profitable and farmers earned the highest profit from cabbage. Hasan et al. (2020) found that bean, brinjal, and tomato production were profitable according to net margin and BCR. Bala et al. (2011) estimated that gross returns and net returns per hectare were highest for tomato, followed by cauliflower, cabbage, and peas.

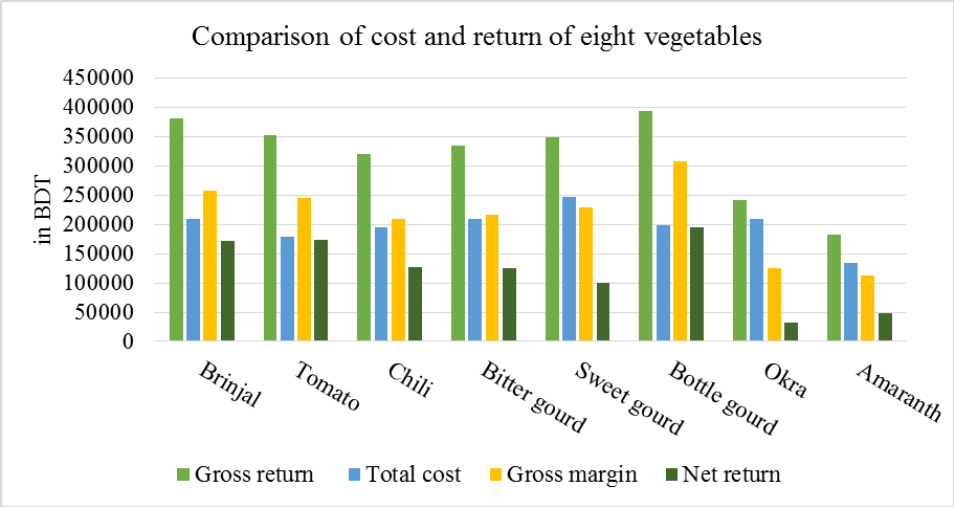

Figure 3. Comparison of costs and return of eight vegetables

Figure 3 shows that in terms of gross return and net return, bottle gourd production is the most profitable followed by brinjal and tomato. However, as a whole all the vegetables are profitable and farmers are happy cultivating these vegetables. The outcome is expected and consistent with several previous studies, for instance, cauliflower, tomato, and cabbage cultivation resulted by Akter et al. (2011) that all of these three vegetables were profitable but the cabbage were comparatively more profitable than the others. From the previous studies, it is no doubt that vegetables can play a significant role in earning cash money, and also their cultivation method is simple. It is also demonstrated that Bangladesh appears to have a high potential for increasing vegetable crops, and char people are attempting to better their standard of living by cultivating vegetables having huge her profitability.

Comparative profitability and costs of different vegetable production

Farmers are logical decision-makers and choose their crops based on several criteria. Some farmers are concerned about total cost, some are about total return, and some are about gross margin. Therefore, it is worthwhile to see the ranking of vegetables from a different perspective to understand the factors that drive farmers to choose their crop to cultivate.

Ranking of vegetables based on total cost and variable cost incurred

The vegetable ranking based on the lowest total variable cost requirement was Amaranth (1^{st}), Bottle gourd (2^{nd}), tomato (3^{rd}), and so on. The ranking based on total cost was Amaranth (1st), tomato (2^{nd}), Chili (3^{rd}), and so on. It is revealed that farmers often go for the least cost production method and in that method, amaranth is the most preferable vegetable for farmers.

Table 2. Ranking of vegetables according to total variable cost and total cost

Name of the vegetable	Total Variable Costs (Tk/ha)	Rank of lowest TVC	Total Cost (Tk/ha)	Rank of lowest TC
Amaranth	68,958	1	134,066	1
Bottle gourd	86,716	2	198,765	4
Tomato	107,772	3	179,272	2
Chili	112,223	4	194,477	3
Bitter gourd	117,406	5	208,860	6
Sweet gourd	119,057	6	247,590	7
Okra	117,406	5	208,860	6
Brinjal	123,524	7	208,855	5

3.4.2. Ranking of vegetables based on gross margin and net return

With respect to the highest gross margin bottle gourd ranked 1st followed by brinjal (2), tomato (3), and sweet gourd (4). The ranking based on the highest net return

received from the vegetables shows bottle gourd ranked 1st followed by tomato (2), brinjal (3), and chili (4). It can be concluded that some farmers might be interested in gross margin and some might be in net return and accordingly their decisions vary for choosing vegetables to cultivate.

Table 1. Ranking of vegetables according to gross margin and net return

Name of the vegetable	Gross Margin (Tk/ha)	Rank of Highest GM	Net Return (Tk/ha)	Rank of highest NR
Bottle gourd	307,167	1	195,118	1
Brinjal	257,576	2	172,245	3
Tomato	244,272	3	172,772	2
Sweet gourd	229,033	4	100,500	6
Bitter gourd	216,318	5	124,865	5
Chili	208, 535	6	126,281	4
Okra	124,348	7	32,894	8
Amaranth	112,884	8	47,776	7

CONCLUSION

Under the agriculture sector, the vegetable sub-sector is essential to Bangladesh's development. To maintain profitable farming with long-term food security, it is critical to establish a lucrative, sustainable, and environmentally friendly agricultural system. There may be countless studies on vegetables, but we are giving the study of major eight vegetables based on farmers' preferences in order to depict the outcome of cost-benefit analysis. According to the study's cost and return analysis, the majority of the costs were incurred for human labor. If current inputs and production technologies are made available to all farmers on time, vegetable production may grow, allowing farmers to enhance their farm revenue and better their life. According to the findings, the benefit-cost ratios of major eight vegetables were greater than one, implying that production of the selected vegetables was profitable in the study areas. This study revealed that it is possible to conclude that there is a significant opportunity in the study areas to boost tomato and brinjal productivity on the basis of the benefit-cost ratio in order to increase farmers' income, employment, and nutritional status. It was also clear that bottle gourd, tomato, and brinjal were successful industries that might produce income and employment opportunities for Bangladesh's rural population.

Based on the findings of the study, several policy recommendations can be prescribed. To encourage collaboration between research, extension services, farmer groups, financial institutions, and NGOs to provide funding and knowledge on high-value vegetable production. To raise community awareness to attract private

investment, ensure quality seed production, and motivate farmers to adopt modern technology through training. To develop insect and disease-resistant varieties and emphasize soil testing and proper fertilizer application to reduce production costs. Government support for free transportation of vegetables and cold storage facilities is crucial. Policymakers should explore options for fair market prices, and financial institutions should provide credit to vegetable producers.

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