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Sustainability of Organic Vegetable Farming in Rural Bangladesh

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Abstract— Organic farming is considered as a sustainable way to produce food for the world growing population. In Bangladesh, the preference for organic food is increasing and there is opportunity to grow more vegetables. But, it is argued that the expansion of organic farming practices has remained limited despite organic agricultural movement in the country since 1980s. Thus, the main objective of this study was to examine the sustainability of organic vegetables farming (OVF) in rural Bangladesh. A cross sectional study was undertaken in five selected villages across the country where 60% of the OVF from the villages was sampled as respondents. The data was collected using semi-structured interview schedule. Frequency, percent, mean, and Pearson Product Moment Correlation were used in the analysis. Results reveal that the respondents were socioeconomically marginal. The average score of the sustainability measurement index of the economic dimension was 91/180 (moderate sustainably). The average score of the index of socio-territorial dimension was 124.75/180, so high sustainably. The Average score of the index of agro-ecological dimension was 154.25/180, also high sustainably. A positively weak significant association was obtained between education, farm size, farming experience, annual income and membership of association, and sustainability of OVF. On the other hand, the association between age and sustainability of OVF was negatively weak significant. The overall sustainability of organic vegetable farming (OVF) was moderate. Ensuring availability of organic pesticides, training and subsidy by agencies (GOs and NGOs) would go a long way to nurture the sustainability of organic farming in rural Bangladesh.

Keywords— **Farming, Organic, Rural, Sustainability, Vegetables.**

INTRODUCTION

Sustainability is a highly discussed issue today. In farming, organic production is considered by people, especially above average, as a sustainable way to produce food for the world growing population. In this regard, the Worldwatch Institute (2013) reported that "organic farming has the potential to contribute to sustainable food security by improving nutrition intake and sustaining livelihoods in rural areas, while simultaneously reducing vulnerability to climate change and enhancing biodiversity. Organic agriculture uses up to 50.0 percent less fossil fuel energy than conventional farming, and common organic practices-including rotating crops, applying mulch to empty fields, and maintaining perennial shrubs and trees on farms-also stabilize soils and improve water retention, thus reducing vulnerability to harsh weather patterns. On average, organic farms have 30 percent higher biodiversity, including birds, insects, and plants, than conventional farms do."

However, owing to the arguments and counter arguments on the definition of sustainable agriculture (Velten, 2015), this paper lays emphasis on the scope covered by MacRae et al. (1989) and Reganold et al. (1990) because of the relevance of their context to the present study. MacRae et al. (1989) views sustainable agriculture as comprising of management procedures that work with natural processes to conserve all resources, minimize waste and environmental impact, prevent problems and promote agroecosystem resilience, self-regulation, evolution and sustained production for the nourishment and fulfillment of all. While, Reganold et al. (1990) stated that for a farm to be sustainable, it must produce adequate amounts of high-quality food, protect its resources and be both

environmentally safe and profitable. Instead of depending on purchased materials such as fertilizers, a sustainable farm relies as much as possible on beneficial natural processes and renewable resources drawn from the farm itself.

In Asia, organic farming is reported (Angelina, 2000) to be a practical means for farmers to achieve household food security and a modest income while contributing to environmental protection. Organic farming evolved after green revolution happened in south Asian region particularly in British India. In Bangladesh, the preference for organic farming is increasing and there is opportunity to grow more vegetables (Uddin et al., 2012), especially if the major identified factors (Sarker, 2010) influencing the extent of practice of organic farming technologies (OFTs) by the Bangladeshi farmers are taken into consideration. These include; knowledge and awareness creation regarding environmental and health issues, simplicity of the OFTs and availability of basic production factors. Increased organically produced vegetables and its consumption could prevent the incidence of malnutrition disorders, reduce the intake of cereals and generate more income for the farmers and vegetable sellers, as well as play vital role in environmental stability, and food security for the people of Bangladesh. Moreover, vegetable export volume will be increased. Therefore, effective collaboration, capacity building, formulations of regulations can help foster the organic production sustainably.

Rahman et al. (2011) argued that in Bangladesh, organic farming research is at the very primitive stage and, infrastructure and marketing behaviour of the required inputs are not so well organized. In the same way, organic farming practices expansion has remained limited despite the fact that organic agricultural movement has been active in Bangladesh since the 1980s. Nevertheless, people are recently becoming more aware of the advantages of organic food especially in capital city (Sarker, 2007; Sarker and Itohara, 2009). The rising awareness could be beneficial for developing countries like Bangladesh, where it can contribute to purposeful and sustainable socio-economic and ecological development (Yussefi and Willer, 2003).

Up until now, however, Bangladeshi farmers have not been able to benefit from the growing global organic market, and they have even failed to create a good domestic market for organic foods. Hence, given the state of affairs, arguments and several observations with regards to the organic farming in Bangladesh, the present study was undertaken to examine its sustainability in selected rural areas of the country.

MATERIALS AND METHODS

This study adopted both descriptive and diagnostic research designs. The investigation was carried out in Kapasia, Monohardi, Mirzapur, Matlab Uttar and Sadar upazila (sub-district) of Gazipur, and, Narshindi, Tangail, Chandpur and Jessore districts of Bangladesh, respectively. The main reason behind the selection of these areas was the practice of organic farming due to a project intervention by the Japan International Cooperation Agency *(*JICA), named SENSE, which aimed to deliver food to consumers directly from farmers. The project provides some input and logistic supports to farmers who produce organic vegetables.

The total number of organic vegetable farmers (OVF) in the districts was 100 (20 from each upazila). Out of this, 12 (60.0%) farmers were sampled as the study respondents from each of the mentioned areas that constitute the study population. The selection followed random sampling. The data were collected using an interview schedule and analysed using both descriptive and inferential statistics. The descriptive statistics include frequency, percent and mean, while the inferential statistics include correlation. The correlation (Pearson Product Moment Correlation) was used to test whether there exist association (and its strength) between the selected characteristics of the respondents and the sustainability of organic vegetable farming. The independent and dependent variable, respectively.

Sustainability of organic farming was measured by adapting Gafsi and Favreau (2010). This variable was divided into three dimensions, namely, economic, socio-territorial and agro-ecological dimensions. Furthermore, four unique criteria were considered under each dimension. Similarly, three statements were included under each point in order to measure the extent of the opinion of the respondents using 4-point Likert-type scale, viz. very high (3), high (2), moderate (2) and not at all (0). In order to have a composite measure for the criteria considered under each dimension, a Sustainability Measurement Index (SMI) was developed and used.

The SMI of individual statement was measured using following formula:

The score SMI of individual statement = $\sum$ (Number of responses opined very high x 3 + Number of responses opined high x 2 + Number of responses opined moderate x 1 + Number of responses opined not at all x 0).

The possible range of the score of SMI of individual statement is between 0 and 180. Score of 0 indicates no sustainability, on the other hand, score of 180 indicates the highest level of sustainability.

As the dependent variable was divided into three dimensions, the average score of the index was measured using following formula:

$\mu = \Sigma X / N$

Where, μ = the average score of the index of each dimension of the variable

X= Score of the individual statements

N= Number of the statements under each dimension of the variable

Again, the average score for all dimensions of the dependent variable was calculated all together applying same formula.

RESULTS AND DISCUSSIONS

Selected characteristics of the respondents

The age of the respondents ranged from 25 to 64 years with an average of 43.13 years. Results in Table 1 indicate that the highest proportion (61.67%) of the respondents were in middle age category followed by young age category (25.0%) and old aged category (16.67%), respectively. The cumulative percent of the young and middle age categories is 83.3 percent, which constitutes a huge majority of the respondents. Middle respondents generally tend to have broader outlook and have much social as well as mass media contact than the older age. It helps them to become more aware and conscious about agricultural and environmental issues as well as to develop favourable response towards sustainable agricultural practices. Similar results were reported by Imran (2011), but Farhad (2008) got different results in his study.

Respondents' level of education varied from 0 to 12 years of schooling with a mean of 4.72. Based on their years of schooling, the respondents were classified into six categories: Illiterate (0), Can sign only (0.5), Primary Education (1 - 5), Secondary Education (6 - 10), and Higher Education (above 10) which is shown in Table 1. Results indicate that the highest proportion (48.33%) of the respondents had primary education, followed by 26.7 percent that can sign only, while 11.67 percent had secondary education. It is observed that 10.0 percent of the respondents were found illiterate and only 3.3 percent of the entire respondents acquired higher education. Educated farmers tend to have high possibility of adopting OVF. Educated persons are more cosmopolite in nature and usually have interest in gaining knowledge about different things. This makes them read newspapers, go to different agricultural shows, watch various agriculture-related programs and become up-to-date about the new technologies. They are also likely to go to the nearby agricultural offices and talk to the officers about the problems they face in the field. The education helps them to be conscious about environment. So, they feel the necessity to adopt sustainable agricultural practices. On that note, having two third of the respondents in the present study being educated shows the tendency for a positive response towards OVF.

Family size of the respondents refers to the total members of the family including the respondents themselves, their spouse, children and other dependents that live, eat and act together in a family unit. The family size of the respondents ranged from 4 to 9 with an average 5.26 (Table 1). Distribution of the respondents according to their family size indicates that half (50.0%) of the respondents belonged to medium family size of 4 - 6 members, while 30.0 percent had large family size of more than 6 members and 20.0 percent fall under small family size of 3 or less members.

Table1. Selected characteristics of the respondents

Variables	Categories	No.	%	Mean
Age	Young (up to 30)	13	25.0	43.13
	Middle (31 - 50 years)	37	61.67	
	Old (> 50 years)	10	16.67	
Level of education	Illiterate	6	10.0	5.3
	Could sign only	16	26.7	
	Primary	29	48.3	
	Secondary	7	11.67	
	Tertiary	2	3.3	
Family size	Small (up to 3 members)	12	20.0	5.26
	Medium (4 - 6 members)	30	50.0	
	Large (> 6 members)	18	30.0	
Farm size	Small (0.02 - 1.00 ha)	50	83.33	0.71
	Medium (1.01 - 3.03 ha)	10	16.67	
	Large (>3.03 ha)	0	0.0	
Farming experience	Low	6	10.0	17.88
	Medium	15	25.0	

	High	39	65.0	
Annual income	Low (BDT 40,000 to 50,000)	14	23.33	93,694.05
	Medium (BDT 50,001 to 150,000)	40	63.33	
	High (> BDT 150,000)	6	13.33	
Contact with information source	Low (score 2 to 6)	18	30.0	7.57
	Medium (score 7 to10)	32	53.33	
	High (score above 10)	10	16.67	
Membership of association	Low	75	45.0	Not Applicable
	Medium	20	12.0	
	High	5	3.0	
Training exposure	No training exposure (0)	24	40.0	7.32
	Low training exposure (1 -7)	33	55.0	
	Medium training exposure (8 -14)	3	5.0	
	High training exposure (>14)	0	0.0	
Cosmopolite	Less	33	55.0	7.48
	Moderate	18	30.0	
	High	9	15.0	
Total		60	100.0	

Therefore, virtually all (80.0%) of the respondents fall under medium to large family sizes. That reveals less awareness/practice of family planning campaigned across the country. Tuli (2011) found similar results in her study, where medium sized family was found more. In Bangladesh, average household size is 4.85 nationally (BBS, 2011) which is smaller than what was obtained (5.26) the study area.

The farm size of the respondents ranged from 0.03 to 3 hectares with an average being 0.71 hectares (Table 1). The findings presented in Table 1 indicate that, most of the respondents (83.33%) had small farm size (0.02 - 1.0 ha), and only 16.67 percent of them had medium farm size (1.01 - 3.03 ha), but none had large farm size (>3.03 ha). Thus, all of them were found under small to medium farm size owners' categories. This might be due to the population increase in the area, which leads to fragmented of farm holdings time and again. However, the national average of household land holding in Bangladesh is 0.81 ha (BBS, 2009) which is greater than the respondents' (0.71 ha). These findings are akin to Islam (2006).

Farming experience scores of the respondents range from 4 to 25 year, with an average being 17.88 year. The results in Table 1 show that the highest percent (65%) of the respondents had high farming experience, followed by medium experience (25%) and low experience (10%), respectively. The cumulative percent of the medium and high experience categories is 90.0 percent, which makes a huge majority of the respondents. Farming experience helps to improve the knowledge and skills of the farmers. Some respondents worked for a long period of time in the field which increased their knowledge as well as skills on farming. Experience also broadens the attitude towards new technologies or innovation. As the average farming experience of the respondents in the present study is 17.88 years, it can be said that most of the respondents are highly experienced in farming. Thus, it could make them have a favourable attitude towards OVF. That eventually makes them able to understand the importance of organic farming in these days.

Annual family income is an important factor in determining social status of a respondent. The annual income of the respondents ranged from Taka 42 to 170 thousand (US$ 500.846 to US$ 2,026.84) with an average of Taka 93,694.05 (US$ 1,117.629). The annual income of the respondents was calculated by considering the income from agricultural and non-agricultural sources. The findings presented in Table 1 show that more than half of the respondents had an annual income of Taka 50,001 to 150,000 which is 63.3 percent, while 23.3 percent of the respondents lead their life with low annual income (50,000 or less) and only 13.3 percent had high annual income (> Taka 150,000). A very big majority of the respondents (86.66 %) belonged to low to medium annual family income

categories. This might be due to the fact that respondents only sell their extra produce of home garden after meeting their own domestic need. Nevertheless, it was observed that OVF did not only increased their family income, but also made them self-reliant. Afrad (2009) found similar result in his study. Interestingly, the average annual income (Taka 93,694.05 equivalent to US$ 1,117.629) of the respondents was higher than the national average per capita income of the country i.e. 92.8 thousand (BBS, 2014). Haider (2010) reported similar findings in his study.

The contact with information sources ranged from 2 to 17 with mean of 7.57. Information displayed in Table 1 indicate that highest proportion (53.33%) of the respondents fall in medium contact category, followed by 30.0 percent low category and 16.67 percent high contact category. Therefore, a big majority (83.3%) of the respondents belong to low and medium contact with the sources of information categories. This might be due to the fact that young respondents are more interested in mass media which make them advance in agricultural information. Information contact exhibits an important role in order to form favourable attitude. Imran (2011) found the similar findings in his study. But, Tuli (2011) and Mukta (2011) reported different findings in their respective studies.

With regards to the membership of association, the score of the respondents ranged from 1 to 6 with a mean of 3.27. Information presented in Table 1 show that majority (75.0%) of the respondents fall under the low membership of association category, followed by medium participation (20.0%) and high participation (5.0%) category, respectively. It means that most of the respondents indicated the propensity to escape from social responsibility through dynamic group action common with associations. These findings are dissimilar with those of Sonia (2009).

The respondents' average score for training exposure is 7.32 days. According to the training exposure score, the farmers were classified into 4 categories, viz. No training (0), Low training exposure (1-7), medium training exposure (8-14), and high training exposure (>14). Table 1 reflects that, most of the respondents had less training experience, where 55.0 percent and 40.0 percent of the respondents had low and no training experience, respectively. Only 5.0 percent of the respondents had medium training exposure and nobody had high training exposure. Living in remote location where communication system is not very good at all might be the reason why access to training was poor. The situation results in limited contact with the organizations that provide training on agriculture and other related subjects. Similar findings were reported by Hasan (2014).

The cosmopolite scores of the respondents ranged from 3 to 13 with an average of 7.48. On the basis of cosmopolite scores, the respondents as shown on Table 1. The results presented show that 55 percent of the respondents is less cosmopolite, followed by 30.0 percent moderate cosmopolite and 15 percent high cosmopolite, respectively. It therefore reveals that majority of the respondents (85.0%) fall between low to medium cosmopolite categories. It is assumed that cosmopolite people are more up-to-date with latest information and may be aware about organic farming practices. Arefin (2013) has found similar findings in his study.

Sustainability of organic vegetable farming

Economic dimension

Economic dimension is divided into four criteria, namely, viability, autonomy, transmissibility and efficiency. Three statements were selected under each of the criterion. The Average score of the index of economic dimension was 91.0 out of 180 (Table 2). According to the results placed in Table 2, the sustainability of OVF with respect to the economic dimension fall into medium category.

Table 2. Economic dimension of sustainability

1.	Economic dimension	Extent of Opinion (N=60)				Sustainability Measurement Index (SMI)
		VH (3)	H (2)	M (1)	NA (0)	
a)Viability						
i	Profitability of OVF	8	12	37	03	85
ii	Uniformity and aesthetic view of the vegetables	6	11	30	13	70
iii	Satisfaction level of the family members	9	13	37	1	90
b) Autonomy						
i	Willingness of the family members working in OVF	18	22	20	0	118
ii	Requirements of external labour forces	0	0	11	49	11
iii	Preparation of compost, land cultivation, weeding, irrigation by own management	49	11	0	0	169

c) Transmissibility						
i	Inspirational to other farmers	6	11	28	15	68
ii	Creating attraction to farmers for self-motivation	5	10	34	11	69
iii	Increasing confidence level of the farmers adoption of OVF	6	12	40	2	82
d) Efficiency						
i	Satisfaction on the amount of yield	3	23	31	3	86
ii	Market price	4	16	28	12	72
iii	Taste, texture and food quality	45	15	0	0	165
The Average score of the index of economic dimension						90. 58 ≈ 91.00

*VH = Very High, H = High, M = Moderate and NA = Not at all

Economically, it can thus be said that, the ability of OVF to continue in the long term and also withstand external market fluctuations is average.

Socio-territorial dimension

Socio-territorial dimension is divided into four criteria, namely, working condition, quality of living, contribution of local economy, and social involvement Three statements were selected under each criterion. The average score of the index of the socio-territorial dimension was 124.75 out of 180 (Table 3). According to the results placed in the Table 3, the sustainability of OVF related to the socio-territorial dimension fall under high category.

Table 3. Socio-territorial dimension of sustainability

2. Socio-territorial dimension		Extent of Opinion (N=60) VH (3)	H (2)	M (1)	NA (0)	Sustainability measurement index (SMI)
a) Working condition						
i	Willingness to work in OVF	20	23	12	5	118
ii	Satisfaction for working in OVF	23	20	10	7	119
iii	Self-feelings for using organic manure and IPM instead of pesticides and inorganic fertilizers	50	10	0	0	170
b) Quality of living						
i	Self-dependence on income from OVF	4	9	44	3	74
ii	Palatability of the vegetables	44	16	0	0	164
iii	Purchase by the local consumers	19	22	16	3	117
c) Contribution to local economy						
i	Jobs created on the farm	36	24	0	0	156
ii	Contribution towards fulfillment of the needs of the local market	16	19	22	3	108
iii	Avoiding middlemen by direct sell in the market	32	26	2	0	150
d) Social Involvement						
i	Communication with the consumers and the markets	20	30	10	0	130
ii	Communication with the local input agencies and NGOs	22	32	6	0	136
iii	Communication with extension organizations, such as DAE, DLS, DOF etc.	4	8	27	11	55
The Average score of the index of socio-territorial dimension						124.75

*VH = Very High, H = High, M = Moderate and NA = Not at all

Socio-territorially, the ability of OVF to ensure sustainability is high. So, the degree of socio-territorial sustainability of OVF in terms of the quality of life of farmers and the importance of services they offer to the society is high. Here, the socio-territorial sustainability of the OVF primarily includes employment generation and contribution to the well-being.

Agro-ecological dimension

Agro-ecological dimension is divided into four criteria, namely, fertilizer pollution and soil fertility, crop rotation, agro and natural biodiversity, and resource management. Three statements were selected under each criterion. The average score of the index of agro-ecological dimension was 154.25 (Table 4). The results in Table 4 shows that the sustainability of OVF fall under high category, in relation to agro-ecological dimension.

Table 4. Agro-ecological dimension of sustainability

3. Agro-ecological dimension	Extent of Opinion (N=60)				Sustainability measurement index (SMI)
	VH (3)	H (2)	M (1)	NA (0)	
a) Fertilizer Pollution & Soil fertility					
i Improving status of the soil health	56	4	0	0	176
ii Use of synthetic pesticide and chemical fertilizer	0	7	9	44	23
iii Use of green manure, compost, poultry litter, ash, cow dung etc.	57	3	0	0	177
b) Crop rotation					
i Status of following the crop rotation	25	16	10	9	117
ii Fascination in practicing crop rotation	31	28	1	0	150
iii Use of leguminous crops in crop rotation	32	26	2	0	150
c) Agro & Natural biodiversity					
i Control of the insect pest infestation applying IPM techniques e.g. pheromone trap	58	2	0	0	178
ii Presence of useful insects such as aphids, honey bee and so on	59	1	0	0	179
iii Fascination in using organic pesticide e.g. Neem, Mahogany etc.	60	0	0	0	180
d) Resource Management					
i Appropriate use of soil	55	5	0	0	175
ii Appropriate use of water	54	6	0	0	174
iii Appropriate use of energy; e.g. solar ray, labourer, modern agricultural tools etc.	52	8	0	0	172
The average score of the index of agro-ecological					154.25
The Average Sustainability Measurement Index of OVF					122.58

*VH = Very High, H = High, M = Moderate and NA = Not at all

Since the score for agro-ecological dimension is high, then the tendency of the OVF system to combine efficient use of natural resource and minimal environmental cost is high. Consequently, the practices concerning resources managem ent, particularly, soil, water and energy management, and respecting the balance of the ecosystem.

Also in Table 4, the average sustainability measurement index of OVF was found to be 122.58. Generally, the overall sustainability of OVF falls under the medium category. But then, it is worthy of note that the weakness of one dimension cannot be compensated by good marks in other dimensions, as observed by Gafsi and Favreau (2010).

Association between the dependent and the independents variables

The association between education, farm size, farming experience, annual income and membership of association was positively significant. On the other hand, the association between age and sustainability of OVF were negative and significantly correlated. However, the association of family size, contact with sources of information, training experiences, and cosmopolite was not significant (Table 5).

Table 5. Association between the dependent and the independents variables

Dependent variable	Independent variables	Correlation co-efficient (r)
Sustainability of OVF	Age	-0. 2875*
	Education	0.3035*
	Family size	-0.1955NS
	Farm size	0.4515**
	Farming experience	0.2953*
	Annual Income	0.2856*
	Contact with sources of information	-0.1580NS
	Organizational participation	0.4165**
	Training experiences	0.1850NS
	Cosmopolite	-0.1725NS

Note: N=60, Degree of freedom = 59; *Significant at 0.05 level of probability; **Significant at 0.01 level of probability

The strength of association between the correlated variables is weak. Therefore, the effect of the correlation would have less effect.

Problems faced during OVF

The results in Table 6 reveal that the problem with respect to the 'lack of organic pesticides' was the most serious challenge according to the opinion of respondents (91.67 %). 'Insufficient subsidy from the GOs and NGOs to promote organic farming' was the 2nd problem opined by 86.67 percent respondents. The third and fourth ranked problems were 'Physical deformity' and 'A little premium price for the production' opined by 83.33 percent, 80.0 percent of the respondents, respectively. 'Insufficient transport facilities' ranked the fifth according the opinion of 75.0 percent respondents (Table 6). 'Lack of training' positioned 6th as opined by 70.0 percent respondents. 'Inadequate supply of manure, compost and cow dung' placed 7th according the responses from 63.33 farmers. 'Insufficient promotion by mass media, 'Lack of technical knowledge', and 'Use of crop residue as fuel' ranked 8th, 9th and 10th by the opinion from 58.33 percent, 50.0 percent, 48.33 percent of the respondents, respectively (Table 6).

Table 6. Problems faced during OVF

Problems	Frequency (N=60)	Percent	Rank
Lack of organic pesticides	55	91.67	1
Insufficient subsidy from the GOs and NGOs	52	86.67	2
Physical deformity	50	83.33	3
A little premium price for the production	48	80.00	4
Insufficient transport facilities	45	75.00	5
Lack of training	42	70.00	6
Inadequate supply of manure, compost and cow dung	38	63.33	7
Insufficient promotion by mass media	35	58.33	8
Lack of technical knowledge	30	50.00	9
Use of crop residue as fuel	29	48.33	10

For that reason, the findings indicate variety of challenges confronted OVF by the respondents. From 1-8 ranked were above 50 percent, indicating their importance and the necessity to overcome them through the required efforts by the responsible parties.

CONCLUSIONS

Based on the major findings and their logical interpretation, the present study infers that majority of the respondents were in their active age, having substantial farming experience, and low socioeconomic profile. The sustainability of organic vegetable farming in rural Bangladesh is economically moderate, socio-territorially and agro-ecological high. Overall, the sustainability status of organic vegetable farming is moderate, but if variables such as education, farm size, farming experience, annual income and membership of association could be improved then the situation would be better up. In addition, it is pertinent to increase public awareness, enhance transport system from rural areas, train and retrain farmers, and subsidize organic inputs by GOs and NGOs for the sustainability of organic farming in rural Bangladesh.

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