BUILDING GREEN COMMUNITIES:
HOW ECO-FRIENDLY FARMING AND RURAL INNOVATIONS IMPROVE LIVELIHOODS IN KAMALGANJ, BANGLADESH

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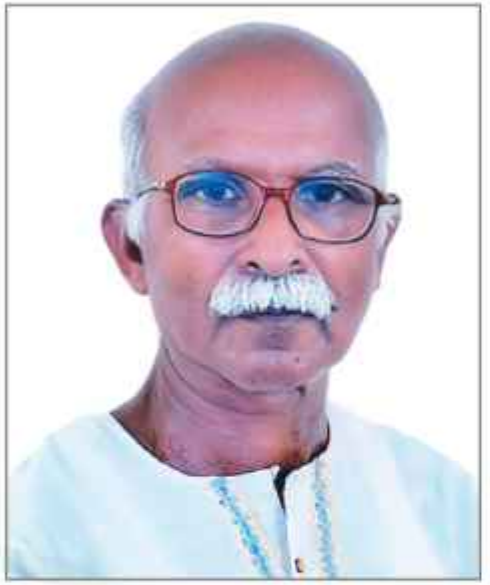

DWIPENDRA CHANDRA BHATTACHARJEE
Chairman
Patakuri Society.

Preface

Aligned with global agricultural advancements, Bangladesh is undergoing a significant shift from conventional methods to a modern, technology-driven system for vegetable and crop production. This evolution is transforming the sector from subsistence farming into a vibrant commercial industry, substantially increasing national yield and securing Bangladesh's position as the world's third-largest vegetable producer. Rising consumer demand for vegetables—essential for creating palatable, nutritious, and balanced diets—highlights the critical importance of this transition. Producing safe, high-quality vegetables and crops relies on a stable foundation of core agricultural principles, which must be upheld even as continuous improvements are adopted. To propel this vital sector forward, the Patakuri Society is preparing to launch the "Ecology Friendly Safe Vegetable and Crop Production and Marketing" Value Chain sub-project, under the umbrella of the Rural Micro Enterprise Transformation Project (RMTP). This initiative will directly engage 11,500 vegetable and crop farmers in Kamalganj upazila, Moulvibazar district. Its primary objective is to elevate the incomes of marginal farmers and micro-entrepreneurs by providing them with eco-friendly technologies and practices. Key interventions include soil testing, organic fertilizer and pesticide application, Good Agricultural Practices (GAP), access to quality seeds and seedlings, and nursery development—integrated throughout the entire cycle of safe production, processing, and marketing. The accompanying book, "Building Green Communities: How Eco-Friendly Farming and Innovation Improve Livelihoods in Kamalganj, Bangladesh," documents the tangible achievements and lessons learned from this project's implementation. I am confident that the knowledge and skills disseminated through this project will establish an enduring model of ecological farming and sustainable agricultural practice. Moreover, the introduction of new value-added products will unlock fresh market opportunities for micro-entrepreneurs. I extend my sincere best wishes for the resounding success of this transformative initiative.

Chairman

DEBASHISH DUTTA
Chief Executive
Patakuri Society.

Foreward

The primary driving force of Bangladesh's economy and livelihood is agriculture. It plays a crucial role in the prosperity of a vast population by enhancing productivity and income, fulfilling nutritional needs, and creating employment for men and women in rural areas. To meet the country's increasing demand for vegetables, farmers are currently using excessive chemical fertilizers and harmful pesticides. This, on one hand, is destroying soil health and the natural self-regulating capacity of ecosystems, and on the other hand, is having multifaceted negative impacts on the environment and public health. The organic matter content in agricultural land has decreased from 5% to a current level of 0.9%. As a result, the number of microbes in the soil is continuously declining, and soil functionality is severely impaired, leading to the disruption of the natural balance of the ecosystem. Excessive use of chemical fertilizers and pesticides in agricultural land is also increasing greenhouse gas emissions and environmental pollution. With the support of the Palli Karma-Sahayak Foundation (PKSF), the "Ecology Friendly Safe Vegetable and Crop Production and Marketing" Value Chain sub-project is being implemented in Kamalganj Upazila of Moulvibazar district by the organization "Patakuri Society". This project is assisting farmers in producing and marketing various vegetables and other crops in an environmentally friendly manner. With financial assistance from the IFAD, DANIDA, and PKSF, the RMTP project is implementing approximately 30 sub-projects in the horticulture sector across the country. Through this project, various technologies are being extended to the farmer level, which plays a supportive role in environmental protection and mitigating the adverse effects of climate change. On behalf of the organization, I extend heartfelt thanks and gratitude to PKSF for enabling the publication of a research-based book titled "Building Green Communities: How Eco-Friendly Farming and Innovation Improve Livelihoods in Kamalganj, Bangladesh," on the ongoing sub-project in Kamalganj Upazila. I believe this book will inform project members and other farmers about environmentally friendly and climate-resilient technologies and inspire them to adopt these technologies in their own farming practices.

Chief Executive

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ACKNOWLEDGEMENT

It is a great privilege to conduct this study on "Building Green Communities: How Eco-Friendly Farming and Rural Innovations Improve Livelihoods in Kamalganj, Bangladesh" under the Ecology-Friendly Safe Vegetable and Crop Production and Marketing Sub-Project. This study involved extensive research, fieldwork, and analysis, and its successful completion would not have been possible without the support of numerous individuals and institutions. I wish to extend my sincere gratitude to all who contributed. First and foremost, I am deeply grateful to Patakuri Society for facilitating this evaluation and providing continuous guidance throughout the research process. I am particularly thankful to Md. Tarek Nasir Ullah, Value Chain Facilitator, Rural Microenterprise Transformation Project (RMTP), whose insights, field support, and valuable notes during the field visits and report writing greatly enriched the study and ensured the quality of its findings. I also extend my sincere appreciation to all the members of the Project Management Unit (PMU), RMTP, PKSF, for their invaluable guidance, technical advice, and support in ensuring smooth data collection, communication, and interpretation of findings. My gratitude goes to the farmers, local communities, and key informants in Kamalganj upazila, Moulvibazar District, whose cooperation and willingness to share their experiences made this study meaningful and insightful. I also thank the data enumerators and all local participants, whose time, knowledge, and assistance were essential to the implementation of this study. Finally, I acknowledge the support of PKSF, IFAD, DANIDA, and other stakeholders for funding and facilitating the sub-project. Their commitment to promoting sustainable micro-enterprises, eco-friendly agricultural practices, and inclusive rural development provided the foundation for this evaluation. I hope that the findings of this study will offer valuable insights for policymakers, practitioners, and sector leaders in designing and implementing future interventions in the safe vegetable and crop production sector.

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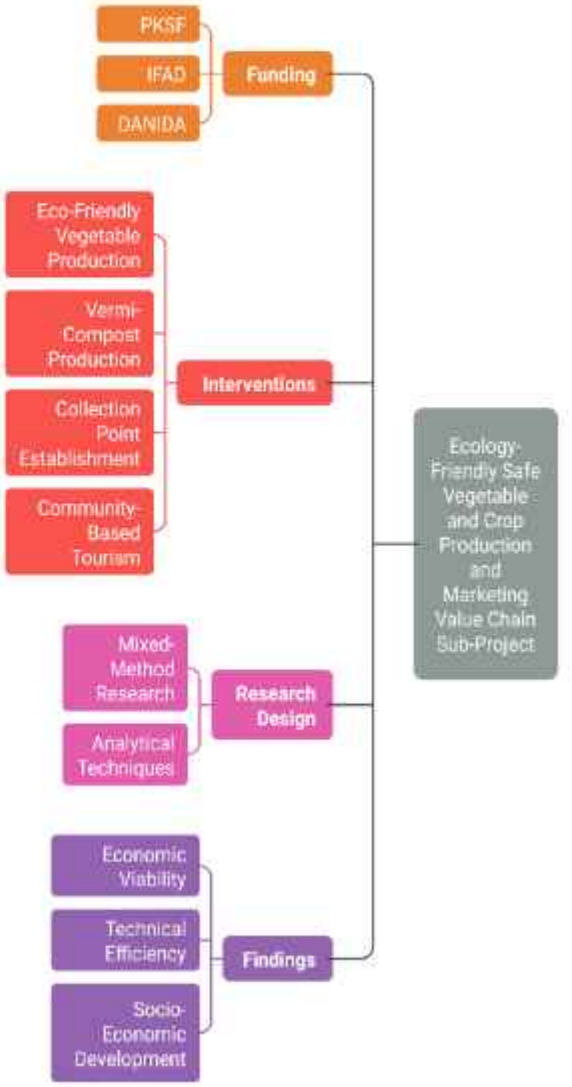
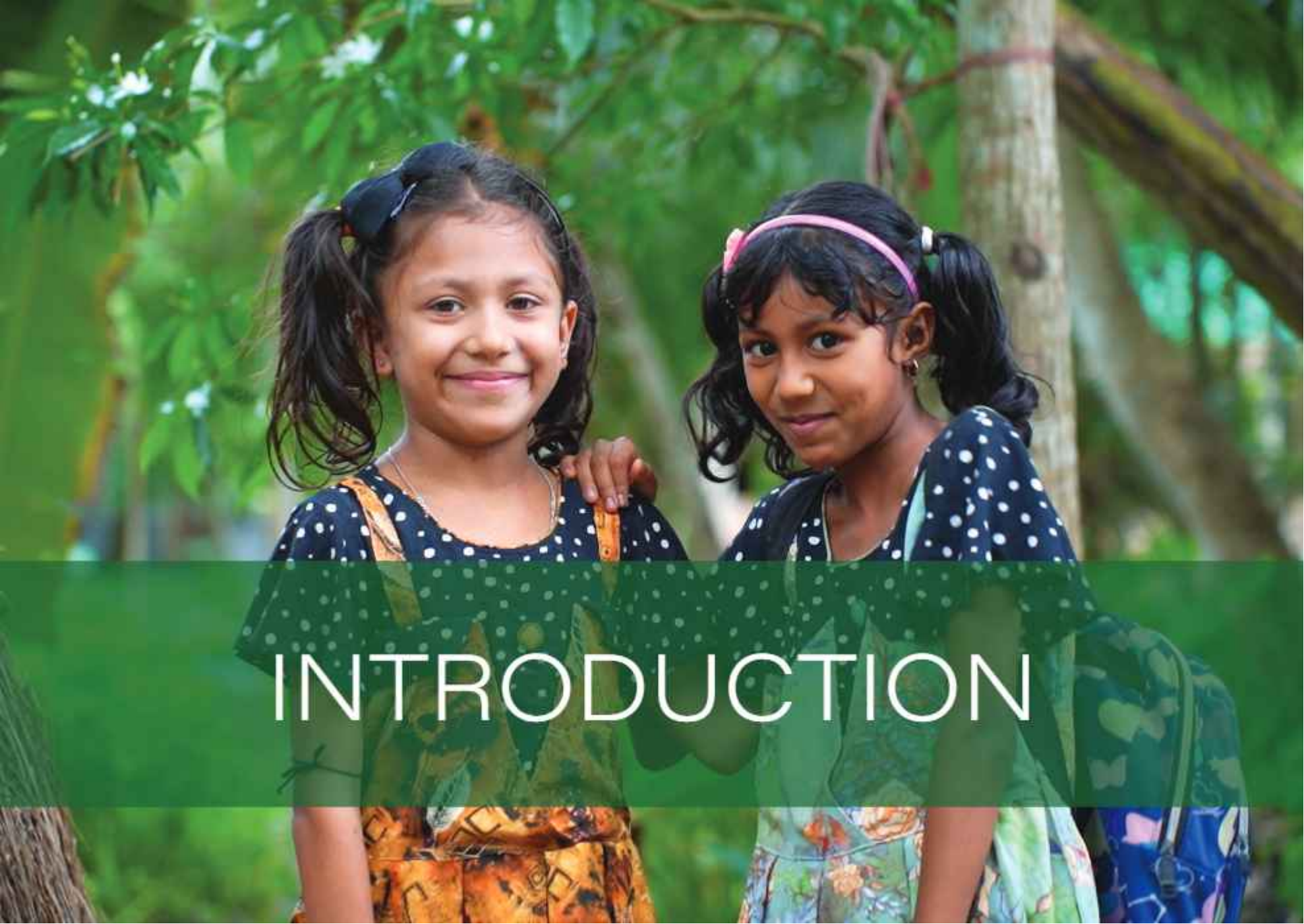
This Study is part of
Ecology Friendly Safe Vegetable and Crop Production and Marketing a Sub-Value chain project
Rural Microenterprise Transformation Project (RMTP)

Summary

The "Ecology-Friendly Safe Vegetable and Crop Production and Marketing Value Chain Sub-Project," implemented by the Patakuri Society in Moulvibazar District, aimed to boost smallholder productivity and promote environmental sustainability through eco-friendly agricultural practices. Key interventions included eco-friendly vegetable production, vermi-compost production, establishment of collection points, and community-based tourism (CBT). The project used a mixed-method research design, including surveys and interviews, to assess outcomes. Findings highlighted that eco-friendly practices, especially grafted tomato production, were economically viable, with significant technical efficiency gains identified. Vermi-composting proved effective for soil management but faced market access challenges. CBT contributed positively to local development, though infrastructure and financing issues persisted. Overall, the project exemplified the benefits of sustainable agricultural practices and community engagement and offers insights for future rural development initiatives in Bangladesh.

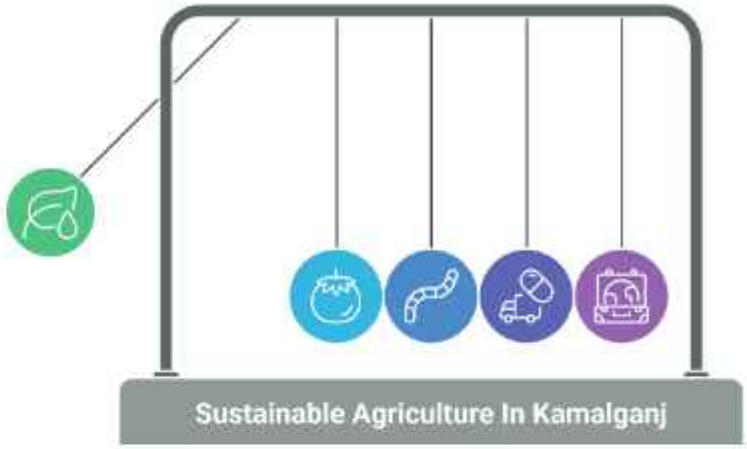
Ecology-Friendly Safe Vegetable and Crop Production and Marketing Value Chain Sub-Project



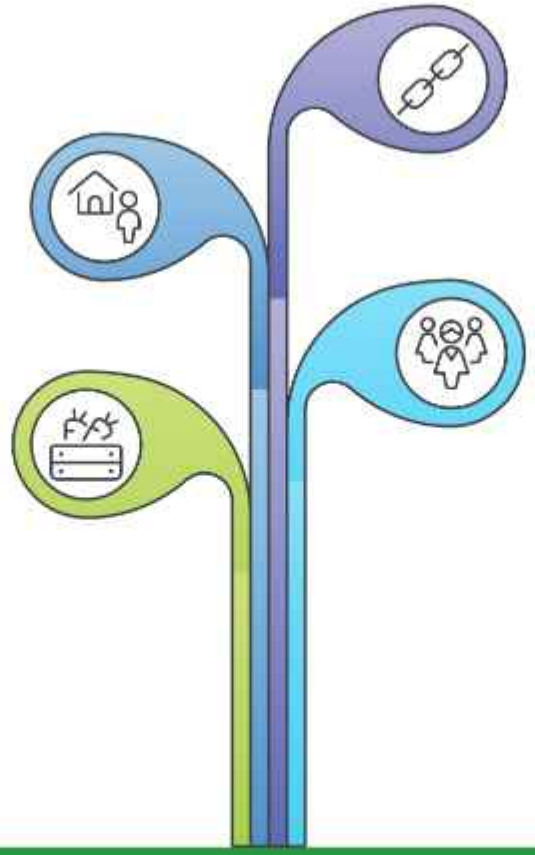


INTRODUCTION

Sustainable agriculture is vital for economic growth, food security, and environmental conservation. In Bangladesh, eco-friendly farming practices are essential for long-term agricultural productivity and rural income. Grafted tomato cultivation is popular for its higher yields and disease resistance, while practices like integrated pest management and organic inputs enhance soil health and farmer income. Vermicomposting improves soil structure and nutrient retention, benefiting smallholder farmers through initiatives like the Rural Microenterprise Transformation Project which promotes sustainable practices. Efficient marketing through collection points reduces post-harvest losses for perishable crops like tomatoes. Additionally, community-based tourism in regions like Moulvibazar fosters socio-economic development and cultural preservation. This study highlights how sustainable agricultural practices and community-driven initiatives can improve livelihoods and promote environmental sustainability in Kamalganj upazila.



OBJECTIVES



Household Welfare

Vermi-compost production improves household welfare significantly.

Economic Viability and Productivity

Eco-friendly practices boost economic viability and productivity.

Value Chain Efficiency

Collection points enhance value chain efficiency in vegetable production.

Socio-Economic Development and Gender Empowerment

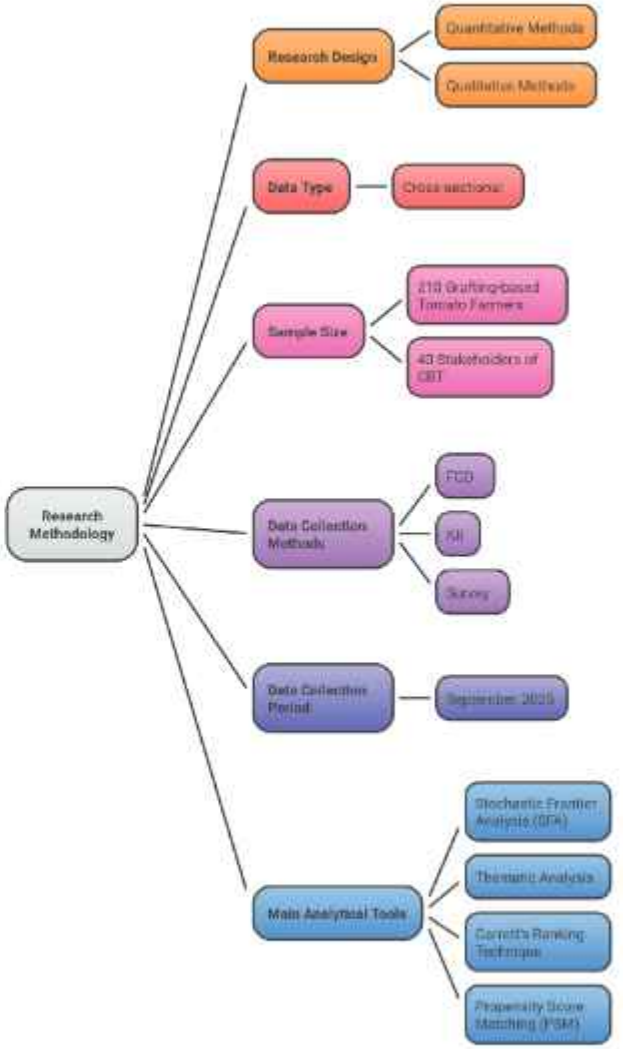
Community-based tourism fosters socio-economic development and empowerment.

1. To examine the adoption of eco-friendly farming practices on economic viability and productivity and its determinants.
2. To evaluate the role of community-based tourism (CBT) in promoting socio-economic development and gender empowerment.
3. To investigate the impact of vermi-compost production on the household welfare.
4. To examine the impact of collection points on value chain efficiency of vegetable production.

METHODOLOGY

Research design	: Mixed (quantitative and qualitative methods)
Data type	: Cross-sectional.
Sample size	: 210 grafting-based tomato farmers & 40 stake holders of CBT.
Data collection methods	: FGD, KII, Survey
FGDs	: Grafting tomato & vermi-compost
KII	: Community-based tourism
Data collection period	: September, 2025
Main Analytical tools	:

- Stochastic Frontier Analysis (SFA)
- Thematic Analysis
- Garrett's Ranking Technique
- Propensity Score Matching (PSM)



RESULTS & DISCUSSION

4.1 Profitability and eco-friendly practices' impact on technical efficiency

4.1.1 Descriptive statistics

The descriptive statistics of socio-economic characteristics of tomato farmers in Kamalganj upazila, the status of eco-friendly practices, and the input used by sampled tomato farmers are presented in Table 1. The average age of tomato farmers was 42 years in the study area, which indicates that most of the tomato farmers were in their middle and active age. Middle-aged farmers are more involved in vegetable production due to their risk-bearing capacity and considerable experience (Hasan et al., 2025). The household heads had an average of five years of schooling, indicating that most tomato producers had completed primary education. Education is a crucial factor to increase awareness and adoption of good agricultural practices (Hasan et al., 2024). Our findings indicate the limited adoption of eco-friendly practices. The average household size of tomato-growing households was 5 members, indicating that a medium-sized family may provide adequate labor for grafted tomato production, which is labor-intensive in Bangladesh. The national rural average family size is also around five members (BBS, 2023). In the study area, the average number of earning members per household was one, suggesting a low dependency ratio. The agricultural sector is male-dominated (Peralta, 2022), which aligns with the findings of this study stating that 91% of households were headed by males in the study area. The majority, 93%, of farmers (i.e., household heads) were married, indicating family stability, which may favorably affect labor allocation and management. Vegetables, specifically tomatoes, were the main source of income for 95% of respondents, indicating a high level of specialization in vegetable farming. Such specialization may reduce inefficiency in vegetable production by enhancing technical knowledge and skills (Hasan et al., 2020). The tomato growers had a mean experience of 22 years in vegetable cultivation, which is likely to positively influence the productivity of grafted tomato production. Access to extension services from government and non-government institutions was relatively high in the study area, estimated at 83%, which is encouraging, as extension services, training, and credit play a crucial role in promoting eco-friendly practices and advanced production techniques. Access to training and extension services has a positive impact on productivity (Antwi-Agyei and Stringer, 2021; Hossain and Rahman, 2021; Boothby et al., 2010). Also, limited credit availability may constrain the adoption of eco-friendly practices, which may often require a handsome amount of investment (Zhang et al., 2025). In the study area, 53% of farmers received training, but only 23% of farmers had access to credit for tomato production. The descriptive statistics on the land tenure system show that 57% of farmers grew tomatoes on their own land, 33% on leased land, and 10% under mixed tenure arrangements. This distribution indicates a considerable share of tenant farming.

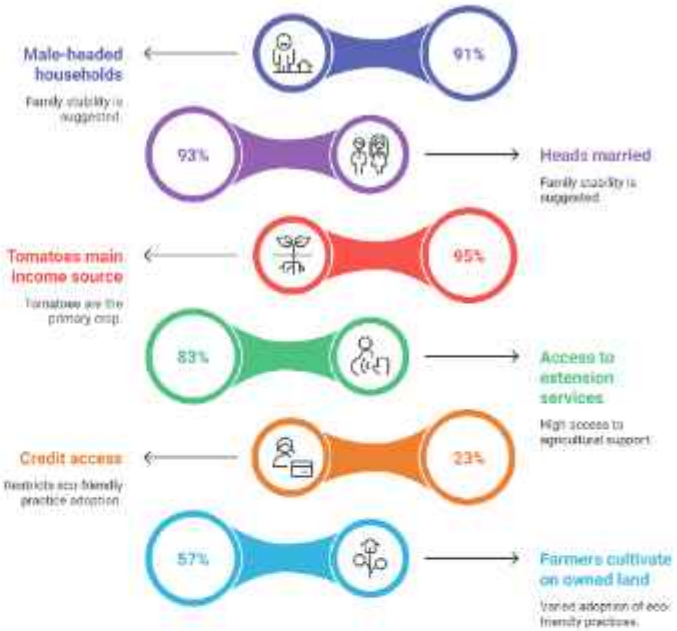
Table 1. Descriptive Statistics

Variables	Unit	Mean/Percentage	Standard deviation
Socio-economic related variables			
Age	years	42.0	12.0
Education	years	5.0	3.32
Household size	number	5.0	1.64
Number of earning members	number	1.0	0.69
Gender			
Female (0)	%	9.0	28.09
Male (1)	%	91.0	28.09
Marital Status			
Unmarried (0)	%	6.0	23.58
Married (1)	%	93.0	25.97
Others (2)	%	1.0	0.09
Occupation			
Vegetable production (0)	%	95.0	0.19
Others (1)	%	5.0	0.17
Experience	years	22.0	11.49
Access to extension service			
No (0)	%	17.0	37.81
Yes (1)	%	83.0	37.81
Access to training			
No (0)	%	47.0	50.00
Yes (1)	%	53.0	50.00
Access to credit			
No (0)	%	77.0	42.22
Yes (1)	%	23.0	42.22
Land tenure			
Own (0)	%	57.0	49.61
Lease (1)	%	33.0	47.13
Mixed (2)	%	10.0	30.00

Variables	Unit	Mean/Percentage	Standard deviation
Eco-friendly farming related variables			
Sources of grafted saplings			
Own (0)	%	41.0	49.32
Purchased (1)	%	59.0	49.32
Years to adoption of grafting	years	5	2.1
Use of vermi-compost			
No (0)	%	56.0	49.79
Yes (1)	%	44.0	49.79
Cow dung			
No (0)	%	6.0	24.41
Yes (1)	%	94.0	24.41
Yellow paper use			
No (0)	%	55.0	49.84
Yes (1)	%	45.0	49.84
Pheromone trap use			
No (0)	%	58.0	49.40
Yes (1)	%	42.0	49.40
Mulching film use			
No (0)	%	26.0	44.33
Yes (1)	%	74.0	44.33
Input-Output related variables			
Output	Kg	68510.0	67246.50
Land	Ha	0.26	0.20
Labor	Man-days	323.0	260.60
Material cost	Tk.	705803.0	638268.00
Irrigation cost	Tk.	31257.0	24865.70
Tractor cost	Tk.	30234.0	34338.60

Source: Authors' estimation, 2025.

The adoption of eco-friendly practices among tomato farmers was varied and specifically focused on pesticide reduction. About 59% of farmers produced grafted saplings in their own homestead area or nursery, while 41% purchased grafted seedlings from a local market or nursery. The average time to adoption of grafting techniques was 5 years among tomato producers. Regarding organic soil management, 44% of farmers applied vermi-compost to produce tomatoes, while cow dung remained the main organic input in the study area. About 94% of farmers applied cow dung as organic fertilizer for tomato production. The high use of cow dung reflects traditional organic practices, whereas vermi-composting, being a relatively modern method, remains less adopted. The use of pest management practices such as yellow sticky papers (45%), pheromone traps (42%), and mulching films (74%) shows growing awareness of non-chemical pest control. These practices are essential for reducing pesticide dependency, thus lowering production costs and environmental damage. Table 1 also shows that the average yield of grafted tomato was 68510 Kg per hectare, with a standard deviation of 67246.5 Kg, indicating a considerable variability in yield among farmers. This may be the result of differences in management practices, technologies, and input application. The mean landholding among tomato farmers was 0.26 ha in the study area, suggesting smallholder tomato producers in Bangladesh. The per hectare average cost of materials, irrigation, and tractor of tomato production in the study area were calculated to be 705,803 Tk., 31,257 Tk., and 30,234 Tk. Respectively. These findings are consistent with other studies, for instance (Das and Jahan, 2022). The mean amount of labor was calculated to be 323 man-days per hectare, indicating the labor-intensive nature of tomato production in the study area.



4.1.2 Profitability of Grafted Tomato Production & Mixed Cropping

Table 2 represents the profitability analysis of grafted tomato production in Kamalganj upazila. The findings demonstrated the impact of various costs and returns on tomato growers' profitability and its economic viability. The findings show that the per hectare average cost of production was calculated to be 1,057,161 Tk. The total variable cost of tomato production in the study area amounted to 872,494 Tk., involving seedling, staking, vermi-composting, chemical fertilizer, and plant protection material costs. The total fixed costs, including family labor and land use, accounted for 184,667 Tk. The cost of labor, land use, and physical input materials were the major contributors to the cost of tomato production. Tomato farmers received a total return of 1,507,220 Tk., resulting in a gross margin of 634,726 Tk. and a net profit of 450,059 Tk. The benefit-cost ratio of tomato production was calculated to be 1.43, suggesting grafting-based tomato production was profitable. Farmers gained 1.43 Tk. for every 1 Tk. invested, which highlights the economic viability of tomato production.

The profitability findings from this study are consistent with the previous studies that indicate significant economic benefits of tomato production. The average BCR of 1.43 that indicates a positive return on investment is somewhat moderate compared to BCR values reported for other regions. For example, past studies reported the BCR of 1.89 (Yunus et al, 2023) and 1.30 (Hasan and Bai, 2016) for conventional tomato farming in Mymensingh, Bangladesh. The sampled tomato producers of this study used the BARI-8 hybrid variety of tomato. The BCR of this variety was found to be 2.64 (Hajong et al, 2018) in Jessore district and 1.85 (Samshunnahar et al, 2016) in Rajshahi district of Bangladesh. The incidence of flood during the production period in some part of the study area is the main reason for the lower BCR findings of the BARI-8 variety in this study. Additionally, the price of inputs and outputs, whether farm-gate or market, is both time and location sensitive and affects both the cost and returns, and that can be another reason for a lower BCR than the reference BCR. Also, variations in BCR are attributable to differences in farming systems, input costs, and local agro-ecological conditions.

Table 2. Per hectare profitability of tomato production under mono and mixed cropping system.

Variables	Unit	Quantity	Price	Cost / Returns
Seedling cost	Number	21203	10.23	216907
Staking cost	Number	21457	3.05	65444
Vermi-compost cost	Kg	5036.1	13.80	69498
Cost of cow dung	Kg	11806	2.00	23616
Cost of chemical fertilizer	Tk.	-	-	109159
Cost of vitamin use	Tk.	-	-	5833
Cost of yellow paper	Number	83	45	3735
Cost of Pheromone trap	Number	56	60	3360
Cost of Mulching	Tk.	-	-	99739
Cost of plant protection materials	Tk.	-	-	108512
Cost of irrigation	Tk.	-	-	31257
Cost of tractor	Tk.	-	-	30234
Cost of Hired labor	Man-days	263	400	105200
A. Total Variable cost	Tk.			872494
Cost of Family labor (a)	Tk.	60	400	24000
Cost of land use (b)	Tk.	-	-	164667
B. Total Fixed cost (a + b)	Tk.			184667
C. Total cost of production (A+B)	Tk.			1057161
D. Total Return	Tk.	68510	22	1507220
E. Gross Margin (D – A)	Tk.			634726
F. Net margin (E – B)	Tk.	-	-	450059
G. Benefit-Cost ratio (BCR) (D/C)			1.43	
Mixed cropping with grafting tomato				
H. Total cost for growing other crops	Tk.	-	-	42736
I. Total revenue from other crops	Tk.	-	-	143396
J. Total cost of production under mixed cropping (H+C)	Tk.	-	-	1099897
K. Total return under mixed cropping (I +D)	Tk.	-	-	1650616
L. Net margin of Mixed cropping (K - J)	Tk.	-	-	550719
M. Benefit -Cost ratio (BCR) under mixed cropping system (K/J)			1.50	

Source: Authors' estimation, 2025.

However, the considerable input costs observed in this study, particularly for vermi-composting and mulching, reflect the emphasis on sustainable organic amendments and soil cover techniques. These practices are known to enhance soil health and reduce chemical dependency (Manzoor et al., 2024). The profitability scenario of the study area supports the sustainability of tomato production. Because the application of organic fertilizer and eco-friendly techniques enhanced both yield and production quality, thereby improving profitability (Laily et al., 2021). Labor remains a significant cost component of grafting-based tomato cultivation, constituting a considerable amount of total expenses when including hired and family labor, highlighting labor-intensive activities such as staking, mulching, and pest management. The net profit and benefit-cost ratio (BCR) increased under the mixed cropping system in the study area. Table 2 shows that the BCR became 1.50 for the tomato producers who adopted the mixed cropping farming system, which was 1.43 for the mono cropping system. The per hectare net margin also increased from 450059 Tk. to 550719 Tk. on average in the study area.

Since the farmers incorporated high-value vegetables and crops like French beans, radish, and potatoes with tomato, they received a higher return for their vegetables. Also, they did not apply additional physical inputs except seed and saplings for these additional vegetables, which saved their cost. Thus, mixed cropping generated several benefits to the agricultural system in the study area by reducing the demand for synthetic inputs. The system benefited farmers in terms of health and economics by demanding lower application of chemical inputs, contributing to food safety for consumers, and lessening the damage to the ecosystem and environment compared to a mono-cropping system. Overall it has increased the income of farmers who are involved with mixed cropping systems in their tomato cultivation. Previous studies also documented the agronomic and socio-economic benefits of mixed cropping. For example, Horner et al. (2019) found that intercropping field pea varieties increased yields and improved root microbial communities, while Tang et al. (2024) found that multiple cropping enhanced soil bacterial diversity and fertility in paddy fields. Balandaitė et al. (2024) highlighted improvements in biodiversity and ecosystem services under multi-cropping systems, and Yao et al. (2024) demonstrated that mixed oat-field pea systems increased forage yield and quality. Beyond productivity, Shaibur et al. (2021) showed that mixed cropping in Bangladesh improved farmers' income and employment opportunities.

Grafted Tomato Production Profitability in Kamalganj

Mixed cropping systems significantly enhance profitability and sustainability in grafted tomato production.

4.1.3 Model Specification Test Results

Table 3 compares the Cobb-Douglas and Translog production functions for estimating technical efficiency by following the stochastic frontier approach. The Cobb-Douglas production function, with 26 parameters, yielded a log-likelihood of -140.67, an AIC of 167.89, and a BIC of 201.78. In contrast, the Translog production function, with 40 parameters, estimated a log-likelihood of -186.45, an AIC of 193.33, and a BIC of 280.36. Since the Cobb-Douglas production function has both lower AIC and BIC than the Translog function, the findings indicate that the Cobb-Douglas production function should be preferred over the Translog production function. Consequently, the Cobb-Douglas production function was chosen for estimating technical efficiency in the sampled tomato farms.

Table 3. Specification of model for efficiency estimation.

Null Hypothesis	DF	Log-likelihood value	AIC[7]	BIC[8]
Cobb-Douglas production function	26	-140.67	167.89	201.78
Trans-log production function	40	-186.45	193.33	280.36

DF-degrees of freedom. AIC-Akaike information criterion. BIC-Bayesian information criterion.

Source: Authors' estimation, 2025

4.1.4 Estimates of stochastic production frontier

The estimated parameters of the stochastic production function, using maximum likelihood estimation (MLE), are reported in Table 3. The data analysis was conducted in STATA 18 software. Table 4 represents a significant Wald Chi-square statistic (i.e., -140.67), suggesting that the joint effect of all independent variables on tomato output is statistically significant. This indicates that the model is well fitted. For ease of interpretation, all input and output variables were normalized by dividing them by their respective sample means. This normalization permits the estimated first-order parameters of the Cobb-Douglas production function to be interpreted as partial output elasticities with respect to a unit change in each input variable, while holding all other inputs at their sample mean values (Huang et al., 2016).

Table 4. Estimates of stochastic production frontier and technical inefficiency model.

Variables	Symbol	Coefficient	Standard Error	z	P>|z|
Dependent variable: Tomato production					
Ln land	β_1	0.273***	0.105	2.65	0.008
Ln labor	β_2	0.069***	0.018	3.83	0.000
Ln materials	β_3	-0.037**	0.018	-2.05	0.040
Ln irrigation cost	β_4	0.156	0.105	1.49	0.135
Ln tractor cost	β_5	0.057**	0.025	2.51	0.012
Constant	β_0	0.576***	0.159	3.62	0.000
Dependent variable: technical inefficiency					
Age	Z_1	0.017	0.012	1.31	0.190
Education	Z_2	-0.007**	0.003	2.33	0.020
Household size	Z_3	-0.085**	0.045	-1.97	0.049
Experience	Z_4	-0.017	0.013	-1.33	0.184
Number of Earning members	Z_5	0.017*	0.009	1.88	0.060
Dummy gender (1)	Z_6	0.343	0.391	0.88	0.381
Dummy access to extension (1)	Z_7	-0.500***	0.102	-2.94	0.003
Dummy access to training (1)	Z_8	-0.458**	0.232	-1.97	0.049
Dummy access to credit (1)	Z_9	-0.366	0.311	-1.18	0.239
Dummy adoption of mixed cropping (1)	Z_{10}	-0.982***	0.246	-4.07	0.000
Dummy land tenure leasing (1)	Z_{11}	0.790***	0.208	3.78	0.000
Dummy land tenure mixed (2)	Z_{12}	0.318	0.471	0.68	0.500
Dummy sources of grafted saplings (1)	Z_{13}	0.027	0.251	0.11	0.916
Years to adoption of grafting	Z_{14}	-0.128***	0.058	-2.59	0.010
Dummy vermi-compost use	Z_{15}	-0.023**	0.011	-2.09	0.037
Dummy yellow paper use	Z_{16}	-0.134**	0.056	-2.35	0.019
Dummy pheromone trap use	Z_{17}	-0.480**	0.235	-2.04	0.041
Dummy mulching film use	Z_{18}	-0.539**	0.270	-1.99	0.047
Constant	Z_0	-2.243**	0.879	-2.55	0.011
Mean technical efficiency			70.82		
Log Likelihood			-140.67		
Wald Chi^2			35.45***		
Prob > Chi^2			0.000		
Number of observations			210		

****significant at 1% level, **significant at 5% level, *significant at 10% level.*
Source: Authors' estimation, 2025

Table 4 also shows that the estimated coefficients of land (significant at the 1% level), labor (significant at the 1% level), and tractor (significant at the 5% level) had expected positive signs and were statistically significant. The elasticities of land, labor, and tractors were estimated to be 0.273, 0.069, and 0.057, respectively. These elasticities suggest that land was the most essential input of tomato production, followed by amount of labor and tractor cost. These findings emphasize the favorable impact of land and labor on tomato production and align with the theory of production economics, which states that output is a function of both fixed and variable input. However, the estimated coefficient of material cost was -0.037, which had a negative sign and was statistically significant at the 5% level. This implies that the reduction of 1% cost in physical input could increase 3.7% of tomato production in the study area. The negative impact of material costs on production underscores the importance of cost-effective input management in tomato cultivation.

Tomato production in Bangladesh is labor intensive, and for this reason, land and labor are the dominant contributors to it (Mitra and Yunus, 2018), which is consistent with this study's findings. Previous studies (e.g., Younas et al., 2024; Hasan et al., 2020; Sibiko et al., 2013; Dipelou and Akinbode, 2008) also reported that the larger farm sizes and increased labor inputs could enhance productivity. The insignificance of irrigation costs in this study contrasts with expectations, possibly due to the study area's reliance on natural rainfall, reducing the need for irrigation. However, this finding is also consistent with the prior research, indicating that water availability and irrigation practices can significantly affect crop yields (Hassan et al., 2020).

4.1.5 Impact of eco-friendly practice on technical efficiency

The use of mulching films is related to physical control of weeds (Jabran, 2019); installation of yellow sticky papers and pheromone traps is related to integrated pest management (Mohapatra et al., 2024); and application of vermi-compost and adoption of mixed cropping is related to reduction of synthetic inputs and promotion of biodiversity (Moreira et al., 2024). All these practices are eco-friendly, which protects biodiversity, ecosystems, and the environment through reducing pollution. The main focus of this paper was to examine the impact of these practices on efficiency, and the findings are presented in Table 4. The results show that the estimated coefficients of variables related to these eco-friendly practices had expected negative signs, indicating adoption of these practices reduces the technical inefficiency in tomato production. The coefficients of adoption of mixed cropping, vermi-compost application, yellow paper use, pheromone trap use, and mulching film use were estimated to be -0.982 (significant at the 1% level), -0.023 (statistically significant at the 1% level), -0.134 (significant at the 5% level), -0.480 (significant at the 5% level), and -0.539 (significant at the 5% level), respectively. These coefficients imply that mixed-cropping-adopting farmers were about 98% technically more efficient than their counterparts. Similarly, vermi-compost, yellow paper, pheromone lure, and mulching film users were 2.3%, 13.4%, 48%, and 53.9% technically more efficient than non-users in the study area, respectively. Table 5 in this paper also presented a comparison of technical efficiency between eco-friendly practice-following farms and non-following farms. The findings suggest that the mean technical efficiency of vermi-compost using farms (73%) was higher than their counterparts (67%). Similarly, the average technical efficiency of tomato farms that applied yellow paper, pheromone traps, and mulching films was higher than the non-using farms. The average technical efficiency of mixed cropping farms was 72%, which was also higher than the non-mixed cropping farms (67%).

The findings of this study are also consistent with the prior research. Mkhabela (2010) found that vegetable-based mixed cropping positively affects the technical efficiency. Amos et al. (2004) also showed that mixed cropping systems enhance technical efficiency and productivity in Nigeria. Moreira et al. (2024) documented the favorable impact of intercropping, which is also a type of mixed cropping, on productivity and raising farmers' income. The positive impact of vermi-compost application on soil health promotion and productivity enhancement was found in the studies of Gazi et al. (2024) and Manzoor et al. (2024). The techniques of chemical control in the form of yellow paper use and the pheromone trap technique significantly enhanced the productivity of vegetables, especially tomato production (Kifelew et al., 2024; Mohapatra et al., 2024). Evidence of the positive impact of plastic mulching films, whether biodegradable or not, on yield, productivity, and efficiency through weed control and input use efficiency in vegetable production, especially tomatoes, is found in the past literature (Burato et al., 2025; Hu et al., 2023; Xiao et al., 2023; Amare and Desta, 2021).

The results of this study could be explained by the agronomic and economic benefits associated with the adoption of eco-friendly practices in tomato production. Mixed cropping probably enhanced resource use efficiency by promoting complementary interactions among crops, which resulted in better soil fertility management, pest suppression, and lowered dependency on chemical inputs. The application of vermi-compost might enhance soil structure, increase microbial activity, and improve nutrient availability, which collectively contributes to better plant growth and yield performance. Unlike chemical fertilizers, vermi-compost releases nutrients gradually, leading to more efficient nutrient absorption and reduced wastage, which is also another reason for efficiency improvement. The use of yellow sticky papers and pheromone traps, both components of integrated pest management (IPM), reduced pest infestations through physical and behavioral control mechanisms. This minimized crop losses and decreased reliance on synthetic pesticides. Similarly, the use of mulching films conserved soil moisture, suppressed weeds, and maintained favorable soil temperatures. These effects created better plant growth conditions and reduced competition for nutrients and water, resulting in higher productivity and efficiency. Overall, the findings suggested that eco-friendly practices improved input utilization and yield outcomes by enhancing soil health, pest control, and resource management. Consequently, farmers who adopted these practices achieved higher technical efficiency compared to non-adopters.

Table 5. Summary of technical efficiency

Eco-friendly practices	No. of farms	Technical efficiency	Standard deviation
Vermi-compost using farms	95	0.73	0.20
Vermi-compost non-using farms	115	0.67	0.17
Use of yellow paper	98	0.71	0.21
Non-use of yellow paper	112	0.69	0.17
Use of pheromone trap	91	0.74	0.19
Non-use of pheromone trap	119	0.66	0.18
Use of mulching films	151	0.71	0.19
Non-use of mulching films	59	0.68	0.18
Adoption of mixed cropping	97	0.72	0.21
Non-adoption of mixed cropping	113	0.67	0.17
Mean	210	70.82	0.19

Source: Authors' estimation, 2025.

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4.1.6 Findings of focus group discussion (FGD) on grafting tomato

The focus group discussion (FGD) was conducted with 12 tomato farmers who used grafting techniques to produce tomato seedlings in their own nurseries/at home or purchased grafted seedlings from market or nearby farmers in Kamalganj Upazila. The grafting technique has generated significant positive outcomes for all tomato producers, particularly smallholders. Participants reported that the grafting technology improved plant survival, reduced soil-borne diseases, and enhanced their yields by about 20 percent compared to non-grafted varieties. Farmers primarily used the BARI-8 hybrid variety of tomato, cultivated during the summer season. Approximately 41.67 % of farmers produced grafted seedlings in their own nurseries or at home, while the remainder purchased seedlings from the market or other farmers. Despite the higher cost of seedlings and the substantial requirement for synthetic inputs, grafted tomatoes were found to be economically viable, with a benefit-cost ratio ranging from 1.20 to 1.60, indicating profitability. Farmers noted that grafted seedlings were often sold at higher prices in the market, which is beneficial for the selling farmers but disadvantageous for buyers farmers. The grafting technique has been widely adopted in the study area. Farmers also observed longer fruiting periods, reduced pesticide use, and improved soil health, consistent with the RMTP project's eco-friendly objectives. However, they identified challenges such as limited technical skills to produce grafted seedlings at home, high costs of synthetic inputs, and market price fluctuations. Overall, farmers expressed strong interest in continuing grafted tomato cultivation and emphasized the need for further training, local seedling production facilities, and marketing support to sustain and expand adoption in the area. Although grafted seedlings are 1.5-2 times more expensive than regular seedlings in the study area, the increased yield and better marketability can justify the cost, and may results in higher profits and improved household income.

COMMUNITY TOURISM

4.2.1 Manipuri community-based tourism and its management

The community-based tourism (CBT) initiative was established in 2018 by 10 Manipuri people as a locally driven effort to promote sustainable rural tourism while creating livelihood opportunities in the Vanubil village of Kamalganj upazila of Moulvibazar district. The CBT initiative began with a homestay model and was supported infrastructurally by the local administration and the Bangladesh Tourism Board (BTB). Later, at the growing stage, the CBT initiatives received support from several non-government organizations such as Patakuri Society and Palli Karma-Sahayak Foundation (PKSF). The establishment of a ten-member management committee ensured participatory decision-making and local ownership from the outset.

At the initial stage, the CBT project faced several adaptation challenges, including community resistance and limited infrastructure. Despite these barriers, community members gradually accepted the initiative, recognizing its potential for income generation and local development. Initial investments were made personally by one founder, who also took on multiple roles, including that of a tourist guide. In the absence of basic facilities such as restrooms, he reinvested early earnings to build necessary amenities. Later all partners contributed to investments. However, institutional support from BTB was critical in overcoming infrastructural constraints and legitimizing the initiative at an early stage.

4.2.2 Assessment of Socio-Economic Benefits

After the collection of information from the stakeholders, the stakeholders were asked to rank their perceived benefits to provide statistical strength to their qualitative information. The stakeholders ranked ten identified benefits from least important (1) to most important (5). The collected rank-based information was then analyzed using the Garret ranking technique (Garrett and Woodworth, 1969). The findings of Garrett's ranking analysis are presented in Table 1.

The result shows that job opportunity creation is the most significant benefit of CBT, with an average Garrett score of 66.80. Stakeholders perceive CBT as an important source of job opportunities within the community. Stakeholders ranked women's participation and empowerment as the second most important benefit (65.18), highlighting the role of CBT in promoting gender-inclusive development. Income generation was also highly valued, with "Participation in CBT has increased income" and "CBT has increased the sales of local handicrafts and traditional dresses" ranked third (64.82) and fourth (63.80), respectively. The production and sale of organic and traditional food were ranked fifth (61.85), reflecting additional economic benefits linked to local entrepreneurship.

Cultural and social benefits, such as fostering community cohesion (rank 8, 60.03) and enabling tourists to learn about local culture and traditions (rank 7, 60.53), were recognized but considered secondary to direct economic impacts. Similarly, benefits related to collective welfare, including "Revenue from CBT supports collective wellbeing" (rank 6, 60.60) and "Tourists contribute to community welfare initiatives" (rank 10, 57.45), were perceived as less influential in motivating stakeholder participation.

Overall, the findings suggest that stakeholders prioritize the direct economic benefits of CBT, particularly employment, income generation, and women's empowerment, over broader social or collective welfare benefits. This indicates that while CBT contributes to holistic community development, its immediate economic impact is the primary driver of stakeholder engagement and support.

Table 6. Stakeholders ranking score for benefits of community-based tourism.

Benefits	5	4	3	2	1	Total	Total score	Avg. score	Rank
Revenue from CBT supports collective wellbeing.	6	18	9	6	1	40	2424	60.60	6
Tourists contribute to community welfare initiatives	13	20	4	3	0	40	2298	57.45	10
CBT attracts domestic and international tourists.	9	17	10	4	0	40	2364	59.10	9
CBT fosters community cohesion and a sense of shared ownership.	8	19	7	4	2	40	2401	60.03	8
CBT encourages the production and sale of organic and traditional food	4	18	7	10	1	40	2474	61.85	5
Tourists can learn about local culture, traditions, and indigenous practices.	6	20	6	7	1	40	2421	60.53	7
CBT has increased the sales of local handicrafts and traditional dresses.	4	14	9	8	5	40	2552	63.80	4
Participation in CBT has increased income	2	15	5	14	4	40	2593	64.82	3
CBT prioritizes women's participation and empowerment	2	12	5	19	2	40	2607	65.18	2
CBT initiatives have created employment opportunities	0	11	12	9	8	40	2672	66.80	1
Garrett Tabulated Value	52	58	63	70	81				

Source: Authors estimation, 2025.

4.2.3 Opportunities and barriers of community-based tourism

Table 7 showcases the perceived opportunities of the CBT initiative based on Garrett ranking scores from stakeholders. The highest-ranked opportunity is the increase of tourist accommodation capacity (average Garrett score 48.23), highlighting its potential to enhance revenue and employment. That is followed by collaboration with garment owners for scaling up local clothing products (45.13) and encouraging other community members to participate (44.95), reflecting the importance of partnerships and community engagement. Opportunities related to cultural preservation, institutional support, and environmental contribution received comparatively lower scores, indicating they are recognized but less prioritized.

Qualitative observations support these findings. The ongoing process of partnerships with Bangladesh garment manufacturers may have facilitated product diversification and integration of traditional Bengali designs, adding value to local handicrafts. The homestays have expanded capacity to host up to 100 tourists at one homestay, aligning with the highest-ranked opportunity. Continued support from the Bangladesh Tourism Board and stakeholders such as the Patakuri Society (i.e., an NGO) strengthens credibility while maintaining financial autonomy. Overall, the results suggest that scaling infrastructure, fostering collaborations, and promoting community involvement are central to maximizing CBT benefits.

Table 7. Opportunities of community-based tourism.

Opportunities	5	4	3	2	1	Total	Total score	Average score	Rank
Continuation of institutional support make the initiative at international standard	5	4	3	2	1	40	1646	41.15	5
Integration of mainstream tradition with community tradition-based handicrafts and other products	9	18	7	6	0	40	1730	43.25	4
Contribute to environment betterment	5	23	3	9	0	40	1446	36.15	6
Encouragement for other community people	14	20	5	1	0	40	1798	44.95	3
Collaboration with garment owners for scaling up clothing products	7	15	5	13	0	40	1805	45.13	2
Increase of tourist accommodation capacity	5	15	13	6	1	40	1929	48.23	1
Garrett Tabulated Value	37	46	54	63	77				

Source: Authors estimation, 2025.

Table 8. Barriers of community-based tourism.

Barriers	5	4	3	2	1	Total	Total score	Average score	Rank
Security issues	10	20	3	7	0	40	1610	40.25	4
Extreme heat conditions	7	24	5	4	0	40	1618	40.45	3
Financial constraints	7	13	8	11	1	40	1823	45.58	2
Poor road infrastructure	2	15	10	11	2	40	1958	48.95	1
Overdependence on the founders	11	20	7	1	1	40	1549	38.73	5
Garrett Tabulated Value	24	40	50	60	75				

Source: Authors estimation, 2025.

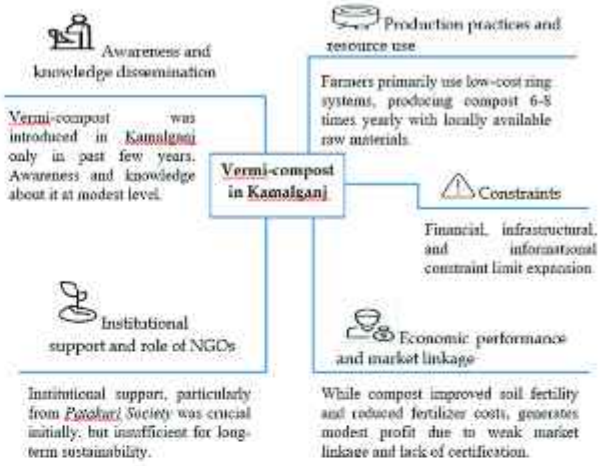
However, the barriers faced by community-based tourism initiatives are presented in Table 3, using the similar Garrett ranking method. The findings indicate that poor road infrastructure is perceived as the most critical barrier, with the highest average Garrett score of 48.95. This suggests that inadequate access roads significantly limit the movement of tourists and goods, directly affecting the sustainability and growth of CBT activities. Financial constraints rank second, with an average Garrett score of 45.58. This reflects challenges in securing sufficient funding for operations, maintenance, and expansion, which can hinder the ability of communities to effectively manage tourism initiatives. Extreme heat conditions are identified as the third most significant barrier (average score 40.45). This indicates that climatic factors, such as high temperatures, affect both tourist comfort and community participation in tourism activities. Security issues follow closely in fourth place, with an average score of 40.25, highlighting the need for measures to ensure tourist and resident safety to maintain trust and visitation. Finally, over-dependency on the founders is ranked lowest (average score 38.73), suggesting that reliance on a few individuals for leadership or management may pose challenges but is perceived as less severe compared to infrastructure, financial, and environmental barriers.

Overall, the Garrett ranking emphasizes that infrastructural and financial issues are the most pressing challenges for CBT development, while environmental and organizational factors are also relevant but comparatively less critical. Addressing these barriers strategically can enhance the effectiveness and sustainability of community-based tourism initiatives.

VERMICOMPOST

4.3 Vermi-Compost Adoption, Production Dynamics, And Institutional Support

The study found that vermi-composting in Kamalganj upazila has grown through NGO-led training and peer learning, though adoption remains limited. Farmers mainly use low-cost ring systems, producing compost 6–8 times yearly with locally available materials. Vermi-composting improved soil fertility and reduced fertilizer costs but generated modest profits due to weak markets and lack of certification. Institutional support, particularly from the NGO (Patakuri Society) was crucial initially but insufficient for long-term sustainability. Financial, infrastructural, and informational constraints continue to limit expansion despite clear environmental and agronomic benefits. The detailed discussion on the findings is represented in the following sub-sections of this section.



4.3.1 Production practices and resource use

Two main production systems were observed: the ring method and the block (brick) method. Among the 20 producers, the majority (approximately 80 percent) used concrete rings due to lower cost and easier management. Each ring cost between 400 and 500 Tk., while constructing a block structure required 1,000 Tk. The block system, although more durable and capable of producing higher volumes, demanded greater investment and labor.

Farmers typically used locally available materials such as cow dung, banana leaves and stems, and vegetable residues. Earthworms (Eisenia fetida) were either supplied by Patakuri Society or purchased from peers at subsidized prices (approximately 1,200 Tk. per kilogram). Setting up one compost unit required about two days of labor, costing between 800 and 1,000 Tk. Producers with limited resources constructed temporary shades using bamboo and polythene, while others invested up to 12,000 Tk/ to build permanent sheds. These investments align with those reported in similar rural projects (Rahman et al, 2021), highlighting the role of household capital in determining production scale.

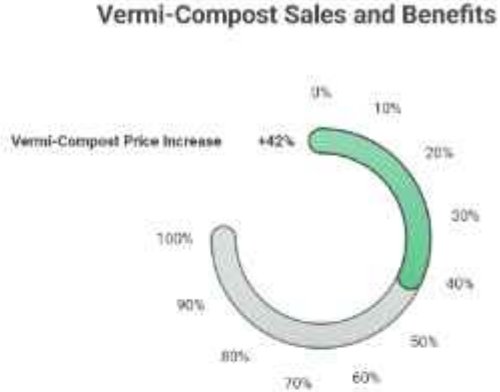
Vermi-compost production cycles occurred 6–8 times per year, depending on temperature and material availability. The process required careful moisture regulation and shading to protect worms from excessive sunlight or rain. Producers observed that the ring method demanded less maintenance time but yielded smaller quantities than the block system.

4.3.2 Economic performance and market linkages

Farmers reported selling vermi-compost at an average farm gate price of 12 Tk. per kilogram. Local traders (paikars) visited households to collect the product, which reduced marketing costs but limited producers' bargaining power. In local markets, prices were typically 5–10 Tk. higher, yet the transportation cost (approximately 300 Tk. per trip) offset potential profits. Most producers sold directly from their farms, while some used the compost on their own land to reduce chemical fertilizer expenses. Producers recognized that vermi-compost improved soil health and productivity, particularly for rice and vegetable crops. They also noted better crop appearance, taste, and market value of vegetables—a finding consistent with Gazi et al. (2024), who reported similar benefits in vegetable-growing regions.

Despite modest profit margins, producers viewed vermi-composting as a supplementary income source rather than a full-time enterprise. The activity's sustainability depended on access to organic materials, family labor, and reliable buyers. The lack of organized marketing channels and storage facilities emerged as significant bottlenecks.

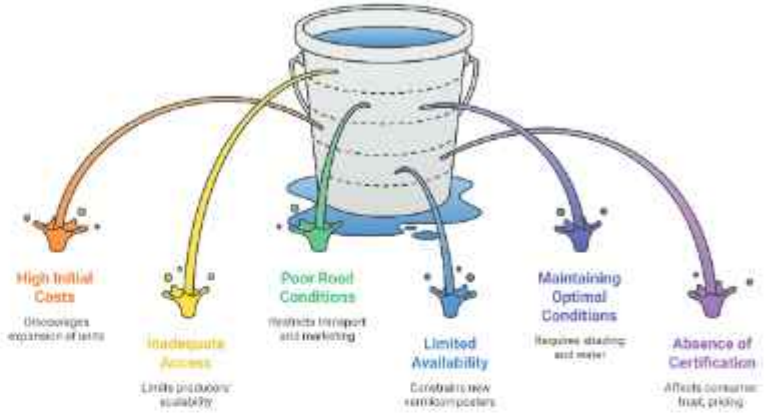
Similar challenges have been documented in India and Nepal, where small-scale compost producers struggle with inconsistent demand, lack of certification, and weak market integration (Singh and Sirohi, 2021). These structural barriers limit economies of scale and disincentives new entrants despite positive agronomic outcomes.



4.3.3 Constraints to production and expansion

The main constraints identified were financial, infrastructural, and informational. High initial investment costs discouraged expansion, particularly for block-based units. Inadequate access to microcredit and lack of subsidies limited producers' capacity to scale up operations. Poor road conditions further restricted transport and marketing opportunities, especially during the monsoon season.

Another challenge was the limited availability of quality earthworms, which constrained new entrants. Farmers relied on peer supply or occasional NGO distributions. Maintaining optimal moisture and temperature during dry or hot periods was also problematic without proper shading or water facilities. Additionally, the absence of product certification and standardized packaging affected consumer trust and pricing. Farmers recommended developing storage and labeling systems to ensure consistent quality and attract higher market prices. These findings align with the literature on organic fertilizer enterprises, which emphasizes the importance of certification and market formalization for sustainable growth (Khatun et al, 2020).




COLLECTION POINT

4.4 Effect of collection point on value chain efficiency

This part discusses the findings from propensity score matching (PSM), which shows the causal impact of collection point on value chain efficiency. The post-harvest loss of tomato growers and speed of selling of tomatoes were used as proxy variables to represent the value chain efficiency. The findings ultimately contribute to the tomato grower's welfare. Collection points were found in two sampled villages under two selected unions, which were established by the project. Since a collection point serves all villages under a union, the project examined the impact of the collection point on value chain efficiency for tomato producers at the union level without compromising the representability of findings. Tomato producers who had access or could access a collection point in their union were regarded as the treated group and coded as 1, whereas those who did not have access to a collection point and sold their tomatoes at the farm gate were regarded as the control group and coded as 0. So, the collection point is the treatment variable for conducting PSM.

The collection point serves as a sales center for all types of crops and vegetables, but this report undertook tomato producers only as a case to maintain the consistency in investigation. Also, almost all selected respondents sold their tomatoes at the farm gate to Paikars and not at the market; therefore, the notion of selling at the market-place or Arat (a marketplace that combines buyers and sellers) was excluded in this report. The variables age, education, gender, household size, number of earning members, experience in farming, access to extension services, access to training, access to credit, and land size and quantity of tomatoes sold by farmers are included as covariates for matching in the PSM. Descriptive statistics on these variables are represented in Table 1.

Table 9. Propensity score estimation using probit model (post-harvest loss and sale).

Variables	Coefficients	Standard Error	Z	p > |z|
Dependent variable : Access to collection point				
Age	-0.036***	0.012	-2.85	0.004
Education	0.042**	0.021	1.97	0.045
Dummy gender	-0.255	0.328	-0.78	0.438
Household size	0.134*	0.072	1.86	0.063
Number of earning members	0.292	0.165	1.77	0.077
Experience	0.039***	0.013	3.13	0.002
Dummy access to extension service	0.335***	0.123	2.73	0.006
Dummy access to training	0.046***	0.017	2.68	0.006
Dummy access to credit	0.401	0.252	1.59	0.112
Land size	0.016***	0.006	2.73	0.005
Quantity of tomato sold	-0.006***	0.002	-2.69	0.007
Constant	1.233**	0.628	1.96	0.050
Log likelihood ratio		-123.15		
LR chi^2 (7)		35.52		
Prob > χ^2		0.000***		
Pseudo R^2		0.127		
Observations		210		

**** significant at 1% level, ** significant at 5% level, *significant at 10% level.*
Source: Authors' estimation, 2025

The first task in PSM analysis is to estimate propensity scores on the basis of the probability of those farmers who had access to a collection point, given their socio-economic characteristics. The propensity scores for the treated and controlled groups were estimated utilizing the Probit model, which is presented in Table 9. The propensity score was estimated to do matching on a single variable in this step. The pseudo R^2 value, stated in Table 9, is 0.127, which is quite small and depicts that sampled tomato farmers were not significantly different in their characteristics. Therefore, a good match between treated and controlled farmers is attainable. The findings of propensity score estimation illustrate that, among covariates, age, education, household size, experience, access to extension services, access to training, land size, and quantity of tomatoes sold significantly influence the farmers' access to collection points. The estimated sign of coefficients indicates that education, household size, experience, access to extension services, access to training, and land size had positive effects on access to collection points in the study area, while age and quantity of tomatoes sold had negative effects.

The second step of PSM requires the choice of a matching estimator. Several matching estimators are available to facilitate the PSM. For matching the control and treated farmers, matching estimators were tested based on the value of pseudo R2, the equal mean test known as the balance test, and the matched sample size (Dehejia and Wahba, 2002). A matching estimator was chosen that generated the lowest pseudo R2 value, balances most independent variables, and provides a large matched sample size. Table 10 represents the outcome of the matching estimation selection analysis. The kernel matching with bandwidth 0.10 was chosen as a valid estimator, which provided the lowest pseudo R^2 (0.009), balanced the most explanatory variables (11), and matched the large sample size (192) for subsequent analysis and effect estimation.

In the PSM analysis, the next stage is to examine the overlap or common support region among the treated and controlled groups of farmers. Table 11 represents the distribution of predicted propensity scores, which lies between 0.1413838 and 0.9077775 for the treatment group and between 0.0012640 and 0.9003465 for the control group. Hence, the common support region lies between 0.0012640 and 0.9077775. Farmers whose propensity scores are greater than 0.9077775 and smaller than 0.0012640 are not included for matching and estimating the average treatment effect on treated (ATT) due to lack of overlap. Since no match is possible, 18 observations of the treated group were discarded for further analysis.

Figure 1 delineates the distribution of propensity scores, which represents another way of demonstrating common support. It indicates that there is a considerable overlap in common support. The graph's upper half shows the propensity score distribution for farmers who had access to a collection point, while the bottom half shows the propensity score distribution for those who had no access. The distribution of propensity scores indicates the fulfillment of the common support criterion in propensity score matching (PSM) analysis, ensuring that the treatment and control groups' propensity score distributions sufficiently overlap.

Table 10. Performance of different matching estimators.

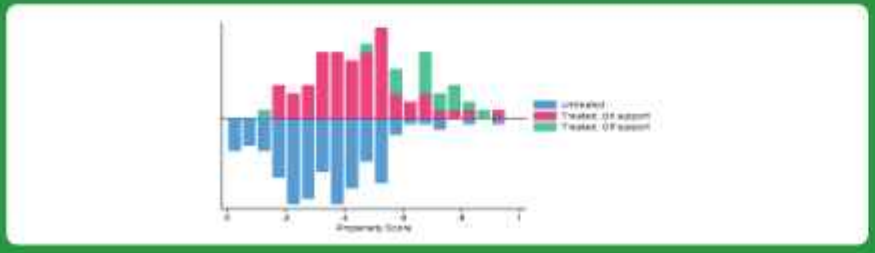


Table 10. Performance of different matching estimators.

Matching estimator	Post-harvest loss			Speed of sale		
	Pseudo R^2	Balancing test	Matched sample	Pseudo R^2	Balancing test	Matched sample
Nearest Neighbor Matching						
Neighbor 1	0.048	9	209	0.048	9	209
Neighbor 2	0.009	10	209	0.009	10	209
Neighbor 3	0.025	7	209	0.025	7	209
Neighbor 4	0.025	7	209	0.025	7	209
Radius Matching						
Band width 0.01	0.130	7	209	0.130	7	209
Band width 0.10	0.130	7	209	0.130	7	209
Band width 0.25	0.130	7	209	0.130	7	209
Band width 0.50	0.130	7	209	0.130	7	209
Kernel Matching						
Band width 0.01	0.009	11	192	0.009	11	192
Band width 0.10	0.027	9	209	0.027	9	209
Band width 0.25	0.014	9	209	0.014	9	209
Band width 0.50	0.070	8	209	0.070	8	209
Caliper Matching						
Caliper 0.01	0.052	8	192	0.052	8	192
Caliper 0.10	0.048	7	209	0.048	7	209
Caliper 0.25	0.048	7	209	0.048	7	209
Caliper 0.50	0.048	7	209	0.048	7	209
Radius matching						
Caliper 0.01	0.029	9	192	0.029	9	192
Caliper 0.10	0.009	10	209	0.009	10	209
Caliper 0.25	0.025	8	209	0.025	8	209
Caliper 0.50	0.103	7	209	0.103	7	209

Source: Authors' estimation, 2025

Table 12 states that 18 tomato producers are off support while 192 farmers are on support. Only controls whose propensity scores lie in a predetermined common support zone of the propensity score matching are matched with each treatment unit. Households outside of this zone are not included in the analysis (i.e., 18 treated farmers are discarded).

Table 12. Common support.

Treatment assignment	Support		Total
	Off support	On support	
Untreated	0	127	127
Treated	18	65	83
Total	18	192	210

Source: Authors' estimation, 2025

The next task after selecting the best matching estimator in the PSM is to employ that estimator to analyze how better propensity scores and covariates are balanced. Tests like reduction in the mean of standardized bias between unmatched and matched farmers, a t-test to check equality of means, and a chi-square test for joint significance for covariates that are used to determine the balancing power of the estimator. Table 13 represents the findings of these tests. Before matching, the standardized difference in covariates ranged from -26.10% to 40.80%. After matching, the standardized difference lay between -4.0% and 19.8%, which is under the threshold level (i.e., 20%) proposed by Rosenbaum and Rubin (1983). So, the sample differences in unmatched data significantly outweigh those in matched data. That means the procedure of matching produces a considerable extent of balance between the treated and control groups. Moreover, estimates of the t-statistics showed that all explanatory variables were insignificant after matching, although 3 of those were insignificant before.

Table 14 illustrates that the standardized mean difference for all independent variables utilized in the PSM is lowered to 4.6% after matching, which was 16.9% before matching. The estimate of pseudo R^2 became lowered to 0.009 after matching form before (0.127), and the combined significance of all independent variables was insignificant, which was significant before (i.e., p > LR chi^2 = 0.000). These findings imply that the specification of propensity in terms of balancing covariates between treated and control farmers is successful. The results also ensure the reliability of the chosen matching estimator and its suitability to measure the average treatment effect on the treated (ATT) for sampled tomato producers.

Table 13. Covariance balancing test (post-harvest loss and speed of sell).

Variable	Sample	Mean		% Reduction		t-test	p > |t|
		Treated	Control	%Bias	Bias		
Age	Unmatched	42.19	41.10	15.2	53.5	2.45**	0.018
	Matched	41.72	41.85	-1.2		-0.03	0.949
Education	Unmatched	4.59	5.80	-22.4	48.9	-2.31**	0.024
	Matched	5.03	4.71	9.5		0.55	0.581
Gender	Unmatched	0.89	0.92	-10.6	-115.6	-0.76	0.449
	Matched	0.90	0.84	19.8		1.15	0.254
Household size	Unmatched	5.09	5.42	-19.3	43.1	-2.14**	0.034
	Matched	5.16	5.35	-11.4		-0.66	0.511
Number of earning member	Unmatched	1.48	1.34	20.0	93.9	1.43	0.155
	Matched	1.43	1.43	-1.2		-0.07	0.944
Experience	Unmatched	24.59	19.97	40.8	86.1	2.86***	0.005
	Matched	23.67	23.85	-1.6		-0.09	0.929
Access to extension service	Unmatched	0.78	0.85	-18.0	5.3	-2.02**	0.045
	Matched	0.79	0.86	-17.0		-0.97	0.332
Access to training	Unmatched	0.48	0.55	-12.6	53.8	-2.55***	0.008
	Matched	0.50	0.48	5.8		0.33	0.741
Access to credit	Unmatched	0.26	0.23	9.2	91.5	0.65	0.514
	Matched	0.23	0.22	0.8		0.05	0.964
Land size	Unmatched	59.62	63.16	-7.4	20.0	-2.21**	0.038
	Matched	60.10	57.27	5.9		0.42	0.676
Sold quantity	Unmatched	13297	17012	-26.1	76.8	-1.75*	0.082
	Matched	13933	13071	6.0		0.52	0.605

****Significant at 1% level. **Significant at 5% level. *Significant at 10% level.*
Source: Authors' estimation, 2025

Table 14. PSM matching quality test.

Sample	Pseudo R^2	LR chi^2	p > LR chi^2	Mean bias	B	R	%Var
Unmatched	0.127	35.35	0.000	16.9	80.0	0.47	29
Matched	0.009	4.82	0.940	4.6	38.5	0.74	0

Source: Authors' estimation, 2025

The last step of PSM is the estimation of the average treatment effect on the treated (ATT), which quantifies the impact of the collection point on the value chain efficiency, specifically post-harvest loss and speed of sale. Table 15 shows the estimate ATT that represents the effect of collection point outcome variables (i.e., post-harvest loss and speed of sale). The findings indicate that farmers who had access to a collection point were able to reduce their post-harvest loss of tomatoes significantly, with a difference of 0.134% compared to their counterparts. Table 15 also shows that tomato growers who had access to a collection point sold their tomatoes faster than those farmers who did not have access to a collection point, with a significant difference of 0.283%.

Table 15. Impact of collection point on post-harvest loss and speed of sell.

Variable	Sample	Treated	Control	Difference	Standard error	t-stat
Post-harvest loss	Unmatched	5.439	5.417	0.022	0.011	1.92*
	ATT	5.557	5.418	0.134	0.049	2.69***
Speed of sell	Unmatched	9.134	8.503	0.630	0.333	1.89*
	ATT	9.149	8.865	0.283	0.119	2.37**

*Significant at 10% level. **Significant at 5% level. ***Significant at 1% level.

Source: Authors' estimation, 2025.

Although the differences in post-harvest loss between the treated and control farmers are modest in magnitude, the findings on post-harvest loss are meaningful given the perishable nature of tomatoes and the high baseline losses reported in Bangladesh, where farm-level losses can reach 12.5% and total value-chain losses approximately 22.9% (Sharma, 2018). Collection points may reduce handling, storage time, and transportation delays, which may reduce the damage and spoilage, consistent with findings from previous studies on post-harvest losses in perishable crops (Khatun & Rahman, 2020). Faster market transactions are critical for perishable crops and vegetables like tomatoes, as delays may increase the risk of quality deterioration and price reductions. This aligns with the evidence from the Food and Agricultural Organization (FAO) indicating that inadequate transport, storage, and market coordination are major contributors to slow sales and losses in vegetable supply chains (FAO, 2019). The faster sale observed suggests that collection points not only aggregate crops and vegetables efficiently but also facilitate timely access to markets, enhancing overall value-chain performance. This outcome suggests that collection points are an effective intervention to improve tomato value-chain outcomes, though the significant but moderate effect signals that complementary arrangements, such as improved transport, storage, and market information systems, may result in greater benefits for tomato producers as well as other farmers.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CONCLUSION

The Patakuri Society's project under the Rural Microenterprise Transformation Project (RMTP) has significantly advanced sustainable agricultural practices in Kamalganj upazila. Key interventions, including grafted tomato cultivation, vermi-compost use, integrated pest management, and community-based tourism (CBT), have enhanced productivity, profitability, and environmental sustainability for smallholder farmers, particularly benefiting the Manipuri community. Grafted tomatoes improved yield and resistance to diseases, while vermi-compost enhanced soil fertility and reduced reliance on synthetic fertilizers. Despite challenges such as limited finance, technical knowledge, and market access, the introduction of collection points improved marketing efficiency. CBT initiatives have started generating employment and empowering women through cultural activities. Overall, the project demonstrates that integrating eco-friendly agricultural methods with community economic activities fosters sustainable rural development and suggests that scaling such initiatives can lead to inclusive growth in Bangladesh.

Patakuri Society Under RMTP

Traditional Agriculture
Low productivity, limited income

Sustainable Practices
Grafted tomatoes, vermi-compost, IPM

Community Tourism
Homestays, handicrafts, cultural preservation

Efficient Marketing
Collection points, reduced post-harvest losses

Sustainable Development
Higher income, environmental protection

POLICY IMPLICATIONS

- Strengthening extension services and continuous capacity-building programs is essential for providing farmers with technical guidance on grafting, composting, and pest management.

- Establishing regular training and demonstration programs can enhance farmers' understanding and adoption of sustainable practices.

- Expanding access to low-interest credit facilities and improving rural infrastructure, including roads and storage systems, will enhance market access and minimize post-harvest losses.

- Promoting farmer cooperatives or producer organizations can improve coordination within the value chain, increase bargaining power, and facilitate collective marketing.

- Gender-inclusive policies should promote women's participation in agricultural enterprises, vermi-compost production, and tourism-related activities through training and microcredit access.

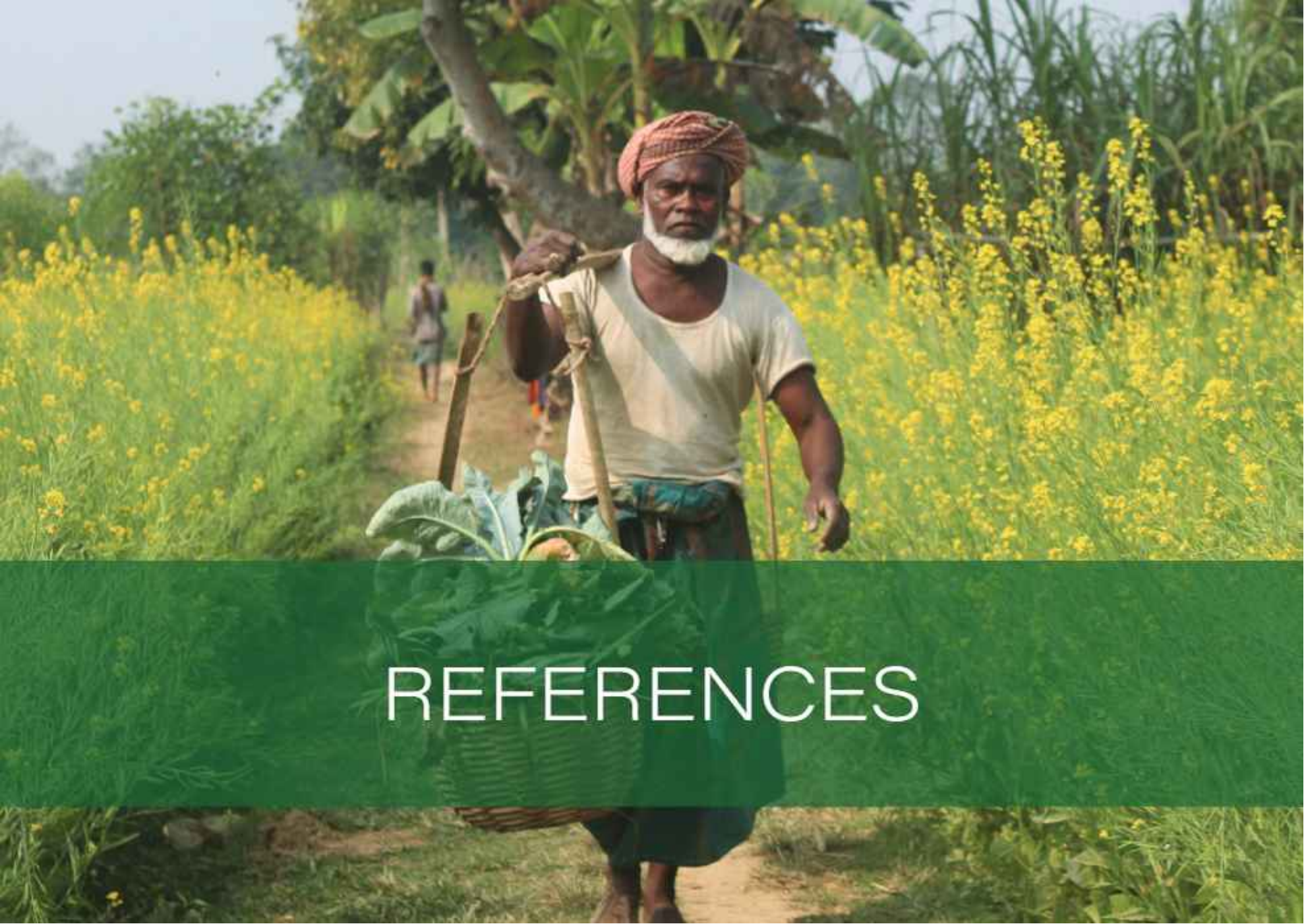
- Institutionalizing community-based tourism within local and regional development plans is crucial for policy attention.

- Public-private partnerships, enhanced marketing networks, and investment in tourism infrastructure are necessary for the sustainability of community-based tourism initiatives.

- Policy incentives for organic fertilizers and eco-friendly pest control technologies can encourage sustainable practices among farmers.

- Certification and branding schemes for eco-friendly agricultural products may increase consumer trust and market opportunities for farmers.

- Establishing a monitoring and evaluation framework will help track socio-economic and environmental impacts, informing future program design.



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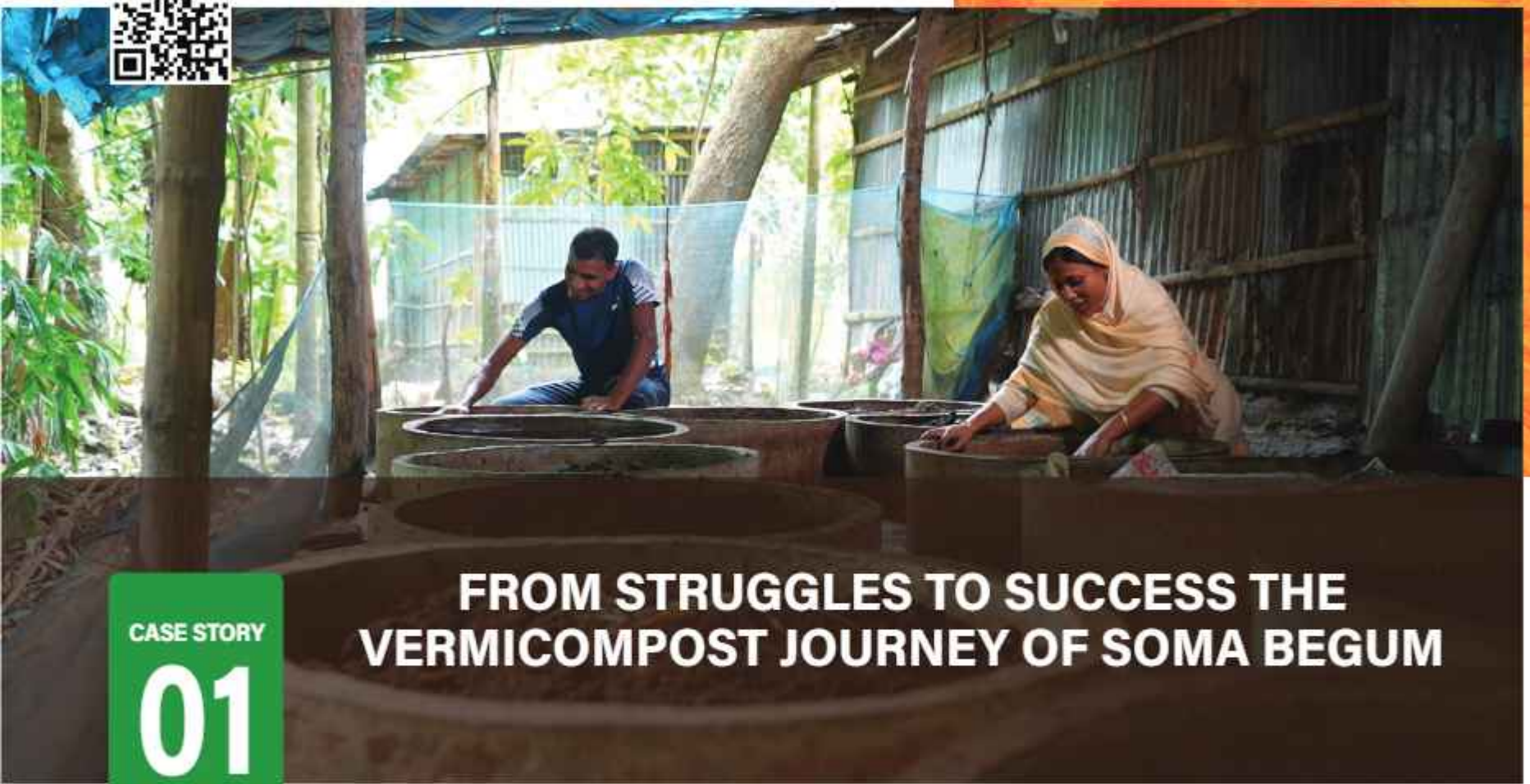
More about project and work please click the link

https://www.youtube.com/watch?v=HxnKVIxTczU

CASE STORY



CASE STORY

01

FROM STRUGGLES TO SUCCESS THE VERMICOMPOST JOURNEY OF SOMA BEGUM

Mst. Soma Begum, a farmer from Bikramkalas village, Munshiganj Union, Kamalganj Upazila, Maulvibazar, once faced a pressing challenge: scarcity of eco-friendly agricultural inputs, particularly organic fertilizers, for her vegetable cultivation. In 2022, she first learned about vermicompost and began experimenting with a single production ring and 250 grams of red worms. Initially, many villagers mocked her, and even her in-laws were against it. But she promised her family that she would only continue it if the outcome was satisfactory, and ignored the criticism and continued her work. Soma viewed vermicomposting as a household activity rather than a commercial opportunity.

Her perspective shifted after receiving training and start-up support from the RMTP's Safe Vegetable Production and Marketing Project under Patakuri Society. Equipped with technical knowledge and mentorship, she scaled up production and tested vermicompost against traditional fertilizers in bottle gourd cultivation. The results were evident: the vermicompost-enhanced pit produced healthier crops with higher yields, convincing Soma and neighboring farmers of its potential. With BDT 10,000 in start-up support, Soma built a protective shed and added production rings. She also participated in training on vermicompost production, Marketing, and quality management, complemented by regular guidance from project experts. Patakuri Society further facilitated market linkages, connecting her to traders and customers, and helped establish branding through customized packaging. Today, Soma operates 16 production rings and one cemented vermi tank, producing approximately 400–420 kg of high-quality compost per month. She uses 40% for her own crops, improving harvests, and sells 60% in the local market at BDT 10/kg, creating a steady income stream. Her success inspired ten neighboring women to begin vermicomposting, forming a cluster that collectively produces 1–1.5 tons per month, generating net profits of BDT 9–10 per kg. Soma's entrepreneurship has expanded beyond income generation. She is now socially and economically empowered, respected as a role model in her community, and actively encourages other women to adopt eco-friendly farming practices. Her household of nine—including her husband, two daughters, parents-in-law, and sisters-in-law—benefits from both her income and leadership. Specially her daughters, as now she can handle her daughter's school expenses, from the school uniform to other costs. Looking forward, Soma aims to scale production up to one metric ton per cycle, further strengthening her market presence and income potential. She dreams of selling compost in bulk to companies, demonstrating the possibilities of transforming small-scale innovation into a commercially viable and sustainable enterprise. Soma Begum's journey exemplifies how knowledge, mentorship, and market support can transform a motivated farmer into a successful entrepreneur, catalyzing women's empowerment and sustainable agricultural practices.

CASE STORY

02

MD. MATIUR RAHMAN TRADING SAFE VEGETABLES USING MOBILE VAN

Md. Matiur Rahman, a long-time vegetable retailer from Halima Bazar in Kamalganj, Maulvibazar, has been selling vegetables for the past 7–8 years. Until 2023, his business was constrained by limited transport capacity, weak consumer trust in vegetable safety, and seasonal price fluctuations. He carried only 20–30 kg of vegetables manually to market, which restricted income and outreach. Moreover, customers often doubted product safety, while reaching multiple markets was nearly impossible without reliable transport.

In 2023, Matiur received support from the Patakuri Society through the ecology friendly safe vegetable and crop production and marketing sub-project of RMTP. This proved transformative. With a battery-powered van, he doubled his carrying capacity and introduced a mobile market model, regularly rotating between Halima Bazar, Sreemangal's Shomshernagar area, and three nearby villages—Borochek, Shirawil, and Idgahtila. He branded his van under the "Nirapod Shobji" (Safe Vegetables) name, signaling quality and safety to buyers. Alongside this, he received training on vegetable production and organic plant protection methods, enabling him to prepare natural pesticides and ensure the quality of both his own produce and vegetables sourced from other farmers.

CASE STORY

03

JAMIR KONA VEGETABLE COLLECTION AND MANAGEMENT POINT STRENGTHENING FARMER MARKET ACCESS

The Jamir Kona Vegetable Collection and Management Point, located in the Sylhet region, is a farmer-led initiative supporting more than 100 members, managed by a seven-member committee. Members represent smallholder, medium, and large-scale farmers: 15–20 small farmers (<50 decimals), 40 medium farmers (50–150 decimals), and 15–20 large farmers (>150 decimals). The association sources vegetables from across Sylhet, Kamalganj, Moulvibazar, Habiganj, Comilla, and even Dhaka, supplying regional and urban markets. Before the establishment of the collection point, farmers faced multiple constraints: limited transportation, high dependence on brokers who claimed substantial commissions, low and volatile prices, and the inability to access buyers directly. Many smallholders often incurred losses of BDT 10–20 per kg, while the logistical challenges of transporting small volumes reduced profitability and limited market reach.

Project Involvement and Interventions

Through the Patakuri Society-supported Safe Vegetable Production and Marketing Project, farmers were mobilized to address these challenges collectively. Patakuri Society catalyzed the initiative by promoting collective marketing, facilitating infrastructure development, and providing technical support. Farmers jointly invested BDT 100,000 to establish the collection point, which includes washing, grading, sorting, and packaging facilities. Patakuri Society contributed BDT 75,000, constructed the facility, and provided essential equipment including tube wells, washing tubs, plastic crates, weighing scales, tables, chairs, and a wheelbarrow to transport 5–200 crates at a time. The project also offered capacity-building support, training farmers and dealers on market management, record-keeping, and collective decision-making. A dedicated accountant assists with fund management, while regular meetings and group discussions improve coordination and transparency.

Operations and Market Coordination

The collection point operates as a one-stop hub for aggregation and marketing. Farmers bring their produce in large (28 kg) or small (25 kg) crates, and 20–25 dealers from nearby districts and Dhaka visit daily to purchase vegetables at negotiated prices. By bypassing middlemen, farmers retain the full selling price and avoid commission costs, while dealers benefit from large volumes of high-quality, sorted vegetables in a single location. Key crops include tomato (primary), cucumber, cauliflower, bitter gourd, beans, snake gourd, turnip, bottle gourd, sweet pumpkin, yard-long beans, and potatoes. Farmers cultivate a nine-month tomato variety, enabling production during off-season periods such as Kharif-I/Summer, with yields of 18–20 kg per plant. Typical crate prices range from BDT 100–150, depending on season.

Results and Impacts

The collection point has significantly improved farmer incomes, providing an additional BDT 2–3 per kg compared to brokered sales. Bulk selling lowers transportation costs, increases market stability, and boosts farmer confidence. Transparent pricing and direct dealer interaction reduce stress and encourage sustainable practices such as reduced pesticide use, pheromone traps, and mulching to conserve moisture and control weeds (~BDT 8,000 per bundle, usable for two seasons).

Beyond economic gains, the collection point has strengthened farmer organization and collective action. Members benefit from market information, access to shared infrastructure, training, and networking opportunities, which were previously unavailable.

Role of Patakuri Society

Patakuri Society played a catalytic role by mobilizing farmers, providing technical and financial support, and establishing infrastructure for a sustainable marketing hub. The project strengthened market linkages, enhanced transparency, and built farmer capacity in management and operations.

Future Plans and Sustainability

To ensure long-term sustainability, the landowner plans to establish an input shop on-site and facilitate vegetable trading, allowing farmers to continue using services while contributing a minimal service fee. The collection point remains open to all members, maintaining inclusive access and ensuring ongoing support for smallholder farmers.

Conclusion

The Jamir Kona Collection and Management Point illustrates how collective action, infrastructure support, and capacity building can transform rural market systems. By reducing middleman interference, increasing incomes, and providing reliable market access, it has created a sustainable model for farmer empowerment and safe vegetable marketing in the Sylhet region.

Collection Point: Farm's Gateway to the Market

Farmer Mobilization

Farmers are organized and encouraged to participate in collective marketing efforts.

Infrastructure Development

Essential facilities like washing, grading, and packaging areas are established.

Capacity Building

Farmers receive training on market management, record-keeping, and decision-making.

Market Coordination

Farmers and dealers negotiate prices and trade vegetables at the collection point.

Increased Income

Farmers earn higher profits by bypassing middlemen and selling directly to dealers.

Sustainable Practices

Farmers adopt eco-friendly methods like reduced pesticide use and mulching.

Farmer Empowerment

Farmers gain control over their market access and achieve long-term sustainability.

CASE STORY

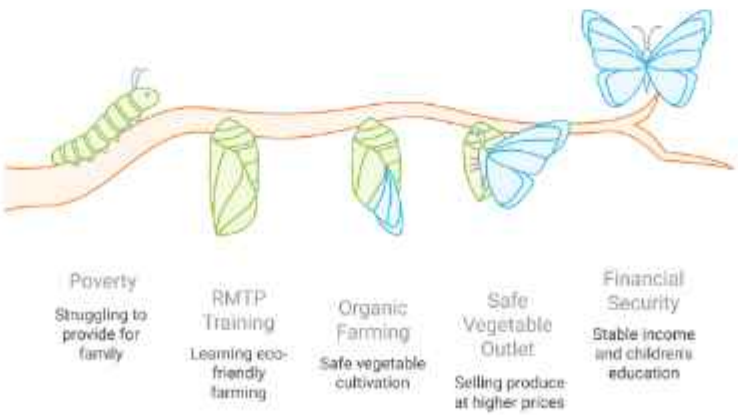
04

FROM HARDSHIP TO LEADER THE JOURNEY OF REHENA BEGUM

Rehena Begum, a 37-year-old mother of four from a remote village in Moulvibazar, knew the struggle of poverty all too well. Despite her work as a tailor and her husband's farming, providing for their family and keeping their children in school was a constant battle. Her turning point came in 2022 when she joined the RMTP Project run by Patakuri Society. Through training, she learned eco-friendly farming techniques—from making organic fertilizer to using pheromone traps for pest control. She realized her husband's reliance on costly chemicals was not only unhealthy but also unprofitable, with middlemen taking most of the earnings. Driven by this new knowledge, Rehena and her husband shifted to poison-free vegetable cultivation. Her safe produce quickly became a hit with health-conscious customers. Seeing the demand, she rallied other local farmers and, with support from Patakuri Society, opened a dedicated safe vegetable outlet at the village entrance.

The shop was an instant success. Rehena now sells her vegetables for 10-15% more than conventional ones, earning a stable monthly income of 15,000-20,000 taka. This financial security has ended her family's hardships and secured her children's education. She even used her earnings to buy an electric sewing machine, replacing her manual one. Now a leader of a safe-vegetable producer group, Rehena has inspired 20-30 local farmers to adopt organic methods. Her future plans include expanding the outlet, launching online sales, and reaching larger markets. Rehena's journey is a powerful testament to how knowledge and determination can transform a life and uplift an entire community.

Rehena's Journey to Prosperity



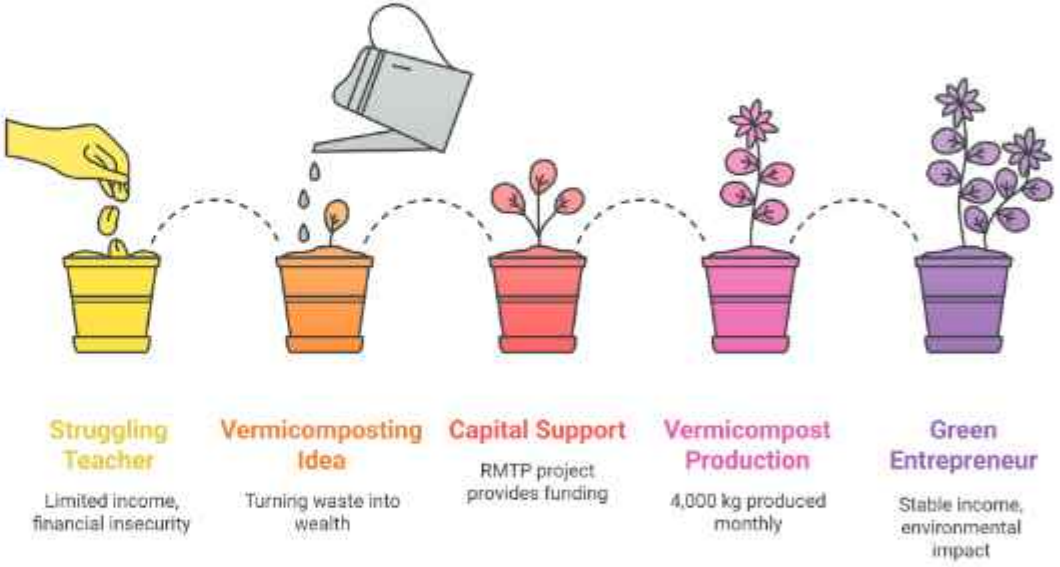
CASE STORY

05

ONE TEACHER'S JOURNEY TO A GREENER FUTURE

In a small village in Kamalganj, Moulvibazar, Junayed Ahmed Akash dedicated his life to teaching. Yet, despite his efforts, making ends meet for his family was a daily struggle. He dreamed of a better life, and he found his inspiration not in a far-off place, but right in his own community—in the rising demand for organic farming. Akash saw an opportunity in vermicomposting, a way to turn waste into wealth and help his local environment. For a long time, this dream was stalled by one formidable barrier: a lack of capital. That changed with the journey and crucial support from the Patakuri Society of RMTP project, PKSF. Akash's vision finally took root. He built his first vermicompost unit, and his life—and impact—began to transform.

Today, what was once a dream is now a thriving enterprise. Akash produces 4,000 kg of nutrient-rich vermicompost every month. The venture brings his family a stable net income of 30,000 BDT, replacing uncertainty with dignity and financial security. But his success story grows beyond his own home. By providing an organic alternative, Akash is helping his fellow farmers nourish their soil without harmful chemicals. His work is a quiet revolution against climate change. Each month, his vermicompost prevents an estimated 6,000 kg of CO_2 emissions—a carbon-saving effort equal to that of a small forest of 285 trees as well as alignment with SDG 1,2,12,13. Junayed Ahmed Akash is more than a teacher and farmer; he is a green entrepreneur. His story proves that with a little support, a single idea can blossom into a force for economic resilience, community health, and a healthier planet.



CASE STORY

06

GAZI MOINUDDIN - A SUCCESS STORY FROM NURSERY BUSINESS

Gazi Moinuddin is a well-known name in the nursery sector of northeastern Bangladesh. For nearly three decades, he has been producing vegetable seedlings and grafted saplings. Although he started working alone, over time, he has become not only a businessman but also a trusted partner for small farmers who are committed to producing safe vegetables. His nursery is located in Purbo Guramara of Adampur Bazar, Kamalganj Upazila, Moulvibazar District.

From there, he produces and sells grafted and improved seedlings of tomato, watermelon, eggplant, bottle gourd, bitter gourd, pumpkin, and many other vegetables. Since starting in 1996, with 29 years of experience, he has earned a reputation not only for quality but also expanded his market reach to districts such as Sylhet, Sunamganj, Habiganj, Brahmanbaria, Narayanganj, Tangail, Cumilla, and Mymensingh.

Patakuri Society: A Partner in Change

In 2022, his business took a new turn when he joined with the NGO Patakuri Society. The organization provided him with a modern polyhouse (100 ft × 30 ft) and essential nursery equipment worth about 250,000 BDT. This support improved both his production capacity and the quality of seedlings. Most importantly, Patakuri Society connected him with farmers under their project who are dedicated to safe and organic vegetable production. As a result, Gazi Moinuddin gained a steady customer base. At present, about 80% of his sales go to farmers, while the rest is supplied to wholesale traders.

New Adaptations in the Market for Safe Food

Among these new farmers, Gazi Moinuddin noticed a rising demand for inputs that were not widely used before, such as vermicompost, cocopeat, yellow sticky paper, and pheromone traps. He did not limit himself to selling seedlings alone, but also began providing these inputs along with technical support. He advises customers on planting according to land size, teaches them how to control pests and diseases, and, when needed, supports them with high-quality seedlings to solve problems. This knowledge and expertise he had gained through working with scientists from BARI Gazipur and Sylhet Agricultural University.

Growth and Impact

The results came quickly. Over the last three years (2022–2025), his business has grown by 50–60%. His income has also risen significantly from BDT 200,000 annually in 2022 to BDT 800,000 in 2025. Each season, he produces about 300,000 grafted tomato seedlings, along with thousands of watermelons, eggplant, chili, and papaya seedlings. To meet demand, he has entered into both written and verbal agreements with wholesale traders in Sreemangal and other areas, which have ensured secure sales channels.

Challenges and Future Plan

Despite his success, several challenges remain: rising prices of inputs each year, outbreaks of plant diseases and pests, transportation difficulties for seedlings, and occasional shortages of high-quality seeds from seed companies. He believes nursery owners need regular modern training to keep up with new technologies. In the future, he aims to expand beyond vegetables into producing flowers, fruit, and forest tree seedlings. To achieve this, he is prioritizing advanced training in soil management, Integrated Pest Management (IPM), business skills, and market linkages.

Conclusion: An entrepreneur to Follow

The story of Gazi Moinuddin shows how sincere effort combined with the right support can enable a small entrepreneur to make a large-scale impact. He is not only selling seedlings but also equipping farmers with the knowledge and advice needed for safe vegetable production. His journey demonstrates that with proper guidance and mindset, rural enterprises can thrive and play a vital role in strengthening the country's food security.

CASE STORY

07

TURNING SOIL INTO GOLD: A MODEL FOR PROFITABLE AND SAFE VEGETABLE FARMING IN MOULVIBAZAR

Md. Abdul Mannan, from Shukurullahgaon village, Madhabpur Union, Kamalganj Upazila, Moulvibazar, has been cultivating tomatoes for over eight years. Initially, he grew watermelon on both his own and leased land (approximately 10 bigha), but climate variability increasingly made watermelon cultivation risky and less profitable. High production and labor costs, coupled with limited knowledge of eco-friendly practices, further constrained his farming. Early dependence on chemical inputs also raised environmental and economic risks. In 2016, Mannan shifted to tomato cultivation, beginning with 7 decimals using 500 seedlings purchased from nearby Guramara, of which 350 survived. Encouraged by initial success, he gradually expanded his tomato area: 15 decimals in the first year, 45 decimals the next, and 60 decimals thereafter.

He also began sharing knowledge with neighboring farmers, training two in 2017 and expanding the network to 30 farmers who now follow his organic and safe vegetable practices. To ensure sustainability and high yields, Mannan established a nursery producing seedlings for both his own farm and sale to villagers (approximately 100 seedlings per decimal). He introduced organic and eco-friendly practices, including mulching to reduce weeding costs (from BDT 30–40k per Bigha (30 decimal) to BDT 10k), application of vermicompost (400 kg per Bigha (30 decimal) in two rounds), cow manure, organic plant medicines (Star PGR, Square Flower), and probiotics. Pest and disease management includes yellow and pheromone traps, careful removal of virus-infected plants, and soil resting post-harvest. Seedbeds are prepared following Good Agricultural Practices (GAP), including bleaching for disease control, structured cost planning, and precise nutrient application. These interventions have resulted in remarkable outcomes. His first tomato harvest generated BDT 700,000 in sales against BDT 300,000 costs on a small area. Recently, on a 10-Bigha (30 decimal) plot with an investment of BDT 20 lakh, he sold tomatoes worth BDT 48 lakh, earning a net profit of approximately BDT 23 lakh. Yield averages 3,000 plants per Bigha (30 decimal), producing 15 tons of tomatoes, with each plant yielding 5–10 kg. Mannan sells directly to dealers from Sylhet, Dhaka, and Brahmanbaria, reducing middleman dependence and increasing profitability. Beyond personal success, Mannan has emerged as a mentor and leader, training 30 farmers to adopt organic tomato cultivation and safe vegetable practices, spreading knowledge on mulching, vermicompost use, and eco-friendly pest management. His leadership has enhanced local production capacity, community awareness, and income generation across the area. The Patakuri Society played a catalytic role in this transformation. Training sessions, field demonstrations, and continuous follow-up encouraged the adoption of organic fertilizers, mulching, and pheromone traps, while raising awareness of the "Nirapod Shobji" (Safe Vegetable) concept. Technical and infrastructure support included installing a deep tube-well and providing a water pump/machine, reducing labor intensity and irrigation costs. Patakuri Society also provided ongoing guidance for disease management, pest control, and organic practice adoption. Md. Abdul Mannan's farming journey illustrates the power of knowledge, mentorship, and strategic technical support in transforming high-risk, conventional farming into profitable, environmentally sustainable, and community-oriented agriculture. His leadership has empowered fellow farmers, increased incomes, and contributed to the adoption of safe vegetable production practices in Moulvibazar.

CASE STORY

08

"MANGAL MOYUM" – THE EVOLUTION OF COMMUNITY TOURISM

"Mangal Moyum", whose Bengali meaning is "আলোকিত বাড়ী", is a place bustling with local and foreign tourists throughout the year. The owner of this illuminated house is the President of the Community Based Tourism Association, Niranjan Singha, Raju. He is a Manipuri. He was primarily a jewellery businessman. He has a family with one son, one daughter, and his wife. Due to his business, he became acquainted with various stakeholders, and they became interested in learning about Manipuri culture and traditions. Later, the idea of a 'homestay' started revolving in his mind, and in 2015, the journey of 'Manipuri Community Based Tourism' began by hosting guests at his own home in Mazar Gaon, Bhanubil, Adampur Union, Kamalganj Upazila, Moulvibazar District. Over time, the number of guests started increasing, and the demand for better accommodation and food facilities grew.

In this context, the Palli Karma Sahayak Foundation (PKSF) stood by Niranjan Singha through the local development partner organization, Patakuri Society, and enhanced the facilities of the house. Currently, 10-14 guests can stay here at a time. A training center has been developed where, along with various trainings, meetings and workshops are held. Along with the expansion of these services, employment has been created. Where 4-6 Manipuri men and women work. The features of this community tourism are not just accommodation, food, or training; the main characteristic is staying in the habitat of the Manipuri people and enjoying and learning about their traditional food, clothing, wedding ceremonies, dance, and music. The preparation of traditional Manipuri cuisine involves various types of herbal vines, leaves, and spices. Several Manipuri families supply these ingredients to "Mangal Moyum". Furthermore, Manipuri attire, especially the Manipuri saree, is highly valued, which domestic and foreign tourists purchase for their families. These sarees are supplied by the local Manipuri community. Consequently, local employment has been created for "Mangal Moyum". This is showing new dreams to the Manipuri community. PKSF and Patakuri Society are working to brand these dreams. As a result, "Thaballoi", "Kundabali", and "Shiroilili" have been developed, and various government and non-government donor organizations have shown interest in working here. Today, "Mangal Moyum" has not only illuminated itself but has also illuminated the local Manipuri community.

CASE STORY

09

AYJUN BIBI'S GREEN DREAM SPROUTS A VILLAGE-WIDE MOVEMENT

Ayjun Bibi, a woman from Katabil village, Bangladesh, who, with the support of the PKSF-supported RMTP of Patakuri Society, transformed her dream of producing vermicompost into a thriving reality. Her success not only improved her own livelihood but also sparked a village-wide movement towards organic farming, empowering other women and significantly boosting local incomes. In 2022, Ayjun Bibi, a 49-year-old woman hailing from a low-income farming family in Katabil village, became a member of the PKSF-supported RMTP (Rural Microenterprise Transformation Project) of Patakuri Society. This membership proved to be the catalyst for realizing her long-cherished ambition: producing vermicompost. Ayjun had initially learned about vermicomposting but lacked the necessary resources and knowledge to put the idea into practice.

The turning point arrived in 2023 when she participated in project-led training programs. These programs equipped her with crucial business and technical skills, providing her with the confidence and expertise needed to launch her own vermicompost enterprise. Following the training, she received input support from the project, enabling her to acquire the necessary materials and equipment to begin production. The results were almost immediate. Ayjun witnessed a significant improvement in her crop yields, a direct consequence of using her own vermicompost. Neighboring farmers, impressed by the quality of her crops and the effectiveness of her fertilizer, quickly became her first customers. The demand for her vermicompost soon exceeded her production capacity, highlighting the growing interest in organic farming within the community. Recognizing the potential for further impact, the project took a proactive step in mid-2024. It empowered five new members of the Patakuri Society to become vermicompost entrepreneurs themselves. This strategic expansion aimed to meet the increasing local demand and establish a sustainable supply chain. The newly trained entrepreneurs quickly scaled up production, ensuring a steady supply of vermicompost for the local market.

This collaborative effort effectively formalized a local vermicompost industry, creating new economic opportunities and promoting environmentally friendly agricultural practices. Inspired by Ayjun Bibi's success and the collective progress of the new entrepreneurs, other women in the village independently started their own vermicompost production cycles. This organic growth of the initiative demonstrates the power of community-led development and the ripple effect of empowering individuals. Collectively, these women are now producing approximately 2,000 kg of vermicompost per cycle, generating individual earnings ranging from 4,000 to 8,000 Taka. This supplementary income has dramatically increased family incomes by an estimated 25-40 times, providing a significant boost to the economic well-being of the community. Furthermore, the widespread adoption of vermicompost has significantly increased local acceptance of organic fertilizers, paving the way for more sustainable agricultural practices. Looking ahead, the vermicompost producers of Katabil village have ambitious plans for the future. Their primary goal is to expand production volume to meet the growing demand and further solidify their position in the local market. They also aim to promote safe vegetable cultivation throughout the village, encouraging the adoption of organic farming methods to ensure healthier and more sustainable food production. In addition to local sales, the group is exploring opportunities to expand their market reach through online sales platforms and by establishing supply channels with corporate entities. These strategic initiatives will not only increase their income but also contribute to the broader adoption of organic farming practices and the creation of a more sustainable agricultural ecosystem. Ayjun Bibi's story is a testament to the transformative power of empowering individuals and fostering community-led development. Her green dream has not only improved her own life but has also sparked a village-wide movement towards sustainable agriculture, creating new economic opportunities and promoting a healthier environment for future generations. The success of the vermicompost initiative in Katabil village serves as an inspiring example of how targeted interventions and community participation can drive positive change and create a more sustainable and prosperous future for rural communities.