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Impact of Vermicompost Technology on Socio-Economic Profile, Agro-Ecology and Community Enterprise of Merginalized Household at Saline Prone Patuakhali Coast of Bangladesh

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ABSTRACT: An intensive survey was carried out in different villages of Lotachapli union among the targeted marginalized farmer to assess the household knowledge and adoption strategy, productivity and plant biodiversity. The study also aimed to know its socio-economic impact, vermicompost based enterprise development and challenges confronted in their production, storage and marketing of vermicompost. Data has been collected using pre tested two different questionnaires. The survey result revealed that there was a positive change of villagers knowledge which make aware them about the beneficial impact of vermicompost on soil health and ultimately led them to received maximum household yield. Maximum respondents (66.67%) took primary education in Musulliabad followed by lower secondary (60.00%) in Mombipara village. The highest (91.11%) women participation was ensured in vermicompost production at khajura village which was the effective indicator of women empowerment. The technology positively increased productivity and plant biodiversity in the household area. Vermicompost production helped to increase up to 13.8% additional income by direct selling as well as raised production of different vegetables and fruits cultivated in the homestead areas. As the vermicompost is a good quality organic fertilizer, it ensured the improvement of soil physical health by adding organic matter, increasing water holding capacity and minimizing soil salinity in horticultural crops cultivation. Among the studied villages maximum 62% followed by 53.33% respondents having small (<5 decimal) households in Musulliabad and Mombipara villages respectively. Therefore, the results of comparison study between vericompost user and non-user revealed that vermicompost users were consumed significantly higher food than the vermicompost non user farmer group, which may due to the increase of their production as well as economic profit gained from vermicompost, that ultimately led them more intake of nutritious and healthy foods.

Keywords*:* Vermicompost, Socio-economic, Agro-ecology, Community enterprise, Patuakhali coast and Bangladesh.

I. INTRODUCTION

Bangladesh is predominantly an agricultural country and her agriculture sector plays a vital role in accelerating the economic growth. Actual statistics are central support to the design of policies for development of agriculture sector as well as for eradication of poverty and improving food security. It also plays a key factor for proper planning and successful implementation of activities of all sub-sectors of agriculture. Food and nutritional security of the low laying and disadvantaged coastal community in Bangladesh is increasingly threatened by climate change. With a view to addressing quality of life of the extremely poor and vulnerable community of disaster prone Patuakhali coast, different non-government organizations (NGOs) are working for their livelihood improvement. The socio-economic condition of Latachapli union community was mainly dependent on agro-fisheries resources as per information received from the community people of Kalapara in Patuakhali district. Small portion of the community people were engaged in business, service and other technical and non-technical profession from where they were engaged in business, service and other technical and non-technical profession from where they were earning their livelihoods. Traditional agriculture is currently characterized by excessive inputs of chemical fertilizer, pesticides and herbicides, while the insufficient

application of organic fertilizers [1,2]. The common use of pesticide is a major challenge in trying to accomplish sustainable agriculture [3] resulted in the contamination of all necessities of life, i.e. air, water and food [4,5] and could pose potential risks to food and the environmental safety as well as to human health and losses of agricultural biodiversity [6,2]. Vermicomposting has been reported to be a cost-effective, viable and rapid technique for the efficient management of livestock manure [7]. Earthworms are often referred to as farmer's friends and nature's ploughmen and in soil formation process, earthworms are extremely important. Earthworm activity not only accelerates the decomposition of the organic matter [8,9] but also makes nutrient available for plant growth [10,11]. During their feeding, earthworms promote microbial activity greatly, which in turn accelerates the breakdown of organic matter and stabilization of soil aggregates. Vermicompost contain nutrients in forms that are readily taken up by the plants such as nitrates, exchangeable phosphorus and soluble potassium, calcium and magnesium.

Master plan of Bangladesh Government for Agricultural development of the southern region has prioritized homestead agricultural production and plant biodiversity conservation in the southern coastal districts [12]. The 8th (July 2020 – June 2025) Five Year Plan of Bangladesh has included, increasing marginalized household productivity, plant genetic resources maintenance, genetic diversity of plants, and conserve local landraces for protection from extinction [13] those are aligned with the objectives of present study. The geographic condition of the studied area has constant environmental challenges with gradual seasonal changes, high salinity and higher than average frequency of shocks (cyclone and tidal surges). Although the coastal region has 30% of Bangladesh's arable land, increasing soil and water salinity has severe consequences for national food and agricultural systems. Due to climate change and other productivity constraints, farmers of the exposed coast struggle to produce significant surplus, and in turn have low farm gate prices which limits profit, rendering agriculture a dismal and insecure livelihood. In the study area, homestead is the major raised land which is a great source of livelihood materials, a nearest place for exchanging and recycling ingredients, option and origin for organic farming and activity spot for direct participation by all family members without limiting by time period.

Keeping these potentials in mind, the study area (Latachapli union) was selected for vermiculture technology to address the household's vulnerability issues. Climate change make extra pressure on the food security, moreover the studied communities are target group of in this vulnerable climate change affected coast of Bangladesh [14]. Since inception of the research, vermiculture technology has proved its promises as a growing technology for agricultural productivity, plant biodiversity, environmental soundness, earning source, livelihood support and community enterprise etc. Many of the people of this community are engaged with the varmiculture as it is a wonderful alternate income source for them. Hence, this systematic study has been thought fruitful for the assessment of qualitative and quantitative change parameters due to adoption of vermiculture technology in study area.

II. METHODOLOGY

2.1 Focus Group Discussion/ Experts opinion

Before going to face to face data collection from farmers Focus Group Discussion (FGD) was performed with DAE personnel, Scientists and Non-Government Organization (NGO) officials. Within the time expert opinion from consultant and educational institute (university teachers) was collected.

2.2 Study area and population

A total 1000 household of studied area (Latachapli union) was the study population. From which 225 farm families of different five villages (Khazura, Musulliabad, Tulatoli, Maitvanga and Mombipara) under Latachapli union of Kalapara upazila following the formula of Yamane [15].

Total sample size of the study was 225 which were drawn from different household of the vulnerable communities and caritas beneficiaries of Kalapara upazilla. The sample size was determined by using following the formula;

$n=N/[1+N(e^2)]$

Where, n=Sample size, N=Total population and e= Level of significance

In case of control treatment, 45 households were considered non user of vermicompost.

2.3 Survey and data collection

Two separate structured questionnaires were used for data collection of this survey. One questionnaire was used for collection of socio-economic status, climate smart knowledge, vermicompost production and marketing information etc. Different socio-economic indicators viz. main occupation, alternate occupation, family members, household size and household income, production, usage and marketing of vermicompost (incase of vermicompost producers), knowledge score on vermiculture information were included in this study. It is worth noting that other information on household characteristics was collected during these surveys but

only mentioned the ones that are relevant for this study. Another questionnaire was used for collecting 7 days diet pattern data of targeted study population. Seven days household food consumption included cereals as staple food, pulses, fruits and vegetables by the household members. Besides, consumption of animal source foods viz. eggs, meats and fishes by the household members also included in this survey time. The survey assessed daily intake and 7 days follow up in both dietary diversity and individual intakes of food by the household members. Therefore, recording of 7 days' food consumption pattern had done and compared with the secondary data on recommended daily allowances per person to address nutritional abundance or deficits.
All the respondents were informed about the purpose of the survey and verbal and written consent was received from all before their participation. The confidentiality of all information released by respondents was assured. Data were collected by door to door interviewing using pre-tested structured questionnaire. Between April-September 2022, the program was implemented among the households of Latachapli union of Kalapara upazila under Patuakhali district in Bangladesh. Medium to high margin income household families those who were engaged with vermicompost production was included in this study. Households were randomly selected with the help of Caritas, Bangladesh. Five villages of Latachapli union were selected for this study. From each of the villages 45 households were selected. As a result, our total respondents were 225 for vermicompost producers and 45 for control those who were not engaged with vermicompost production. Non-experimental design was followed for the survey data analysis. A comparison between before and after situations of the technology was compared. For comparing the statistical difference, Z-Test was performed.

2.4 Data analysis

Data entry and primary computing were done using Microsoft Excel computer programme. Data were analyzed using the Microsoft Excel, Statistical Package for Social Science (SPSS) and JMP-14 computer programme. Microsoft Excel programme was used for preparing graph. Duncans Multiple Range Test (DMRT) was done for mean comparison of the studied parameter among the five villages. A two tailed Z-test was also done for comparison of income from vermicompost and total income as well as total food consumption of vermicompost user and non-users group.

2.5 Weighing scale and food weight

During the data collection, a portable electronic weighing scale (FF1976) model-14191-744E, capacity-50 Kg/110 lb, division-5 g/0.01 lb, Made in china was used for 7 days diet data collection of selected homesteads. We supplied the electronic scale to each of household for data collection. They took weight of each food item (rice, wheat, pulses, vegetables, fruits, eggs, milk, meat and fish) before get eat or cooking.

III. RESULTS AND DISCUSSION

3.1 Demographic profile of the study population

3.1.1 Educational qualification

Educational qualifications were divided into 4 groups viz. Signatory (less than 2 years education or only able to signing, Primary (three to five years education group), Lower secondary (Six to nine years education group) and Secondary School Certificate (SSC) and more (more than 10 years education group). Maximum respondents were in lower secondary educational group those who have actually 6 to 9 years education. The educational qualification of the studied groups of different villagers in Latachapli union are given in Table 1.

Table 1. Educational qualification of vermicompost non user and user respondents of different villages in Latachapli union

Vermicompost non user/user	Signatory (< 2 yrs)	Primary (3-5 yrs)	Lower secondary (6-9 yrs)	SSC and more (>10 yrs)
Control (non user)	4.44 (2)	44.44 (20)	33.33 (15)	17.78 (8)
Khazura	2.22 (1)	44.44 (20)	42.22 (19)	11.11 (5)
Musulliabad	2.22 (1)	66.67 (30)	24.44 (11)	6.67 (3)
Tulatali	4.44 (2)	40.00 (18)	51.11 (23)	4.44 (2)
Maitvanga	8.89 (4)	33.33 (15)	53.33 (24)	4.44 (2)
Mombipara	4.44 (2)	33.33 (15)	60.00 (27)	2.22 (1)

* Results shown in table in percent and sampling number in the bracket/parenthis.

The lowest participants counted in signatory group where maximum participant (8.89%) took part the survey at Maitvanga village and minimum at Khajura and musulliabad (2.22%). The majority of the studied sample was done those people who had primary and lower secondary education. The highest number of

respondent having primary education (66.67%) took part in musulliabad village whereas this educational level group was the lowest in Maitvanga and mombipara villages (33.33%). About 90% were educated either primary, secondary or tertiary level of 40 years respondents groups that fit with the current results [16]. Maximum lower secondary education was taken in Mombipara (60.00%) followed by Maitvanga (53.33%) and Tulatoli villagers (51.11%). In case of SSC and more educational group maximum participants (17.78%) was in control village and minimum (2.22%) in mombipara respondents.

3.1.2 Gender

Gender of control group and vermicompost producer at different villages of lotachapli union has been presented in Fig. 1. As vermicompost is the additional business of the community people under Caritas beneficiaries, the highest participation was found in Khajura village (90%) followed by Maitvanga (84.44%) and the lowest participation was in Tulatoli (73.33%) followed by control (75.56%) group of studied population.

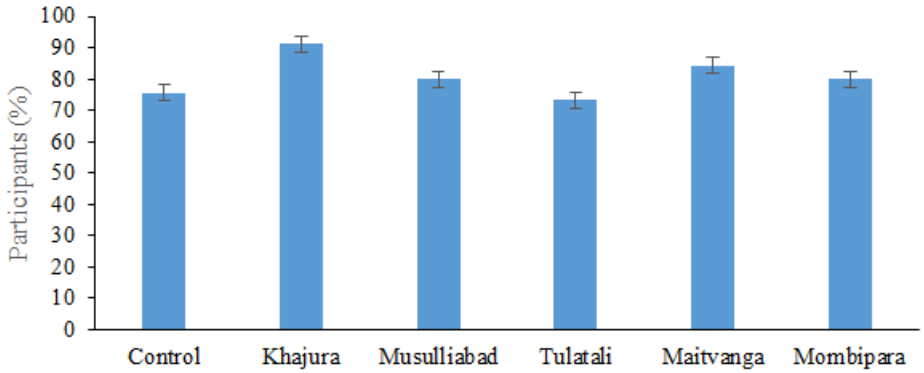

Figure 1. Percentage of female participation in vermicompost production at different villages of Lotachapti union. Vertical bars represent standard error.

3.1.3 Occupations

Different occupational group of control and vermicompost producer in the studied villages of Latachapli union have been presented in Fig. 2.

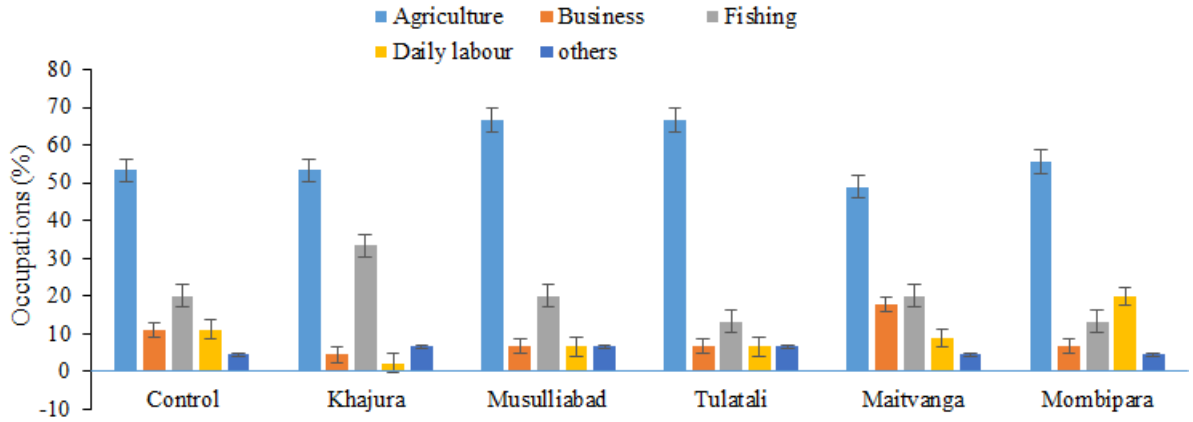

Figure 2. Different occupations of vermicompost non user and user in the studied villages of Latachapli union. Vertical bars represent standard error.

Occupation of the respondents were classified into five different group namely Agriculture, business, fishing, daily labour and others (i.e auto driver, motor cycle driver, hoker etc) where vermicompost production was the additional income source of all the respondents except control villagers. Agriculture occupation was secured maximum respondents among all the studied occupation at different villages of Latachapli union. The highest percentage (66.67%) of people carried agriculture occupation in Tulatoli and Musulliabad villages followed by Mombipara (55.56%), Khajura and control (53.33%) group or villagers and the lowest (48.89%) in Maitvanga. Second largest respondents took part fishing occupation (13.33% to 33.33%) in all the studied villages except Mombipara where daily labour (20%) was the second largest occupation and minimum number of respondents took part of the survey from others occupations like auto driver, motor cycle driver, hawker etc.

3.1.4 Participants category

Categories of participants in accordance to their religion, indigenous and physical ability the participants were divided into 4 groups viz. Muslim, Sonaton, Tribals and Disables. Percentage of Muslim, Sonaton, Tribal and Disable members are given in Table 2. Maximum (62.22%) Muslim religious people from

Musulliabad village followed by Tulatoli and control villagers (55.56%) and it was minimum (40.00%) in Maitvanga village. The highest (35.56%) Sonaton religious peoples were took part the survey from Khajura village and it was lowest (22.22%) in Tulatoli village. Among the Caritas beneficiaries tribal and disable persons were also took part of this survey. The highest (22.22%) tribal and 13.33% disable persons were the respondents of Mombipara and Tulatoli village respectively.

Table 2. Different categories (%) of participants non user and user respondents of different villages in Latachapli union

Vermicompost non user/user	Muslim	Sonaton	Tribal	Disable
Control (non user)	55.56	26.67	8.89	6.67
Khajura	44.44	35.56	13.33	6.67
Musulliabad	62.22	26.67	6.67	4.44
Tulatoli	55.56	22.22	15.56	13.33
Maitvanga	40.00	33.33	17.78	8.89
Mombipara	48.89	24.44	22.22	4.44

3.1.5 Household size

The households size of the respondents of different villages have been presented in Fig. 3. The households were categorized into four different groups viz. less than 5 decimal, 6 to 10 decimal, 11 to 15 decimal and more than 15 decimal.

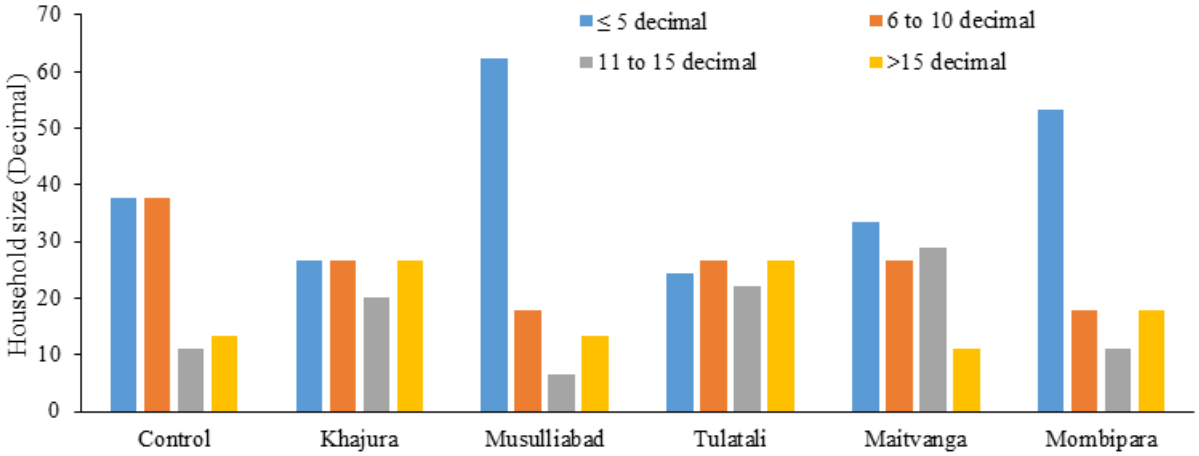

Figure 3. Household size (decimal) of vermicompost non user and user in the studied villages of Latachapli union.

The highest percentages of household (62.22%) was belongs to less than 5 decimal group in Musulliabad village followed by Mombipara (53.33%) and the lowest (24.44%) in Tulatoli village. The control villagers (vermicompost non user) consisted maximum percentage of 6 to 10 decimal sized household (37.78%) followed by Khajura, Tulatoli and Maitvanga villages having same percentage (26.67%) of household. In case of more than 15 decimal household, the highest percent (26.67%) was exists in Khajura and Tulatoli villages and it was the lowest (11.11%) in Maitvanga village.

3.1.7 Family size

The family size was classified into three groups viz. small family (those who have upto 3 members), medium family (those who have 4 to 6 members) and big family (those who have more than 7 members). Family size of control and vermicompost producers at different villages in Latachapli union have been presented in Fig. 4. The survey results revealed that maximum percentage (71.11%) of medium size family was found in Khajura and Mombipara villages followed by Musulliabad (68.89%) and it was minimum (48.89%) in Maitvanga village. There were very limited big families with a percentage range of 8.89% to 24.44% in the studied area.

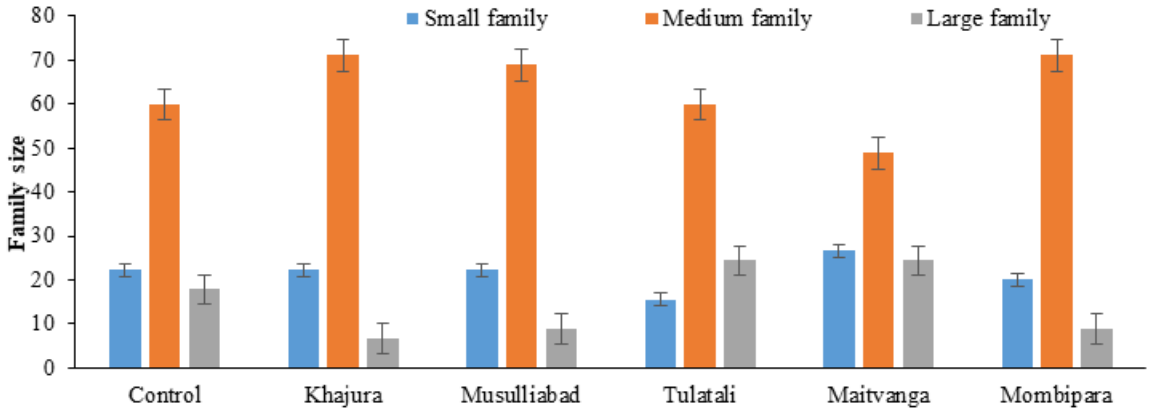

Figure 4. Family size of vermicompost non user and user in the studied villages of Latachapli union. Vertical bars represent standard error.

The family members ranges from 2 to 9 person of the studied household. Comparatively large family exists in Mitevanga village of studied area. Most of them are settler and stay outside or bank of the barrage and they are suffering from tidal surge. This finding is fairly supported by the result of Hasan *et al.* (2021). [16].

3.1.8 Knowledge on vermiculture

The knowledge about vermicompost production was categories in different 3 group viz. less (upto 2.0), moderate (3.0) and good (4.0) knowledge. Knoweledge scored of studied population at different villages of Lotachabli union have been presented in Fig. 5. The results showed that maximum (82.22%) knowledgeable (good category) respondents were in Maitvanga followed by Khajura (80%) whereas good category respondents were minimum in control village (42.22%). The highest moderate knowledgeable respondent (53.33%) was took part of the survey in control group and it was the lowest (11.11%) in Khajura. Among the villagers 5-10% respondents were less knowledge scored about vermicompost production in all the studied villages. From Kandhamal district of Odisha in India [17] found that 58.33% possessed good knowledge and 41.33% had fair knowledge level on vermicompost which supported the present findings.

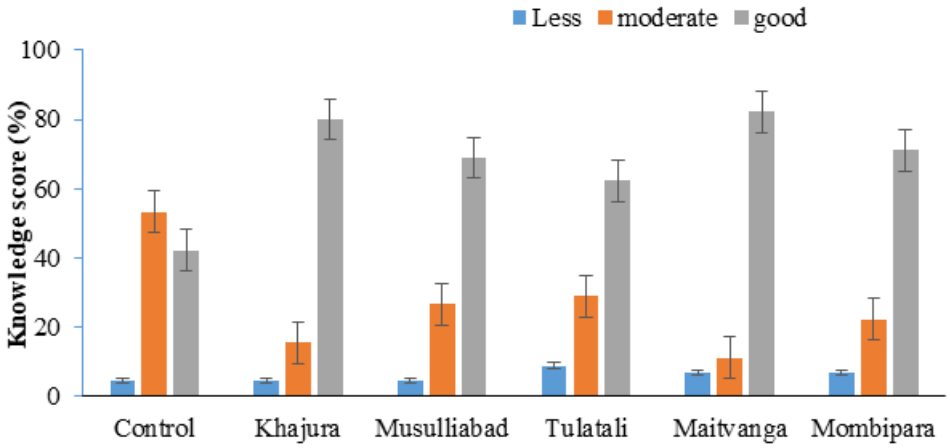

Figure 5. Knowledge score on vermicompost production as climate smart technology of the proyash beneficiaries at different villages of Latachapli union. Vertical bars represent standard error

3.2. Quantitative parameter

3.2.1 Effect of vermicompost on plant biodiversity

The farmers of study area cultivate different indigenous fruits and vegetable species, majority of them grown rice as field crop including local and few high yielding varieties. They cultivate two to more than five crops in a year in their household. This study revealed that the highest percentage of vegetables (73.33%) produced by vermicompost user group of Maitvanga followed by Mombipara (71.11%) villagers and vermicompost non user group cultivate moderate vegetables (66.67%). Use of vermicompost in fruit production was maximum (33.33%) in Khajura village followed by Tulatoli (31.11%) and it was minimum (15.56%) in Maitvanga village.

Table 3. Different types and number of crops cultivation influenced in vermicompost users and control group farmers of different villages in Latachapli union

Vermicompost non user/ user	Types of crops (%)			Number of crops (No.)		
	Vegetables	**Fruit trees**	**Miscelleneous**	**Two-three crops**	**Four-five crop**	**More than five crops**
Control/ Non user	66.67	26.67	6.67	48.89	51.11	0.00
Khajura	55.56	33.33	11.11	0.00	53.33	46.67
Musulliabad	62.22	22.22	15.56	0.00	66.67	33.33
Tulatoli	53.33	31.11	15.56	0.00	60.00	40.00
Maitvanga	73.33	15.56	11.11	0.00	73.33	26.67
Mombipara	71.11	17.78	11.11	0.00	64.44	35.56

In case of number of crops, Vermicompost user group of Maitvanga produced maximum (73.33%) followed by Musulliabad (66.67%) and minimum in control or vermicompost non user group (51.11%). Among the treatments group only control group produced 2-3 vegetables over a year in their household whereas vermicompost users all others villagers produced four to more than five crops. Therefore, Vermicompost non user farmer did not produced more than five crops over the year but all the vermicompost user's farmer produced more than five crop in their household. In case of more than five crops production maximum farmers (46.67%) of Kahjura village followed by Tulatoli (40%) and minimum (26.67%) was in Maitvanga villagers. Researchers reported that vermicompost exerted its different effect on plant species and genotypes which supports this result [18].

3.2.2 Effect of vermicompost on agricultural productivity

The household size of the studied populations was varied from 9.52 decimal to 14.74 decimal which were actually marginal famers of studied populations. Results revealed that the additional income (income from vermicompost) significantly influenced the total income as well as income from vermicompost has significant variation in different villagers of proyash project. The highest contributing income comes from vermicompost users of Khajura (113 kg) followed by Musulliabad (106.40 kg) and the lowest contribution provider was vermicompost users of Mombipara and Maitvanga (38.62 kg and 33.69 kg) villagers which was statistically similar to the vermicompost non user (control) group. The use of vermicompost helps more production which may led them higher income contribution. The research resulted that Vermicompost is free from pathogens, toxic elements, weed seeds which contribute to increase the productivity of tomato, sweet peaper, sweet corn hybrids, pak choi etc crops that properly matched with this study. [19]

Table 4. Household size, vegetable production and total income of vermicompost users and non-users at different villages of Latachapli union

Vermicompost non user/ user	Household size (decimal)	Vegetables production using vermicompost (kg)	Total Income (tk)
Control/ Non user	9.52	20.52 c	7997.78 b
Khajura	14.46	113.44 a	9535.56 a
Musulliabad	10.11	106.40 a	8944.44 ab
Tulatali	14.78	84.38 b	9177.78 ab
Maitvanga	11.16	33.69 c	9084.40 ab
Mombipara	10.09	38.62 c	9626.67 a
Level of significance	NS	**	*
CV (%)	9.87	7.35	25.58

NS= Non significant, ***** and ****=** Significant at 5% and 1% level of probability.

The lowest total income contributor was control household those who were actually vermicompost non users. The highest total income (9626.67 tk and 9535 tk) received from Mombipara and Khajura household whose were statistically different from others villages. Moreover, Tulatoli, Maitvanga and Musulliabad villagers received statistically similar total income. The lowest total income recorded from control (7997.78 tk) households.

IV. INCOME AND CONSUMPTION COMPARISON BETWEEN VERMICOMPOST USER AND NON USER STUDIED POPULATION

4.1 Additional income

Additional income comparison between vermicompost users and vermicompost non users in the studied beneficiary group of caritas are given below (Table 5).

Table 5. Statistical values for comparison of additional income of the studied household head

Statistical values	Vermicompost non users (μ_1)	Vermicompost users (μ_2)
Mean (x)	9.86	10.09
Median	9.09	9.39
Mode	7.50	10.53
Standard deviation (δ)	4.11	4.03
Population (n)	1000	1000

H_0: μ1=μ2

From the table it is found that, calculated value of Z = 6.95 is more than that of critical value or tabulated value of Z (2.704) at 1% level of significance. So, the null hypothesis is rejected. As a result, it can be concluded that vermicompost user farmers were received significantly higher additional income than the vermicompost non user farmer group.

4.2 Total income

Total income comparison between vermicompost user and vermicompost non user in the studied beneficiary group of caritas are given below (Table 6).

Table 6. Statistical values for comparison of total income of the studied household head

Statistical values	Vermicompost non users (μ_1)	Vermicompost users (μ_2)
Mean (x)	8467.78	9056.44
Median	8400.00	8520.00
Mode	7000.00	9100.00
Standard deviation (δ)	1485.90	2187.79
Population (n)	1000	1000

H_0: μ1=μ2

From the table it is found that, calculated value of Z = 7.04 is more than that of critical value or tabulated value of Z (2.704) at 1% level of significance. So, the null hypothesis is rejected. As a result, it can be concluded that vermicompost users were received significantly higher total income than the vermicompost non user farmer group.

4.3 Total consumption

Total consumption comparison between vermicompost user and vermicompost non users in the studied beneficiary group of caritas are given below (Table 7).

Table 7. Statistical values for comparison of total consumption of the studied community

Statistical values	Vermicompost non users (μ_1)	Vermicompost users (μ_2)	Calculated value (Z)	Tabulated value (Z)	Level of significance
Mean (x)	782.07	925.01			
Median	770.38	839.36			
Mode	500.00	650.00	10.62	2.704	**
Standard deviation (δ)	246.67	346.77			
Population (n)	1000	1000			

H_0: μ1=μ2

From the table it is found that, calculated value of Z = 10.62 is more than that of critical value or tabulated value of Z (2.704) at 1% level of significance. So, the null hypothesis is rejected. As a result, it can be concluded that vermicompost users were consumed significantly higher food than the vermicompost non user farmer group. Vermicompost played important roles for agricultural production, maintaining the soil health, organic farming, and environment protection and applied as a tool for income generation [20].

4.4 Effect of vermicompost on dietary diversity

Wide variation was recorded in cereals intake in their everyday meal. Cereals consumption by the household members of the studied villages have been presented in Fig. 6. Therefore, cereals are the staple food all over the country, here average consumption rate by the household members varied from 255.12 g to 360.06 g, where cereals intake was statistically similar except Tulatali village. The lowest average consumption per person was 255.12 g/person/day which is lower than the daily recommended rate 270 g – 450 g [21] and others villagers were took almost similar or statistically similar amount of cereals in their daily diet which were very close to daily dietary cereals or staple recommendation of Bangladeshi people.

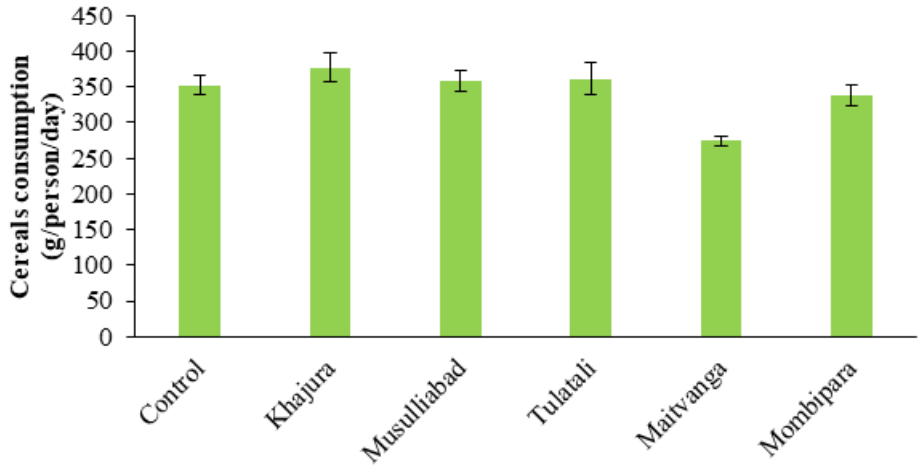

Figure 6. Cereals consumption by the household members of vermicompost non user and user in the studied villages of Latachapli union. vertical bars represent standard error.

Statistically significant variation was observed in all items intake their daily diet except meat consumed in their daily diet of different studied villages except meat consumption (Table 8). Potato consumption was maximum 72.12 g/person/day was recorded in the family member of Maitvanga village followed by Mombipara 63 g/person/day and Musulliabad 59.99 g/person/day and minimum potato consumption was recorded in the diet Tulatoli villagers (23.97 g).

Table 8. Different food items consumed by the household members in their daily diet at different villages of Latachapli union

Vermicompost non user/ user	Family member	Potato (g)	Pulse (g)	Vegetable (g)	Fruit (g)	Fish (g)	Eggs (g)	Milk (ml)	Meat (g)
Control/ Non user	4.76	55.66 ab	27.02 b	95.52 d	68.92 b	54.71 d	20.42 bc	9.06 c	24.49
Khajura	4.22	45.79 bc	24.52 b	178.31 abc	90.20 b	153.34 a	10.25 c	26.53 bc	31.44
Musulliabad	4.29	59.99 ab	31.83 ab	206.96 ab	71.63 b	140.68 ab	8.70 c	29.95 bc	31.64
Tulatali	4.53	23.97 c	30.33 ab	162.48 bc	68.93 b	121.32 abc	43.14 b	29.92 bc	32.12
Maitvanga	5.00	72.12 a	31.62 ab	133.29 cd	38.25 b	96.01 cd	14.90 c	39.11 ab	41.47
Mombipara	4.98	63.79 ab	49.63 a	242.91 a	210.30 a	108.37 bc	102.68 a	58.31 a	25.46
Level of sign.	**NS**	**	*	**	**	**	**	**	**NS**
CV (%)	**33.20**	**8.47**	**10.62**	**9.50**	**12.72**	**6.90**	**15.32**	**13.45**	**15.32**

NS= Non significant, * and **= Significant at 5% and 1% level of probability

The highest amount of vegetables was consumed (242 g/person/day) by the household members of Mombipara village followed by Musulliabad (206.96 g/person/day) which were close to the daily national recommendation. The lowest amount of vegetables consumed by the household members of control treatment whose had no vermicompost production and usage in their household area. More fruit (210 g) get accommodation in the diet of Mombipara villagers which was satisfactory compared to our national recommendation. Others villagers took very worst amount of fruits in their daily diet whose are statistically similar to control treatment and all the villagers took insufficient amount of fruits in their daily diet compared to our daily national recommendation. In case of fish consumption, the highest amount was consumed by the

household members of Khajura village (153.34 g) followed by Musulliabad (140.68 g) which is little satisfactory compared to our national recommendation guideline. The lowest amount of fish consumption was recorded in the daily diet of control treatment or villagers (54.71 g).

Maximum amount of eggs was consumed by Mombipara villagers (102.68 g) followed by Tulatoli (43.14 g) and it was minimum (8.70 g) in the daily diet of Musulliabad villagers. Mombipara villagers took the highest amout of milk (58.31 ml) followed by Maitvanga villagers (39.11 ml) and it was lowest in control villagers (9.06 ml) daily meal. Meat consumption gave the non-significant results which varied from 24.49 g to 41.47 g in their daily diet.

4.5 Vermicompost enterprise development

The rate of vermicompost use in fruits and vegetables manly categorized in three group (i.e. for fruit crop upto 500 g, 501 to 1000 g and > 1000 g; for vegetable crops upto 4 kg, 5 to 8 kg and >8 kg). Percent of respondent vermicompost use in fruits and vegetables crops grown their household at different villages of Latachapli union has been shown in Table-9. The results exhibits that maximum respondents (48.89% to 91.11%) have been used 500 g vermicompost per plant and very few villagers used more than one kg per plant. In case of vegetable crops the highest (71.11% to 20.00%) respondents have been used 5-8 kg per decimal and the lowest respondents (6.67% to 22.22%) used more than 8 kg per decimal.

Table 9. Percent of respondent vermicompost use in fruits and vegetables crops grown their household at different villages of Latachapli union

Vermicompost non user/ user	Vermicompost use in fruit crops (g/plant)			Vermicompost use in vegetable crops (Kg/dec)			Others use (%)
	upto 500 g	**501 to 1000 g**	**more than 1000 g**	**upto 4 kg**	**5 to 8 kg**	**more than 8 kg**	
Control	91.11	8.89	0.00	33.33	66.67	0.00	0.00
Khajura	75.56	4.44	20.00	22.22	62.22	15.56	26.67
Musulliabad	82.22	17.78	0.00	13.33	71.11	15.56	20.00
Tulatoli	73.33	15.56	11.11	17.78	60.00	22.22	15.56
Maitvanga	82.22	17.78	0.00	26.67	66.67	6.67	22.22
Mombipara	48.89	22.22	6.67	15.56	62.22	22.22	22.22

Though the vermicompost technology is very much initial stage but the respondents made it stronger by ensuring versatile use like fish feed, chicken feed, duck and goose feed in their household. The highest percentage of (26.67%) villagers showed versatile use of vermicompost in Khajura followed by Maitvanga and Mombipara (22.22%) whereas it was the lowest (15.56%) in Tulatoli village. The producers marketed their vermicompost using poly bag and sack. Main buyers of their vermicompost were local farmers, entrepreneurs, different government project personnel. They also marketed their products with the help of farmers field school and sometimes took help of middle man or foria. There is need to develop a strong channel for marketing of the produced vermicompost of marginal farmers.

Different villagers income from vermicompost and vegetables production using vermicompost considered as vermicompost user treatment group. Significantly higher income contribution (13.49%) was found in the household of Maitvanga villagers followed by Khajura (10.20%) and Tulatoli (10.19%) and the worst contribution (8.42%) was recorded in Tulatoli village. Therefore, control treatments vermicompost non user i.e other than vermicompost income gave moderate amount of additional income (9.85%) which was similar to vermicompost user group of Musulliabad and Mombipara (9.12% and 9.23% respectively). The vermicompost producers group farmers opinted that they took training on value addition and marketing channel development by which already they work as middleman and sale it in their commercial shop as well as different organization which increased their additional income. This was the first stepping of their entrepreneurship development with vermicompost. The average family income of the respondents was roughly 2870 USD per year, and they also received an additional 115 USD per year from vermicompost. [16]

V. PROBLEMS CONFRONTED BY VERMICOMPOST GROWER IN THE STUDY AREA

The vulnerable community faced few problems in vermicompost technology. They faced problem for inadequate raw cow dung. Natural enemy like ants, rat and birds make damage the earthworm. The breed of earthworm was another problem where they mentioned some of breed was less egg laying those who were produced comperatively lower amount of vermicompost. Finally, they mentioned it was little tough to maintain

proper relative humidity and temperature in the summer season which causes damage of earthworm population and ultimately led them very lower production.

They also identify problems in processing and storage of vermicompost i.e drying and storing. Farmers make dry the vermicompost by opening it in the shed place and finally stored in sag bag or drum where they keep it for 6 months. Though there is farmers group by which they marketed their vermicompost but in summer when production get boost there is scare of buyers of vermicompost. So, they seek easy access of selling it to government and private organizations which help them getting more profit. Bangladesh has 3 million hectares of land that is affected by salinity, mostly in the coastal and south-east districts, with electrical conductivity (EC) values that range from 4 to 16 dS/m [22]. Crop production in the coastal saline areas particularly during Rabi season (dry season) is very limited due to rise in soil salinity. Salinity is one of the harshest environmental conditions that limit agricultural productivity, including tomato production in our studied south central coast of Bangladesh.

VI. CONCLUSION

The study finally concluded that the studied project had significant role in the socio-economic development of studied vulnerable population of Latachapli union under Kalapara upazilla. Besides, manuring with vermicompost increased their household production of fruits and vegetables which led them more consumption. Farmers of this vulnerable coastal areas can adopt the technology for maximizing household production and total income. This study has made the following specific observations:

i. Vermicompost users had significantly higher additional and total income than the vermicompost non user farmer group, which may led them higher amount of food intake to ensure their nutritional supplementation.
ii. Use of vermicompost significantly increased the crop production and also created opportunity to accommodate more crops (>5 crops/year), which not only increased the production but also improved the crop biodiversity.
iii. This technology empowered the women by developing vermiculture based household entrepreneurship.
iv. This technology helped to open the way of fresh and healthy fruits & vegetables production giving minimum chance to contamination in different stages of production, harvest and storage.
v. This technology directly influenced the total income by increased the mean additional income upto 10.09%. Obviously additional income helps them to improve their lifestyle and socio-economic condition.
vi. During COVID-19 the household member gave more time in vermicompost production that increased their garden production which ultimately led them more nutritional intake.
vii. There was lack of proper marketing channel of the vermicompost producer, many of them have huge production but there was scare of buyer. They needed more technology for long term storage of the vermicompost.

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Conflict of interest

There is no conflict of interest in the study

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