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Economic analysis of onion and garlic production as influenced by Micronutrients

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Abstract

A field experiment was conducted in the High Ganges River Floodplain Soils (AEZ 11) at Shyampur, Rajshahi, Bangladesh, to study the effects of micronutrients on onion (cv. Taherpuri) and garlic (local variety). The soil was silty loam with pH 7.6. The trial followed a Randomized Complete Block Design (RCBD) with 11 treatments (T1–T11) and three replications, applying Zn, B, Mo, Mn, Cu, and Cl at specific rates, along with NPKS as a basal dose. Data were collected at 15-day intervals and analyzed using MSTAT-C. Significant effects were observed in both crops. The highest onion yield (13.38 t/ha) was recorded in T4 (Zn + B), along with improved plant height (61.30 cm). The lowest growth and yield were found in T1 (control). In garlic, T3 (B) gave the highest yield (6.38 t/ha), while T4 (Zn + B) showed similar effects. The lowest yield was in T1. Economic analysis showed the highest net income (Tk. 425570) and benefit-cost ratio (1:8.58) for T4 in onion, while T3 had the best return (1:6.50) for garlic. For onion, the combination of Zn+B was optimal, whereas for garlic, B alone proved superior. The nutrient response ranking for onion was (Zn+B) > Zn > B > Mo, while for garlic it was B > (Zn+B) > Zn.

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Introduction

Soil fertility in Bangladesh has been declining due to intensive cropping, imbalanced fertilization, and limited use of micronutrients and organic manures. Most soils contain less than 1.5% organic matter, with some below 1% (BARC, 2005). The country has 30 Agro-Ecological Zones (AEZs), with the study area belonging to the High Ganges River Floodplain (AEZ 11), characterized by calcareous soils with high $CaCO_3$ content and pH ranging from 7.0 to 8.5 (Alam, 2006). Micronutrients like Zn and B become less available as soil pH increases, while B deficiency is widespread due to leaching (Troeh *et al.,* 1993). Micronutrients play a crucial role in plant nutrition, influencing growth and yield as much as macronutrients. Zinc, B, Mn, and Mo are highly sensitive in onion production (Havlin *et al.*, 2007). Zinc deficiency causes stunted growth, Mo influences nitrogen metabolism, Mn affects photosynthesis, and Cu and Cl deficiencies lead to chlorosis and reduced plant vigor. Research on Zn, Cu, B, Mn, and Mo application for garlic production in Bangladesh is limited (Baquee, 1998). Onion ranks first among spices in production and second in cultivated area, while garlic ranks third.

Onion and garlic are widely grown across Bangladesh, with major producing districts including Rajshahi, Dhaka, and Mymensingh (Anonymous, 1977). Despite their importance, yields remain low due to inadequate micronutrient management. Bangladesh ranks seventh in global onion production (894,255 MT) and sixth in garlic production (176,710 MT) (FAO, 2007), requiring significant imports to meet demand. Our study aims to improve onion and garlic production through effective micronutrient management.

Materials and methods

Experimental site and design

The field experiment was conducted at High Ganges River Floodplain Soils (AEZ 11) at Shyampur, Rajshahi, Bangladesh, to study the response of different micronutrient combinations on the growth and yield of onion (*Allium cepa L.)* nd garlic (*Allium sativum L.*). The experiment was laid out in a Randomized Complete Block Design (RCBD) with replications. The soil of the experimental site belonged to the calcareous soil.

Treatments and fertilizer application

The treatments consisted of different combinations of micronutrients, including Zinc (Zn), Boron (B), Molybdenum (Mo), Manganese (Mn), Copper (Cu), and Chlorine (Cl). The control (T1) received no micronutrients, while the other treatments were formulated as follows:

- T1 = Control (No micronutrients)
- T2 = Zn
- T3 = B
- T4 = Zn + B
- T5 = Zn + B + Mo
- T6 = Zn + B + Mn
- T7 = Zn + B + Cu
- T8 = Zn + B + Cl
- T9 = Zn + B + Mo + Mn
- T10 = Zn + B + Mo + Mn + Cu
- T11 = Zn + B + Mo + Mn + Cu + Cl

Each treatment was applied in the recommended doses as per [reference source]. The required quantities of Zn, B, Mo, Mn, Cu, and Cl were applied in the form of [specific chemical compounds]. A uniform basal dose of NPKS fertilizers was applied to all plots.

Crop establishment and management

Onion and garlic seedlings were transplanted at a spacing of [specific spacing] on well-prepared plots. Standard agronomic practices, including irrigation, weeding, and pest control, were followed throughout the growth period.

Data collection

Growth and yield parameters were recorded at different Days after Planting (DAP):

- Number of leaves per plant at 30, 45, and 60 DAPS for onion and 40, 55, 70, 85, 100, and 115 DAPS for garlic.
- Plant height (cm) at 30, 45, 60, and 75 DAPS for onion and 40, 55, 70, 85, 100, and 115 DAPS for garlic.

- Fresh weight of leaves (g), bulbs (g), and roots (mg) at final harvest.
- Yield components, including total bulb yield per hectare.
- Economic analysis, including cost-benefit ratio calculations.

Statistical analysis

The collected data were statistically analyzed using [software/tool] following the Duncan's Multiple Range Test (DMRT) at a 5% significance level to compare treatment means.

Results and discussion

Response of micronutrients on growth of onion

Number of leaves

The numbers of leaves per plant at different days after planting were found to be significant in different treatments (Table 1). The combination T_4 performed the highest number of leaves in all growth periods and the lowest was found in T_1. Similar observation was also observed by EL-Gamelli *et al.* (2000).

Plant height

Plant height was recorded at different days after planting (DAP) and it was observed that effects of micronutrients significantly affect for different micronutrients. The plant height of onion was nearly same at the maturity of the plants (Table 2).

The highest plant height (61.30 cm) was recorded in receiving T_4 and the lowest in control, where plant height at 75 DAP was followed by T_8 (58.88 cm) and T_2 (56.69 cm) respectively. BARI (2007-08) reported that the application of Zn and B significantly increased the plant height of onion.

However, the height of plants increased in receiving T_4 and ultimately leaves numbers were also increased due to influence of T_2 and T_3.

Table 1. Effect of micronutrients on number of leaves per plant of onion at different DAP.

Treatments	30 DAP	45 DAP	60 DAP
T_1 = Control	6.51 c	9.17 d	10.70 e
T_2 = Zn	8.04 b	10.30 b~d	12.05 cd
T_3 = B	7.85 b	10.20 b~d	13.02 b
T_4 = Zn+B	9.90 a	12.53 a	14.63 a
T_5 = Zn+B+Mo	8.16 b	11.33 ab	12.99 b
T_6 = Zn+B+Mn	7.93 b	9.74 cd	13.26 b
T_7 = Zn+B+Cu	8.30 b	9.65 cd	11.69 d
T_8 = Zn+B+Cl	7.86 b	11.17 b	12.46 c
T_9 = Zn+B+Mo+Mn	8.25 b	9.20 cd	12.36 d
T_{10} = Zn+B+Mo+Mn+Cu	8.37 b	9.61 cd	13.21 b
T_{11} = Zn+B+Mo+Mn+Cu+Cl	8.94 ab	10.57 bc	12.22 c
CV (%)	8.38	6.90	2.10

In a column, figures having same letter(s) do not differ significantly by DMRT at 5% level; each parameter represents 30 plants; DAP= Days after planting.

Fresh weight of leaves

Various combinations of micronutrients exhibited significant variations in respect of fresh weight of leaves per plant (Table 3). The maximum fresh weight of leaves (9.21 g) was observed in receiving T_4 followed by T_2 (8.88 g) and the lowest number was recorded in receiving T_6 (4.97 g). Marteens *et al.* (1991) stated that bulb uptakes micronutrient swiftly at the stage of bulb initiation. EL-Gamelli (2000) studied that fresh weight of leaves were positively affected by the application of micronutrients.

The result of this parameter indicated that Zn and B had significant role on the vegetative growth of onion which is in partial accord with the findings of Sindhu and Tiwari (1989).

Table 2. Effect of micronutrients on plant height of onion at different DAP.

Treatments	30 DAP (cm)	45 DAP (cm)	60 DAP (cm)	75 DAP (cm)
T_1 = Control	33.48 c	40.18 c	51.45 ab	55.22 b
T_2 = Zn	37.65 b	43.01 b	51.99 ab	56.69 b
T_3 = B	38.08 b	42.85 b	52.58 ab	55.19 b
T_4 = Zn+B	41.58 a	46.60 a	56.01 a	61.30 a
T_5 = Zn+B+Mo	37.69 b	41.52 bc	52.70 ab	57.28 b
T_6 = Zn+B+Mn	36.85 b	42.41 b	49.85 b	57.60 b
T_7 = Zn+B+Cu	37.99 b	42.59 b	52.42 ab	56.53 b
T_8 = Zn+B+Cl	37.56 b	42.95 b	53.95 ab	58.88 ab
T_9 = Zn+B+Mo+Mn	35.45 bc	41.49 bc	52.60 ab	57.04 b
T_{10} = Zn+B+Mo+Mn+Cu	36.34 b	41.42 bc	52.58 ab	56.36 b
T_{11} = Zn+B+Mo+Mn+Cu+Cl	36.69 b	41.82 bc	53.52 ab	58.53 ab
CV (%)	3.87	2.64	5.49	3.42

In a column, figures having same letter(s) do not differ significantly by DMRT at 5% level; each parameter represents 30 plants; DAP= Days After planting.

Table 3. Effect of micronutrients on fresh weight of onion.

Treatments	Fresh weight of leaves (g)	Fresh weight of bulbs (g)	Fresh weight of roots (mg)
T_1 = Control	6.82 d~f	20.60 de	693.40 e
T_2 = Zn	8.88 b	26.52 b	1084.00 b~d
T_3 = B	7.24 c~f	25.32 bc	1229.00 b
T_4 = Zn+B	9.21 a	31.42 a	1035.00 b~d
T_5 = Zn+B+Mo	7.55 b~e	23.72 b~e	1513.00 a
T_6 = Zn+B+Mn	4.97 g	24.25 b~e	1141.00 bc
T_7 = Zn+B+Cu	8.78 c	22.66 b~e	887.00 c~e
T_8 = Zn+B+Cl	7.70 b~e	21.76 c~e	984.10 b~d
T_9 = Zn+B+Mo+Mn	6.60 ef	25.79 bc	986.70 b~d
T_{10} = Zn+B+Mo+Mn+Cu	5.91 fg	25.03 b~d	816.80 de
T_{11}=Zn+B+Mo+Mn+Cu+Cl	8.55 a~c	19.94 e	1169.00 b
CV (%)	9.71	10.22	13.49

In a column, figures having same letter(s) do not differ significantly by DMRT at 5% level; each parameter represents 30 plants; DAP= Days After planting.

Response of micronutrients on growth of Garlic

Number of leaves

Effect of micronutrients on leaves of garlic was approximately equivalence to onion. Number of leaves per plant is one of the important growth characters which significantly contribute in both plant growth and yield. Effects of T_2, T_3 was observed but combine treatment Zn and B gave the highest leaves number 16.58 (Table 4) followed by T_3.

Therefore, calcareous soil of Bangladesh (AEZ 11, High Ganges River Floodplains) had significant effect on leaves number of garlics receiving T_2, T_3 and T_4. NPKS fertilizers were used as basal dose 13.66 leaves per plant were observed in receiving control which was statistically similar at 40 DAPS. Sulphur had significant effect on the growth of garlic. Peterson (1979) mentioned role of Sin garlic production. Ranjan *et al.* (2005) reported that maximum leaf number was observed when the plant was fertilized by borax. The supplement of micronutrients accumulated reserve substances which enhanced number of leaves. Chlorosis was shown in receiving control observed by Agarwala *et al.* (1979).

Table 4. Effect of micronutrients on leaves number per plant of garlic.

Treatments	40 DAP	55 DAP	70 DAP	85 DAP	100 DAP	115 DAP
T_1 = Control	4.59 a	4.87 ab	7.45 ab	7.73 d	11.42 de	13.66 c
T_2 = Zn	4.60 a	5.23 a	8.22 ab	8.90 a	13.46 ab	15.33 bc
T_3 = B	4.15 a	4.86 ab	7.49 ab	8.51 a~c	13.10 ab	16.58 ab
T_4 = Zn+B	4.31 a	4.71 ab	8.58 a	8.78 ab	13.83 a	18.20 a
T_5 = Zn+B+Mo	4.11 a	4.57 b	7.76 ab	8.18 cd	12.79 abc	13.92 c
T_6 = Zn+B+Mn	4.22 a	4.97 ab	7.71 ab	8.30 b~d	13.12 ab	14.11 c
T_7 = Zn+B+Cu	4.34 a	4.79 ab	7.66 ab	8.22 b~d	12.90 a~c	14.27 c
T_8 = Zn+B+Cl	4.25 a	4.84 ab	7.86 ab	8.25 b~d	12.42 b~d	14.23 c
T_9 = Zn+B+Mo+Mn	4.39 a	4.97 ab	7.29 b	8.28 b~d	11.97 c~e	13.69 c
T_{10} = Zn+B+Mo+Mn+Cu	4.08 a	4.85 ab	7.57 ab	7.89 d	11.29 e	14.17 c
T_{11} = Zn+B+Mo+Mn+Cu+Cl	4.40 b	4.57 b	7.12 b	7.79 d	12.42 b~d	14.36 c
CV %	8.43	6.46	7.86	3.60	4.46	7.21

In a column, figures having same letter(s) do not differ significantly by DMRT at the 5 % level; each parameter represents 30 plants; DAP =Days after Planting.

Table 5. Effect of micronutrients on plant height of garlic.

Treatments	40 DAP (cm)	55 DAP (cm)	70 DAP (cm)	85 DAP (cm)	100 DAP (cm)	115 DAP (cm)
T_1 = Control	33.62 cd	40.49 b	41.31 b	41.79 d	44.04d	52.20 c
T_2 = Zn	36.17 ab	36.10 a	41.42 a	47.26 a	50.15a	57.62 a
T_3 = B	36.00 ab	40.08 a	40.46 a	45.18 a~c	47.30b	56.49 ab
T_4 = Zn+B	37.05 a	39.84 a	40.76 a	45.91ab	50.00a	58.36 a
T_5 = Zn+B+Mo	32.10 de	38.78 a	39.42 a	45.37 a~c	45.58 b~d	52.91c
T_6 = Zn+B+Mn	35.40 a~c	39.38 a	39.53 a	42.93 d	47.20 b	56.24 ab
T_7 = Zn+B+Cu	31.20 e	38.42 a	39.65 a	44.03 b~d	46.13 bc	54.11 bc
T_8 = Zn+B+Cl	36.44 ab	40.90 a	40.99 a	43.15 cd	46.86 bc	54.27 bc
T_9 = Zn+B+Mo+Mn	36.12 ab	39.52 a	41.07 a	43.45 b~d	47.13 bc	53.24 c
T_{10} = Zn+B+Mo+Mn+Cu	37.52 a	40.23 a	41.06 a	41.85 d	44.25 d	53.07 c
T_{11} = Zn+B+Mo+Mn+Cu+Cl	34.47 bc	38.83 a	39.83 a	42.16 d	45.22 cd	52.03 c
CV %	3.37	8.61	6.46	3.05	2.18	2.46

In a column, figures having same letter(s) do not differ significantly by DMRT at the 5 % level; each parameter represents 30 plants; DAP =Days after Planting.

Plant height

The effect of micronutrients on plant height of garlic were found to be significant. Highly significant value on plant height of garlic due to micronutrients was found at 100 DAPS. The maximum height was found in T_4 (58.63 cm, Table 5) and the lowest value was observed in receiving T_{11} (52.03 cm) followed by T_2 (57.62 cm). However, T_2 plays important role in plant height of garlic. Combination of all micronutrients showed negative role in plant height of garlic. This result was also similar to Ranjan *et al.* (2005). They stated that Zn, B was important micronutrients for vegetative growth and yield of garlic.

Analysis of cost of production of onion

Expenses from (control) were 52709.30 tk. (currency in Bangladesh) in production of per hectare yield (Table 6&8). Cost of production for T_4 (Zn + B) treatment was 56110.05 tk. Cost of T_2 (Zn) and T_3 (B) was 54716.30 tk. and 51427.05 tk. According to retail price 36 tk. /kg, gross income in T_4 (Zn + B) was 481680 tk. /ha land and 321840 takas from T_1 treatment whereas, net income from T_4 (Zn + B) was 425569.95 tk. per hectare and also 269130.70 tk from T_1 trialed treatment.

It can be concluded that net income from T_4 is 50 % more than that of control plot. *Cost benefit ratio (1: 8.58) revealed that T_4 (Zn + B) is most suitable for onion production where T_1 (control) expresses 1: 5.12 ration. T_3 (B) possessed (1: 7.99) in benefit cost ration while the ratio 1:7.57 was followed by T_2 (Zn).

Table 6. Economic analysis of onion production as influenced by micronutrients.

Treatments	Production (t/ha)	Production cost	Gross income (Tk.)	Net income (Tk.)	Benefit cost ratio
T_1 = Control	8.94	52709.30	321840	269130.70	1: 5.12
T_2 = Zn	11.50	54716.30	414000	408523.70	1: 7.57
T_3 = B	11.42	51427.05	411120	359692.95	1: 7.99
T_4 = Zn+B	13.38	56110.05	481680	425569.95	1: 8.58
T_5 = Zn+B+Mo	11.65	59455.05	419400	359944.95	1: 7.05
T_6 = Zn+B+Mn	9.89	55767.75	356040	300272.25	1: 6.38
T_7 = Zn+B+Cu	11.18	56584.80	402480	345895.20	1: 7.11
T_8 = Zn+B+Cl	10.25	59716.05	369000	309283.95	1: 6.17
T_9 = Zn+B+Mo+Mn	9.83	60079.45	353880	293800.55	1: 5.89
T_{10} = Zn+B+Mo+Mn+Cu	10.57	60804.20	380520	31975.80	1: 6.26
T_{11}= Zn+B+Mo+Mn+Cu+Cl	10.83	61250.20	389880	328629.80	1: 6.36

Table 7. Economic analysis of garlic production as influenced by micronutrients.

Treatment	Production (t/ha)	Production cost	Gross income (tk.)	Net income (tk.)	Benefit cost ratio
T_1 = Control	5.36	86939.80	482400	395460.20	1: 5.55
T_2 = Zn	5.82	88946.80	523800	434853.20	1: 5.89
T_3 = B	6.38	88333.55	574200	485866.45	1: 6.50
T_4 = Zn+B	6.06	90340.55	545400	455059.45	1: 6.04
T_5 = Zn+B+Mo	5.79	93685.55	521100	427414.45	1: 5.56
T_6 = Zn+B+Mn	5.62	90964.95	505800	414835.05	1: 5.56
T_7 = Zn+B+Cu	5.93	91065.30	533700	442634.70	1: 5.86
T_8 = Zn+B+Cl	5.58	90786.55	502200	411413.45	1: 5.53
T_9 = Zn+B+Mo+Mn	5.47	94309.95	492300	397990.05	1: 5.22
T_{10}= Zn+B+Mo+Mn+Cu	5.76	95034.70	518400	423365.30	1: 5.45
T_{11} = Zn+B+Mo+Mn+Cu+Cl	5.82	95480.70	523800	428319.30	1: 5.48

Analysis of cost of production of garlic

Analysis of cost of production was mentioned in Table 7 and 9. Cost of production T_1 (control) in per hectare management was 86939.80 Tk. Management cost of T_3 (B) treatment was 88333.55 Tk. and 90340.55 Tk. was from T_4 (Zn + B). Labour wages was 100 Tk. per day. Gross income from T_1, T_3 and T_4 were respectively 482400 Tk., 574200 Tk., 545400 tk @ 90

Tk. (@ = 36 Tk. /kg) in present market price. Net income from T_1, T_3 and T_4 were remaining 395460.20 tk., 485866.45 tk. and 455059.45 tk.

However, using treatment T_3 producers of that region may be benefited economically. Hence, producers should practice with T_3 (B) fertilizer for enhancing production rate of garlic. The minimum benefit cost ratio (1:5.22) was demonstrated with T_9 (Zn + B + Mo + Mn) treatment. The value of benefit cost ratio 1: 5.45 was mentioned from T_{10} (Zn + B + Mo + Mn + Cu).

Table 8. Analysis of cost of production for onion (per hectare) A. Input cost: (a) Material cost (Tk.) .

Treatments	Cost of bulbs	Fertilizers										Irrigation	Subtotal (a)
		Urea	TSP	Gypsum	K_2SO_4	ZnO	H_3BO_3	Na_2MoO_3	MnO	$CuSO_4$	NaCl		
T_1	14000	1800	3500	320	900	-	-	-	-	-	-	2400	22920
T_2	14000	1800	3500	320	900	1800	-	-	-	-	-	2400	24720
T_3	14000	1800	3500	320	900	-	1250	-	-	-	-	2400	21770
T_4	14000	1800	3500	320	900	1800	1250	-	-	-	-	2400	25970
T_5	14000	1800	3500	320	900	1800	1250	3000	-	-	-	2400	28970
T_6	14000	1800	3500	320	900	1800	1250	-	560	-	-	2400	25663
T_7	14000	1800	3500	320	900	1800	1250	-	-	650	-	2400	26620
T_8	14000	1800	3500	320	900	1800	1250	-	-	-	400	2400	26370
T_9	14000	1800	3500	320	900	1800	1250	3000	560	-	-	2400	29530
T_{10}	14000	1800	3500	320	900	1800	1250	3000	560	650	-	2400	30180
T_{11}	14000	1800	3500	320	900	1800	1250	3000	560	650	400	2400	30580

(b) Non-material cost (Tk.)

Treatments	Land preparation	Planting cost	Weeding	Harvesting and marketing	Subtotal (b)	Input cost (A = a+b)
T_1	4400	2150	2050	2300	10900	33820
T_2	4400	2150	2050	2300	10900	35620
T_3	4400	2150	2050	2300	10900	32670
T_4	4400	2150	2050	2300	10900	36870
T_5	4400	2150	2050	2300	10900	39870
T_6	4400	2150	2050	2300	10900	36563
T_7	4400	2150	2050	2300	10900	37520
T_8	4400	2150	2050	2300	10900	37270
T_9	4400	2150	2050	2300	10900	40430
T_{10}	4400	2150	2050	2300	10900	41080
T_{11}	4400	2150	2050	2300	10900	41480

Labor cost @ Tk. 100 per day

Overhead cost (Tk.)

Treatments	Cost of lease of lands for 6 months	Miscellaneous cost 5% of input cost	Interest on running capital (for 6 month 13% of cost per year)	Subtotal (B)	Total cost of production [A+B]
T_1	15000	1691	2198.30	18889.30	52709.30
T_2	15000	1781	2315.30	19096.30	54716.30
T_3	15000	1633.50	2123.55	18757.05	51427.05
T_4	15000	1843.50	2396.55	19240.05	56110.05
T_5	15000	1993.50	2591.55	19585.05	59455.05
T_6	15000	1828.15	2376.60	19204.75	55767.75
T_7	15000	1876	2438.80	19314.80	56584.80
T_8	15000	1863.50	2422.55	19286.05	59716.05
T_9	15000	2021.50	2627.95	19649.45	60079.45
T_{10}	15000	2054	2670.20	19724.20	60804.20
T_{11}	15000	2074	2696.20	19770.20	61250.20

The maximum value from benefit cost ratio was 1:6.50 whereas the second rank obtained from T_4. Equivalent ratio was remarked from T_5 (Zn + B + Mo) and T_6 (Zn + B + Mn). Pure Mo was costly than other treated elements. Hence, cheaper rated of molybdated fertilizer was used in this research.

Table 9. Analysis of cost of production garlic (per hectare) A. Input cost: (a) Material cost (Tk.).

Treatments	Cost of bulbs	Fertilizers										Irrigation	Subtotal (a)
		Urea	TSP	Gypsum	K_2SO_4	ZnO	H_3BO_3	Na_2MoO_3	MnO	$CuSO_4$	NaCl		
T_1	44000	1800	3500	320	900	-	-	-	-	-	-	2600	53120
T_2	44000	1800	3500	320	900	1800	-	-	-	-	-	2600	54920
T_3	44000	1800	3500	320	900	-	1250	-	-	-	-	2600	54370
T_4	44000	1800	3500	320	900	1800	1250	-	-	-	-	2600	56170
T_5	44000	1800	3500	320	900	1800	1250	3000	-	-	-	2600	59170
T_6	44000	1800	3500	320	900	1800	1250	-	560	-	-	2600	56730
T_7	44000	1800	3500	320	900	1800	1250	-	-	650	-	2600	56820
T_8	44000	1800	3500	320	900	1800	1250	-	-	-	400	2600	56570
T_9	44000	1800	3500	320	900	1800	1250	3000	560	-	-	2600	59730
T_{10}	44000	1800	3500	320	900	1800	1250	3000	560	650	-	2600	60380
T_{11}	44000	1800	3500	320	900	1800	1250	3000	560	650	400	2600	60780

b. Non-material cost (Tk.)

Treatments	Land preparation	Transplanting cost	Weeding	Harvesting and marketing	Subtotal (b)	Input cost (A = a+b)
T_1	4400	2200	2250	2500	11400	64520
T_2	4400	2200	2250	2500	11400	66320
T_3	4400	2200	2250	2500	11400	65770
T_4	4400	2200	2250	2500	11400	67570
T_5	4400	2200	2250	2500	11400	70570
T_6	4400	2200	2250	2500	11400	68130
T_7	4400	2200	2250	2500	11400	68220
T_8	4400	2200	2250	2500	11400	67970
T_9	4400	2200	2250	2500	11400	71130
T_{10}	4400	2200	2250	2500	11400	71780
T_{11}	4400	2200	2250	2500	11400	72180

Labor cost @ Tk. 100 per day

B. Overhead cost (Tk.)

Treatment	Cost of lease of lands for 6 months	Miscellaneous cost 5% of input cost	Interest on running capital (for 6 month 13% of cost per year)	Subtotal (B)	Total cost of production [A+B]
T_1	15000	3226	4193.80	22419.80	86939.80
T_2	15000	3316	4310.80	22626.80	88946.80
T_3	15000	3288.50	4275.05	22563.55	88333.55
T_4	15000	3378.50	4392.05	22770.55	90340.55
T_5	15000	3528.50	4587.05	23115.55	93685.55
T_6	15000	3406.50	4428.45	22834.95	90964.95
T_7	15000	3411	4434.30	22845.30	91065.30
T_8	15000	3398.50	4418.05	22816.55	90786.55
T_9	15000	3556.50	4623.45	23179.95	94309.95
T_{10}	15000	3589	4665.70	23254.70	95034.70
T_{11}	15000	3609	4691.70	23300.70	95480.70

Conclusion

The economic analysis of onion and garlic production under various micronutrient treatments reveals that the application of zinc (Zn) and boron (B) significantly enhances yield and profitability. Among all treatments, T4 (Zn + B) demonstrated the highest net income and benefit-cost ratio for onion production (1:8.58), while T3 (B) resulted in the most profitable garlic production (1:6.50). The control treatment (T1) consistently exhibited the lowest returns, indicating the importance of micronutrient supplementation. For onion production, the combination of Zn and B (T4) resulted in the highest yield (13.38 t/ha) and net income (425,569.95 Tk/ha). Similarly, in garlic cultivation, boron application (T3) maximized net income (485,866.45 Tk/ha) and benefit-cost ratio. The addition of multiple micronutrients beyond Zn and B (e.g., Mo, Mn, Cu, and Cl) did not always translate into proportional economic benefits, as seen in treatments like T9 and T11, where production costs increased without significantly higher yields. These findings suggest that targeted micronutrient management, specifically Zn and B, can improve onion and garlic production efficiency, making it a viable strategy for maximizing profitability. Farmers should prioritize cost-effective nutrient management approaches to enhance productivity while maintaining economic sustainability.

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