Farmer's Level Sustainability of Sunflower Cultivation in a Rice Based Cropping Pattern of Patuakhali District

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Abstract: *This study discusses the sustainability of sunflower cultivation at farmer's level in a rice based cropping pattern of Patuakhali district.By simple random sampling 110 sunflower farmers were selected.Validity of the questionnaire was confirmed by a panel of experts.A pretested questionnaire was used for data collection.The data were analyzed by using both descriptive and inferential statistics such as mean,standard deviation,correlation and regression analysis. Theresults of regression analysis showthat variables training experience, innovativeness, and sunflower cultivation knowledge were accounted for 75.5 percent total variation in case of sustainability of sunflower cultivation.*
Key words*: Sustainability, sunflower cultivation, cropping pattern.*

I. Introduction

Bangladesh is an agricultural country. Its economy is dependent on agriculture. There is a strong relationship between agriculture and the environment. We have to depend upon the environment for the resources like land, water, sunlight, biological organisms for agricultural production. Besides huge opportunities the environment is also a source of constraints and problems. One of the major problems of agricultural production is land degradation. It occurs by two ways (i) Human factors such as shifting cultivation, faulty cultivation practice, use of practices,irrigation,mining from agricultural land, overexploitation of Biomass from the fields (2) Natural causes (i)Change in Coastal Morphology (ii) River Bank erosion, salinity, floods, droughts, land slide etc.

Patuakhali district is a coastal region of Bangladesh. The main crops grown here are rice, potato, pulse, chilietc. Among them sunflower is a newly introduced oilseed crop in Bangladesh. Many parts of the Patuakhali district are highly susceptible to climate change impacts. Soil salinity, cyclone, tidal surge are the major problems of crop productivity in these reasons. So sustainability maintaining is an important issue.Sunflower is adaptive to moderate drought and soil salinity so sunflower has been grown extensively in this region.The research related to sustainability of sunflower cultivation at coastal region is rare in Bangladesh. For this reason the present study has been conducted on sunflower cultivation. The objectives of this study were as follows:

1. To determine and describe the extent of farmers' level sustainability of sunflower cultivation;
2. To determine and describe some selected characteristics of the farmers as follows:

(age, education, sunflower cultivation experience, area under sunflower cultivation, training experience, farm size, annual income, communication exposure, cosmopoliteness, organizational participation, innovativeness, knowledge on sunflower cultivation) etc.;

3. To identify the contribution of the factors responsible for forming sustainability on sunflower cultivation.

II. Literature Review

A large number of selected characteristics of the farmers have been found in the previous studies. These are- age, education, sunflower cultivation experience, sunflower cultivation area, training experience, farm size, annual income, communication exposure, cosmopoliteness, organizational participation, innovativeness and sunflower cultivation knowledge.

2.1. Selected characteristics of the farmers

Age of the farmers has impact on sustainability of sunflower cultivation.(Teranoet al. 2015;Jadhav et al. 2013) found significant influence while (Rezvanfar et al. 2009;Thanh and Yapwattanaphun 2015) found non-significant influencebetween age and their adoption of sustainable practices. Educationwas assumed to have positive and significant relationship on sustainability of sunflower cultivation conducted by (Jadhav 2013 et

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al.Teklewold et al. 2012) but studies conducted by (Rezvanfar et al. 2009) found negative and non-significant relationship.

Sunflower cultivation experience has association with the sustainability of sunflower cultivation. (Jadhav et al. 2013) found positive and significant relationship between farming experience of the farmers and sustainable agricultural practices but (Rezvanfar et al. 2009;Thanh and Yapwattanaphun 2015) foundnon-significant relationship.

Sunflower cultivation area had significant relationship on farmer's level of awareness on sustainable agriculture (Veeresh (2006-08) while Tey et al. (2013) found a non-significant relationship between sunflower cultivation area and adoption of sustainable agricultural practices.

Training experience has significant influence on the adoption of sustainable practices. Studies conducted by (Jadhav et al. 2013;Thanh and Yapwattanaphun 2015) found significant influence on the adoption of sustainable practices. Farmsize plays an important role on the adoption of sustainable agricultural practices. Studies conducted by (Rezvanfar et al. 2009; Wei et al. 2007) found significant relationship between farm size and sustainable agricultural practices. While (Tey et al. 2013) andThanh and Yapwattanaphun (2015) found non-significant relationship. Annual income has both positive and negative relationship on the adoption of sustainable agricultural practices.

Jadhav et al. (2013) found significant relationship between income of the farmers and sustainable agricultural practices such as organic farming, integrated farming and water conservation. WhileVeeresh (2006-08) found non-significant relationship between annual income and farmer's level of awareness on sustainable agriculture. Studies conducted by Veeresh (2006-08) found non-significant relationship between communication media and farmer's level of awareness on sustainable agriculture. While Rezvanfar et al. (2009) found a positive and significant correlation.

Rezvanfar et al. (2009) found a positive and significant correlation between using level of information sources and communication channels with the level of wheat grower's adoption of sustainable soil conservation practices. While Veeresh (2006-08) found non-significant relationship between communication media and farmer's level of awareness on sustainable agriculture.Cosmopoliteness has relationship on sustainableagriculture. Study of Veeresh (2006-08) shows positive and significant relationship between cosmopoliteness and farmer's level of awareness on sustainable agriculture.Tey et al. (2013) found a significant relationship between farmer's organizational membership and adoption of sustainable agricultural practices. While Rezvanfar et al. (2009) found a negative and non-significant correlation between years of membership in rural communities of wheat growers and their adoption of sustainable soil conservation practices.

Schreinemachersetal. (2006) conducted a study on assessing innovations and sustainability strategies with multi-agent systems .They found significant relationship between network characteristics and the adoption of innovation. Sunflower cultivation knowledge has influence on sustainable agricultural practices. Studies conducted by Rezvanfar et al. (2009);Terano et al. (2015) found positive and significant relationship between level of knowledge of the farmers and their adoption of sustainable agricultural practices. WhileHall et al. (2009) found a negative and non-significant relationship between skill of the farmers and their adoption of sustainable floriculture practices.

III. Materials and Methods

3.1 Study area and data collection

The study was conducted in Dumki and Patuakhalisadarupazilla of Patuakhali district. Dumkiupazilla covers an area of 92.46 sq. km, located in between 22°30′ north latitudes and in between 90°17′ and 90°27′ east longitudes Patuakhali sadar upazilla covers an area of 362.62 sq km, located in between 22°14′ and 22°29′ north latitudes and in between 90°12′ and 90°28′ east longitudes. All the farmers who cultivated sunflower at least for three years constituted the population of this study. For this purpose an up-to-date list of the farmers was prepared with the help of respective Union parishad personnel, Sub-assistant agricultural officer, NGO personal and local leaders. The list comprised of 1100 farmers and these farmers constituted the population of this study. Out of them 10% of the population were considered as the representative of the six unions namely Badarpur which are under Patuakhalisadarupazilla and Sreerampur, Angaria, Pangashia, Labukhali, Muradia under Dumkiupazilla. Besides, a reserve list of 10 percent of the sample size was also prepared to replace any respondent who could not be made available during data collection despite all attempts.

3.2 Variables and measurements

Socio-economic characteristics: These include variables age, education, sunflower cultivation experience, sunflower cultivation area, training experience, farm size, annual income, communication exposure, cosmopoliteness, organizational participation, innovativeness and sunflower cultivation knowledge. Sustainability dependent variable was used to measure farmers sustainability on 10 factors related to sustainability of sunflower cultivation.

Table 1. Description of variables used in the regression model

Variable Name	Variables description and Unit of Measurement
(i) Dependent Variable	
Sustainability	3 point scale (1=Agree,0=Undecided,1=Not agree)
(ii) Independent Variable	
1. Age	Age of the farmers in years.
2. Education	Year of schooling.
3. Sunflower cultivation experience	Completed years of sunflower cultivation.
4. Area under sunflower cultivation	Total area under sunflower cultivation in acre.
5. Training experience	Number of days training received.
6. Farm size	Total farm size of household in hectare.
7. Annual income	Sunflower farmer's total income in taka in "ooo"taka/year.
8. Communication exposure	No. of contact to selected information source.
9. Cosmopoliteness	No. of visits person made to selected places.
10. Organizational participation	Organizational participation nature and duration.
11. Innovativeness	Time duration of adoption of innovation.
12. Sunflower cultivation Knowledge	Scores obtained when asked related questions.

3.3 Analytical Procedure

Different descriptive statistical measures such as frequency, range, mean, percentage distribution, standard deviation, rank order, categories and indices etc. were used to describe and interpret the data. Effect of selected factors on motivation and sustainability of the farmers in sunflower cultivation was determined by using regression co-efficient.

To find out relationships between motivation and sustainability of sunflower cultivation and selected characteristics of the farmers Pearson's product Moment Correlation (r) was used. Five percent level of probability was used to accept or reject any null hypothesis.

IV. Results and Discussions
4.1. General characteristics of Respondents

Majority, 61.00 percent and 34.50 percent of the farmers were middle and young aged .This might be an indication that sustainability of sunflower cultivation was higher in case of middle aged and young aged groups. It was found that a high proportion of sunflower growers 44.60 percent of the farmers had primary level of education. The probable reason of their maintaining sustainability besides their low education is training experience. Among sunflower farmers81.8 percent had short term sunflower cultivation experience. Sunflower cultivation was introduced in these reasons in about 8 years. Majority of the farmers 81.80 percent had short term training experience that is (3-5) years. This may be due to after noticing the benefits of sunflower cultivation from 8 years cultivars the other farmers had started cultivating sunflowers extensively that is for (3-5) years. It mightbe an indication that sustainability of sunflower cultivation had been increased gradually. Approximately58.2 percent farmers had medium sunflower cultivation area. The probable reason is that as they have a few land of their own and they cultivate others land. Majority of the farmers, 48.18 percent farmers had medium training experience. Training experience had contributed much for their perception towards sustainability of sunflower cultivation. This may be due to training helps farmer to conceptualize, understand and diagnose the gravity and application of useful information about sunflower production. Among cultivars 76.4 percent farmers had small and 16.40 percent farmers had medium farm size. The probable reason behind this as they had low land of their own but they lease land for agricultural cultivation. Among sunflower farmers 47.3 percent had medium income. This may be due to as they have a few land of their own.

Majority 49.1 percent and 32% respondents had medium and low communication exposure. The probable reason behind this may be they became experienced about sunflower cultivation.49.00 percent respondents had medium cosmopoliteness.The probable reason may be the newly introduction of sunflower cultivation. 72.7 percent respondents had low Organizational participation. This may be due to though some of them had direct contact with various organizations such as BRAC, FFS club etc. But most of them haven't hold the position of executive member. 77.3 percent respondents had medium innovativeness and it is an important factor for maintaining sustainability. This may be due to most innovative person has the ability to understand and apply complex technical knowledge and he/she can cope with a high degree of uncertainty. Majority54.5 percent respondents had medium sunflower cultivation knowledge.Knowledge is very essential for maintaining sustainability. This may be due to having more knowledge of sunflower cultivation, farmers become aware of the recent information on the various aspects of sunflower production which reduce uncertainty and ensure better production of sunflower.

Table 2 .Socio economic characteristics of farmers

Variables	Category	Frequency	Percentage
Age	Young aged (up to 35 years)	38	34.50
	Middle aged (36-50 years)	67	61.00
	Old aged (above 50 years)	5	4.50
Education	Illiterate (0)	25	22.70
	Primary education (1-5)	49	44.60
	Secondary education(6-10)	33	30.00
	Above secondary education (above 10)	3	2.70
Experience	Short term experience (3-5)	90	81.80
	Long term experience (6-8)	20	18.20
Cultivation area	Low (up to 13)	24	21.80
	Medium (14-33)	64	58.20
	High (above 33)	22	20.00
Training experience	No experience (0)	6	5.45
	Short experience (1-3)	47	42.70
	Medium experience (4-6)	53	48.18
Farm size	Long experience (above 6)	4	3.60
	Marginal (above .02-below 0.2)	4	3.60
	Small (0.21-1.00)	84	76.40
	Medium(1.01-3.00)	18	16.40
	Large (above 3.00)	4	3.60
Annual income	Low income (80-93)	37	33.60
	Medium income (94-107)	52	47.30
	High income (above 107)	21	19.10
Communication exp.	Low exposure (28-36)	32	29.10
	Medium exposure (37-45)	54	49.10
	High exposure (above 45)	24	21.80
Cosmopoliteness	Low Cosmopoliteness (up to 7)	50	45.50
	Medium Cosmopoliteness (8-14)	54	49.00
	High Cosmopoliteness (8-14)	6	5.50
Organizational Participation	No participation (0)	10	9.10
	Low participation (1-3)	80	72.70
	Medium participation (4-6)	15	13.70
	High participation (above 6)	5	4.50
Innovativeness	Low innovativeness (11-15)	11	10.00
	Medium innovativeness (16-20)	85	77.30
	High innovativeness (above 20)	14	12.70
Cultural Knowledge	Low knowledge (27-31)	6	5.50
	Medium knowledge (32-36)	60	54.50
	High knowledge (above 36)	44	40.00

4.2Overall Perceived sustainability of sunflower cultivation

Perceived sustainability score of the farmers ranged from 10 to 20 with the mean of 17.36 and Standard deviation of 1.85. On the basis of their score, the farmers were classified into three categories as "low sustainability" (10-13), "medium sustainability" (14-17) and "high sustainability" (above17).The distribution of farmers according to their sustainability is shown in Table 3.

Majority 50.00 percent respondents had medium sustainability, 48.20 percent respondents had high sustainability and 1.8 percent respondents had low sustainability.So maximum respondents had medium to high sustainability.

4.3Factors affecting sustainability of sunflower cultivation

Table 4 shows the scoring system of sustainability of sunflower cultivationagainst 10 factors .Farmers were asked questions against 10factors by using 3 point scale.(2) for agree (1) for undecided and (0) for not agree. As for example in case of factor1.Amount of land weather increasing nor constant nor decreasing was asked to the respondents. Then 3 point scale was used if he was agreed in case of increasing then (2) was given. If he said that his land was constant then (1) was given and if he said that his land was decreasing then (0) was given.

Table 3 Distribution of the farmers according to their sustainability

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
Low sustainability	2	1.8		
Medium sustainability	55	50.00	17.36	1.85
High sustainability	53	48.20		
Total	110	100.0		

Table 4:Factors affecting sustainability of sunflower cultivation

Factors	Extent of sustainability		
	1.Agree 2.Undecided 3.Not agree	1.Agree 2.Undecided 3.Not agree	1.Agree 2.Undecided 3.Not agree
1. Amount of land	increasing	constant	decreasing
2. Yield of sunflower	increasing	constant	decreasing
3. Suitability of sunflower production in rice land	suitable	fairly suitable	not suitable
4.Economic profitability	profitable	fairly profitable	not profitable
5.Suitability to Environment	suitable	fairly suitable	not suitable
6. Social consistency	consistent	fairly consistent	not consistent
7. Government acceptance	accepted	fairly accepted	not accepted
8.Market accessibility	accessible	fairly accessible	not accessible
9.Level of satisfaction in sunflower cultivation	satisfied	fairly satisfied	not satisfied
10.Future probability of sunflower cultivation	highly probable	fairly probable	no probability

4.4 Correlation analysis among sustainability of sunflower cultivation and selected Variables

Table 5 shows that out of 12 independent variables, the correlation coefficients of 7 variables (sunflower cultivation experience, training experience, communication exposure, cosmopoliteness, organizational participation, innovativeness and sunflower cultivation knowledge) had positive and significant relationship with sustainability of sunflower cultivation. This indicates that with the increase of sunflower cultivation experience, training experience, communication exposure, cosmopoliteness, organizational participation, innovativeness and sunflower cultivation knowledge the sustainability of sunflower cultivation will also be increased. The four variables namely age, Education, Sunflower cultivation area, Annual income had positive and non significant relationship with sustainability of sunflower cultivation which indicates that these variables are not an important factor towards sustainability of sunflower cultivation. Among them only one variablefarm size had negative and non significant relationship towardssustainability of sunflower cultivation which indicates that with the increase of farm size the sustainability of sunflower cultivation had been decreased.

4.5Regression analysis explaining contribution of variables to the farmer's sustainability of sunflower cultivation

To find out contribution of the variables step wise multiple regressions were done and the findings are presented in Table 6.The R^2 value was .755 and F value was109.062, which were significant at 0.000 levels. The R^2 value indicated that 75.5 percent of the total variation in the sustainability of the farmers could be explained by the variables namely training experience, innovativeness, sunflower cultivation knowledge.

Only 3 variables training experience, innovativeness, and sunflower cultivation knowledge were entered into the regression model which accounted for 75.5 percent total variation in case of sustainability. The findings have been presented in the table 6.

From table 6 the study revealed that training experience,β_1=0.608, implies that when training experience of the farmer increases by a unit then their sustainability towards sunflower cultivation increases by 0.608 units. Similarly, Innovativeness β_2=0.164, implies that when Innovativeness of the farmer increases by a unit then their sustainability towards sunflower cultivation increases by 0.164 units. However, Sunflower cultivation knowledge β_3=0.164, implies that when Sunflower cultivation knowledge of the farmer increases by a unit then their sustainability towards sunflower cultivation increases by 0.164 units.

As training experience, innovativeness, sunflower cultivation knowledge, these variables included in the regression analysis were statistically significant, for this reason their significant relationship showed that this variable had significant contribution with the farmer's sustainability of sunflower cultivation.The other 9 variables had no significant contribution to the same.

Table 5:Correlation analysis among sustainability of sunflower cultivation and selected Variables

Dependent variable	Independent variable (Farmers characteristics)	Coefficient of correlation(r)
Sustainability of sunflower cultivation	1.Age	.026[NS]
	2.Education	.054[NS]
	3.Sunflower cultivation experience	.486**
	4.Sunflower cultivation area	.102[NS]
	5.Training experience	.809**
	6.Farm size	-.033[NS]
	7.Annual income	.022[NS]
	8.Communication exposure	.779**
	9.Cosmopoliteness	.649**
	10.Organizational participation	.381**
	11.Innovativeness	.716**
	12.knowledge on sunflower cultivation	.689**
**=Significant at .01 level, NS=Not significant, *=Significant at .05 level		

Table 6:Regression analysis explaining contribution of variables to the farmer's sustainability of sunflower cultivation

Characteristics of farmers	Unstandardized coefficients		Standardized coefficients	t	Sig-level
	β	Standard error	β		
Constant	6.832	1.422		4.805	.000
Training experience	.608	.091	.470	6.674	.000
Innovativeness	.164	.035	.296	4.676	.000
Sunflower cultivation knowledge	.164	.044	.236	3.724	.000
R^2=.755, F=109.062 and P=.000					

Table 7:Change in multiple R^2 for entry of the said variable into the stepwise multiple regression models for farmer's perceived sustainability of sunflower cultivation.

Model	Variables	R square	Adjusted R square	Std Error of the estimate	R^2 change	Variance explaining (percent)	Sig-level
1	Training experience	.654	.651	1.093	.654	65.400	.000
2	Innovativeness	.723	.718	.982	.069	6.900	.000
3	Sunflower cultivation knowledge	.755	.748	.928	.032	3.200	.000

The unique contribution of the variable was determined by taking the changes in R^2 value occurred for entry of a particular variable in the stepwise regression model. The results of Table 7 shows that training experience along could explain 65.4 percent of the total variation in the farmer's perceived sustainability on sunflower cultivation. According to the findings training experience, is the most important variable in

explaining variability in farmer's perceived sustainability and it is the best predictor among the other independent variables. The other two variables namely innovativeness, sunflower cultivation knowledge could explain 6.9 and 3.2 percent variation respectively in case of sustainability.

V. ConclusionAnd Recommendations

The study shows that 50.00 percent respondents had medium sustainability while 48.20 percent respondents had high sustainability and 1.8 percent respondents had low sustainability. The result showed that training experience, innovativeness, sunflower cultivation knowledge, had contribution on sustainability of sunflower cultivation Besides this the study revealed that there were 4 factors that had a significant influence on farmers' sustainability of sunflower cultivation. These are sunflower cultivation experience, communication exposure, cosmopoliteness, organizational participation etc.

The study recommends that sustainability of sunflower cultivation should be increased. A development is meaningless if it remains unsustainable. For maintaining sustainability of sunflower cultivation proper knowledge and skill is very essential. So extension courses should be implemented more to enhance farmersknowledge and skills in terms of sustainability of sunflower cultivation.

References

[1]. Terano, R., Mohamed, Z., Shamsudin, M. N., &Latif, I. A. (2015). Factors Influencing Intention to Adopt Sustainable Agriculture Practices among Paddy Farmers in Kada, Malaysia. *Asian Journal of Agricultural Research, 9,* 268-275.

[2]. Jadhav , V. S., Devendrappa, S., Bhatnagar, A., Huilgol, S., &Sahu, A. K. (2013). Adoption of sustainable agricultural practices by women farmers: *International Journal of Farm Sciences, 3*(1), 112-118.

[3]. Rezvanfar, A., Samiee, A., &Faham, E. (2009).Analysis of factors affecting adoption of sustainable soil conservation practices among wheat growers. *World applied sciences journal ,6* (5), 644-651.s

[4]. Teklewold, H., Kassie, M., &Shiferaw, B. (2012). *On the joint estimation of multiple adoption decisions*. The case of sustainable agricultural technologies and practices in Ethiopia.

[5]. Thanh, N. V., and Yapwattanaphun, C. (2015). Banana Farmers Adoption of Sustainable Agriculture Practices in the Vietnam Uplands: the Case of Quang Tri Province. *Agriculture and Agricultural Science Procedia,5,* 67 – 74.

[6]. Tey, Y. S., Li, Gill, E., Bruwer, G., Abdullah, J., Radam, A., Ismail A. M.,&Darham, M. M. S. (2013). *The relative impact of adoption on profitability of sustainable agricultural practices*: A study for Malaysian farmers.

[7]. Veeresh, S. J. (2011). *Sustainable Utilization of Agricultural waste as a source of Energy and Vermicompost*.PhDThesis. Department of postgraduate studies and research in environmental science, University of kuvempu, India.

[8]. Schreinemachers, P., Tipraqsa, P & Berger, T. (2006).*Assessing innovations and sustainability strategies with multi-agent systems*.International symposium towards sustainable livelihoods and ecosystems in mountainous regions.

[9]. Hall, T. J., Dennis, J. H., Lopez, R. G., & Marshall, M. I. (2009). Factors Affecting Growers Willingness to Adopt Sustainable Floriculture Practices. *Hortscience, 44*(5), 1346–1351.