

Original Research Article

Comment [H1]:

ADOPTION OF RECOMMENDED FERTILIZER DOSE IN FARMER'S FIELD OF BANGLADESH

Comment [H2]: Good

ABSTRACT

The study was conducted to explore the farmer's attitude and level of adoption of recommended fertilizer dose. A survey was conducted at Batiaghata upazila of Khulna, Bangladesh January to February on 2019 on randomly selected 120 respondents in respect of selecting twelve variables. The selected characteristics of the respondents were age, educational qualification, family size, farming experience, annual family income, farm size, organizational participation, agricultural training, cosmopolitanism, extension contact, knowledge, attitude, practice and innovativeness and adoption of recommended fertilizer dose. Data analysis was performed using software SPSS (Statistical Package for Social Science) version 20.0 computer package program. To explore relationship between the concerned variables Pearson's Product Moment Coefficient of Correlation (r) for ratio data and Spearman's Rank Order Correlation Coefficient (ρ) for ordinal data were employed. The result showed that maximum respondents were old aged (41.7%), had secondary level of education (56.70%), belonged to small family size (50%), had high annual family income (966.7%) and high farming experience (40%). Majority of the respondents had low organizational participation (44.16%), low contact with extension agent (57.5%) and medium cosmopolitanism (57.5%) and had no agricultural training (59.2%). The study also revealed that maximum of the respondents (62.5%) showed positive attitude towards adoption of recommended fertilizer dose. Majority of the respondents (46%) were belonged to low to medium adoption category of recommended fertilizer dose in field. Later a t-test was conducted to measure extent of adoption of recommended fertilizer dose in field of respondents, from the result it was seen that in 37% land farmers didn't apply recommended fertilizer dose. Among 120 respondents there was no innovator. Among twelve variables age and farming experience had significant relation with their innovativeness. Among twelve variables educational qualification, annual family income, farm size and extension contact had significant relation with their adoption of recommended fertilizer dose.

Comment [H3]: Use the word majority instead of Maximum

Comment [H4]:

Comment [H5]: The findings revealed that NOT the study. Consider substituting the word.

Keywords: *Recommended fertilizer dose (RFD), Adoption, Innovativeness, Agricultural practice.*

Comment [H6]: It is necessary to include a concluding remark and at least 1 recommendation based on the findings.

1. INTRODUCTION

Bangladesh is one of the most densely populated countries of the world. It has favorable climate for the production of variety of crops. Per capita cultivable land in the country is about 0.2 acres, which is one of the lowest in the world (BARC, 2012). To meet the food grain requirement for the growing population with limited land resources; pressure on land is increasing. The farmers use chemical fertilizers as a supplemental source of nutrients but they do not apply in balanced proportion (BARC, 2005). The organic matter content of Bangladesh soils continuously decreased (Bokhtiar *et al.*, 2005). A recent roundtable meeting on "balanced fertilizer usage" organized by "The Daily Star" (2016) reported that the majority of Bangladeshi farmers did not follow fertilizer recommendation guides. They were also unwilling to perform or rely upon soil tests and explicitly prepared recommendation so

46 the required amount of fertilizers they needed, and instead put faith in tacitly acquired
47 traditional farming experience and knowledge.

48 In our country farmers are using excess fertilizer and irrigation which are expensive and these
49 are the threat for soil and the environment. On the other hand, less fertilizer and irrigation
50 also risk for getting optimum or desired yields. However, today chemical fertilizer has
51 become essential to modern agriculture, but they have many negative consequences and have
52 beyond the reach of ordinary farmers. For instance, Usman and Dosumu (2007) reported that
53 chemical fertilizers and pesticides contribute greatly to enhance soil fertility they are also
54 major sources of farmland pollution and contamination. Meldora (2013) reported that, far
55 from being life sustaining, our modern chemical dependent farming methods strips the soil of
56 nutrients, destroys critical soil microbes, contributes to desertification and climate change and
57 saturates farmlands with toxic pesticides, herbicides, and fertilizers that then migrates into
58 groundwater, rivers, lakes and oceans. Repeated applications may result in a toxic buildup of
59 chemicals such as arsenic, cadmium, and uranium in the soil. Despite the harmful effects of
60 chemical fertilizers, farmers in Bangladesh rely heavily on the use of chemical fertilizers to
61 increase crop yield because soil nutrients have been depleted due to incessant continuous
62 tillage. Environmental degradation is another consequence associated with current
63 agricultural practices of Bangladesh. For maintaining of soil quality and attainable crop yield,
64 it is required to add proper amount of fertilizers and minimize the misuse of soil resources.

65 Evidence shows that among the farmers who apply fertilizer in their fields, majority of them
66 apply at very low level (Isaac, 2007). This culminates into inadequate food production for the
67 rapid growing population. Several factors have been associated with the adoption behavior.
68 These are the independent factors like personal, institution, environmental and socio –
69 economic factors (Matata et al., 2001; Mtenga, 1999 and Nanai, 1993). According to Duvel
70 (1991) the intervening variables are the key determinants of the adoption behavior. Factors
71 affecting adoption include age, education, sex, household size, land holding size, (Kusmiat et
72 al., 2007; Kasie et al., 2012), awareness, income (Asfaw et al., 2011), experience, risk and
73 uncertainties (Drechsel, 2005), innovation attributes like compatibility, trialability, relative
74 advantage (Rogers, 1962; van den Ban and Howkins, 1996), membership in FFS (Kabir,
75 2006). Adaptation is influenced by various factors, some of them include awareness or access
76 to information, income/wealth and access to credit (Nhema chenaand Hassan 2007; Obayelu
77 et al., 2014). Also farmers know about the recommended fertilizer dose but they don't
78 practice it on their own field. What is their attitude towards recommended fertilizer dose!
79 This research is done to find out the reason behind this. In the light of the above, this
80 experiment was aimed to satisfy the following objectives: a) To analyze some of the selected
81 characteristics of the farmers' towards adoption of recommended fertilizer dose. b) To assess
82 farmers' knowledge, attitude and practice of regarding recommended fertilizer dose. c) To
83 determine extent of adoption of recommended fertilizer dose. d) To explore the relationship
84 between selected characteristics of the farmers and their extent of adoption of recommended
85 fertilizer doses.

86 2. METHODOLOGY

87 2.1 Data Collection

88 A sample of 120 respondents was selected in seven unions (Amirpur, Gangarampur, Jalma,
89 Batiaghata, Baliadanga, Bhanderkote and Surkhali) of Batiaghata Upazila in Khulna District.
90 The primary data were collected through face to face interview from 20th of January to 15th
91 of February on 2019. After completion of survey all the interview schedules were compiled
92 for data processing. At first all the qualitative data were converted into quantitative form by

Comment [H7]: Methodology section usually starts with "Research Design", which has to be described extensively to show relevance of the design adopted with the objectives of the study.

93 means of suitable code and score whenever necessary. In several instances indices and scales
 94 were constructed through the simple accumulation of scores assigned to individual or pattern
 95 of attributes. Indices and scales are considered the efficient instrument for data reduction and
 96 analysis.

Comment [H8]: Population of the study not described neither did the researcher discusses the sampling technique used. This helps in authenticating the adequacy of the sample with justification.

97 **2.2 Selection of variables**

98 **Independent variables**

99 In this study selected characteristics of the respondents were considered as independent
 100 variables such as age of the respondents, family size, and educational qualification, farming
 101 experience, organic farming experience, annual income, farm size, organizational
 102 participation, agricultural training, cosmopolitanism, extension contact, knowledge, attitude
 103 and practice. The selected characteristics of the respondents were computed following
 104 standard procedures as used by Pervin et al. (2018) and Shiduzzaman et al. (2018).

Comment [H9]: Selection of variables not suitable for article writing, rather the use of "Theoretical framework" is more appropriate. OR the researcher may decide to use theoretical postulations.

105 **Dependent variables**

106 Extent of adoption of recommended fertilizer dose and innovativeness of the respondent were
 107 the dependable variables. The extent of adoption of recommended fertilizer dose was
 108 measured by percentage of area coverage by recommended fertilizer dose by using the
 109 following formula:

110 Extent of Adoption = $\frac{A_a}{P_a} \times 100$

111 Where

112 A_a = Actual area of adoption of recommended fertilizer dose

113 P_a = Potential area for adoption of recommended fertilizer dose

114 Adoption of recommended fertilizer dose was expressed in decimal. Later the data was
 115 categorized which is ranged from 0 to 1 to identify the respondents level of adoption.

116 Innovativeness is the degree to which an individual is earlier to adopt an innovation than
 117 other members of the social system. The innovativeness of the respondents about
 118 recommended fertilizer using was determined on the basis of time required to adopt
 119 recommended fertilizer dose from first hearing to final adoption of it.

120

Categories	Range
Innovator	$< (\bar{X} - 2Sd)$
Early Adopter	$(\bar{X} - 2sd)$ to $(\bar{X} - Sd)$
Early Majority	$(\bar{X} - Sd)$ to (\bar{X})
Late majority	(\bar{X}) to $(\bar{X} + Sd)$
Laggard	$> (\bar{X} + 2Sd)$

121 (Md. Shiduzzaman et al., 2018)

122 **2.3 Data analysis**

123 Data analysis was performed using the **concerned** software SPSS (Statistical Package for
124 Social Science) version 20.0 computer package program. Statistical treatments such as range,
125 means, standard deviation, maximum, minimum, rank order etc. were used to interpret data.
126 To explore relationship between the concerned variables Pearson's Product Moment
127 Coefficient of Correlation (r) for ratio data and Spearman's Rank Order Correlation
128 Coefficient (ρ) for ordinal data were employed. Five percent (0.05) level of probability was
129 the basis for rejecting any null hypothesis throughout the study.

Comment [H10]: What is the essence of using concerned? Consider removing the word from the whole text.

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131 3. RESULTS AND DISCUSSION

132 3.1 Facts on the Selected Characteristics of the Respondents

Comment [H11]: Try to use a conventional language for article writing please, the words like fact are not acceptable.

133 It has been noticed from the Table 1 that 23.3% respondents were young, 35% respondents
134 were middle aged and 41.7% respondents were old. The age of the respondents ranged from
135 23 to 102 with a mean of 48 and standard deviation of 14.54.

136 Among 120 respondents 0.80% respondent was illiterate, 1.70% respondents could sign only
137 their name and 20% respondents had primary level education. 56.70% respondents had
138 secondary level education. 9.10% respondents had higher secondary level education. 10%
139 respondents completed bachelor science degree and 1.70% respondents had their education
140 up to masters of science degree. Here mean value is 6.62 while standard deviation is 3.98
141 minimum educational level is illiterate which is scored as 0.00 and maximum educational
142 level of the respondents were masters in science (Table 1).

143 From the Table 1 family size of the respondents could be revealed, where 50% respondents
144 belonged to small family, 40% respondents belong to medium family and 9.2% respondent's
145 belonged to large family. Here mean score is 4.97 and standard deviation is 2.26. Lowest
146 number of family member was 2 and highest number of family member was 16.

147 The distribution of the respondents according to their farming experience was given Table 1
148 Farming experience of the respondents ranged from 2 to 70 with a mean of 20.79 and
149 standard deviation of 11.94. Highest number (40%) of respondents had high farming
150 experience followed by medium farming experience (39%) and only 21% respondents had
151 low farming experience.

152 Table 1 contained distribution of the respondents according to their annual income. Annual
153 family income of the respondents ranged from 60,000 to 10, 90,000 with a mean of
154 276878.80 and standard deviation of 195382.67. Data presented in the Table 1 reveal that the
155 majority (66.7%) of the respondents had higher income while 27.5% had medium income.
156 Only 5.8% of the respondents had low income

157 The observed farm size scores of the respondents varied from 0.05 ha to 11.81 ha. The
158 average farm size was 0.67 ha and the standard deviation is 1.11. The distribution of the
159 respondents according to their farm size is shown in Table 1.

160 Organizational participation could be revealed from the Table 1. The observed organizational
161 participation of the respondents ranged from 0 to 12 with a mean of 2.97 and standard
162 deviation of 3.05. Highest proportion (44.16%) of the respondents had low organizational
163 participation followed by high organizational participation (38.34%). On the other hand
164 17.5% had medium organizational participation.

165 From the Table 1 training experience of the respondents could be explored. Training scores
166 experience of the respondents ranged from 0 to 4 with a mean of 0.60 and standard deviation

167 of 0.85. Based on the number of training received respondents are grouped into 4 groups
168 showed in the table. The table indicate that majority of the respondents had no training while
169 two fifth (40%) of them had low training and only one respondents received medium training.

170 From Table 1 cosmopolitanism characteristics of the respondents could be explored. Majority
171 (57.5%) of the respondents had medium cosmopolitanism followed by high cosmopolitanism
172 (39.2%) while only 3.3 % had low cosmopolitanism. Mean of the cosmopolitanism is 15.74
173 and standard deviation is 3.65. Minimum score of the respondent's cosmopolitanism was 5
174 while maximum score of the respondent's cosmopolitanism was 23.

175 Table 1 contains the value of the respondents according to their extension contact. The Table
176 1 reveals that majority (57.5%) of the respondents had low contact while 37.5% had medium
177 extension contact and only 5% had high extension contact. The mean of the extension contact
178 is 11.90 and the standard deviation is 6.26. The lowest value of extension contact is 9 while
179 the highest value is 30. Only 5% had high extension contact. It can be said that is a drawback
180 of department of agricultural extension. It also includes internet use. It's a matter of great
181 regret that our farmers are lagging behind in the sector of using internet use.

182 Table 1 showed the distribution of the respondents according to their attitude. Here 3.3%
183 showed negative attitude, 34.2% showed moderately positive attitude and 62.5% showed
184 positive attitude. Mean score was 37.96 and standard deviation was 3.99. The minimum value
185 of attitude of the respondents was 8 on the other hand maximum score was 47.

186 Table 1 contained distribution of the respondents according to their practice. Majority of the
187 respondents (56.7%) showed high practice followed by medium practice 43.3%. None of
188 them belong to low practice. Practice of the respondents ranged from 19 to 42 with mean of
189 31.52 with a standard deviation of 5.12.

190 (INSERT TABLE 1 HERE)

Comment [H12]: Insert each Table immediately after the description or discussion, that is called in text Table insertion.

191 3.2 Extent of Adoption of Recommended Fertilizer Dose in Crop Field

192 From the Fig. 1 adoption of the respondents in crop field could be revealed. To make this
193 graph t test (two samples assuming equal variance) was done in which difference between
194 potential area under recommended fertilizer dose and actual area under recommended
195 fertilizer dose was measured. The mean of respondent's total land was 152.34 decimal, while
196 the mean of the total land under recommended fertilizer dose was 96.48 decimal. This
197 information was compiled by asking the respondents about their total land amount under
198 cultivation and how much of the land they use recommended fertilizer dose. The value of the
199 t test is 2.05358E-06 (for one tail) and 4.10716E-06 (for two tail) which is significant. In
200 36.66% area of land respondents didn't apply recommended fertilizer dose which is a huge
201 area of land. This land should be taken under recommended fertilizer dose which may help
202 the respondents to get maximum potential yield.

203 (INSERT FIGURE 1 HERE)

Comment [H13]: Insert all figures immediately after describing them or after their notes.

204 3.3 Innovativeness of the Respondents

205 After observing adoption of the respondents a table of innovativeness of the respondents was
206 made which could be revealed from Table 2. Among 120 respondents highest number (45) of
207 respondents belong to early majority group followed by late majority (38). 17 respondents
208 were laggard while only 20 respondents were early adopter. None of them belonged to
209 innovator category. A comparison between research finding and Rogers's diffusion of
210 innovation curve (Fig. 2) was done to justify the findings. Diffusion of innovations is a theory

211 that seeks to explain how, why, and at what rate new ideas and technology spread. Rogers
212 proposes that four main elements influence the spread of a new idea: the innovation itself,
213 communication channels, time, and a social system. The categories of adopters are
214 innovators, early adopters, early majority, late majority, and laggards. According to the
215 Rogers's diffusion of innovation (2008) curve 2.5% will be innovators, 13.5% will be early
216 adopters, 34% will be early majority, 34% will be late majority and 16% will be laggard.
217 According to the research findings none of the respondents were innovator, 16.67% were
218 early adopter, 37.50% were early majority, 31.67% were late majority and 14.16% was
219 laggards. From the Fig 2 it was seen that 31.67% and 14.16% were late majority and laggard
220 respectively. These respondents should be motivated to adopt recommend fertilizer dose to
221 increase yield.

222 3.4 Relationship of the Selected Variables

223 Correlation coefficient is a numerical measure of some type of correlation, meaning a
224 statistical relationship between two variables. Coefficient of correlation was computed in
225 order to explore the relationship between the twelve selected characteristics of the rural
226 women (age, education, family size, farming experience, annual income, farm size,
227 organizational participation, agricultural training, cosmopolitanism, extension contact,
228 attitude, practice,) and their innovativeness and adoption of recommended fertilizer dose.
229 This correlation has been done by using Spearman's Rank Order Correlation Coefficient (ρ)
230 as well as Person's Product Moment Correlation Coefficient (r). Here for age, education,
231 family size, farming experience, annual income, and farm size Pearson's Product Moment
232 Correlation was used because these value could be zero which could be calculated by Pearson
233 Product Moment Correlation and other variables that means organizational participation,
234 agricultural training, cosmopolitanism, extension contact attitude and practice was computed
235 with Spearman's Rank Order Correlation Coefficient. From the Table 3 it was seen that there
236 was significant positive correlation between age and farming experience with respondent's
237 innovativeness. That means the more the age, the more the invention will grow. Also the
238 greater the experience, the higher it will be to innovate. While other ten variables named
239 education, family size, annual income, farm size, organizational participation, agricultural
240 training, attitude and practice had no significant relationship with their innovativeness. Since
241 maximum respondents had small family size, secondary level of education and high annual
242 income they were limited in traditional process of fertilizer application. The computed value
243 of correlation coefficient of education, farm size and annual income had negative relationship
244 with innovativeness of the respondents.

245 It was also seen from the Table 3 that, education, farm size, annual income, agricultural
246 training and extension contact had positive significant relationship with respondent's
247 adoption out of twelve variables. One variable named organizational participation had
248 negative relation with adoption of recommended fertilizer dose. Respondent's maximum
249 involved in NGO which gave them loan in short interest to bring economic solvency in their
250 life, not influence them to adopt new technology.

251 (INSERT TABLE 3 HERE)

252 4. CONCLUSIONS

253 Based on the socio economic background of the respondents it could be concluded that the
254 old aged respondents had less adoption on recommended fertilizer dose. Highest proportion
255 of the respondents had secondary level of education. Majority of the respondent's belonged to
256 small size of family. Maximum respondents had high farming experience and small farm
257 size. However they had high annual income and low family size. On the basis of the finding

Comment [H14]: Insert all tables after the notes on them.

258 it might be concluded that most of the respondents had low organizational participation,
 259 contact with extension agent, and facilities to agricultural training. Based on the correlation
 260 analysis it could be concluded that old aged and high farming experienced respondents are
 261 more innovative. Since maximum respondents had small family size, secondary level of
 262 education and high annual income they were limited in traditional process of fertilizer
 263 application that means they are less innovative. Education, farm size, annual family income,
 264 agricultural training and extension contact had positive significant relation with respondent's
 265 adoption of recommended fertilizer dose while organizational participation had negative
 266 relation with their adoption since maximum respondents had low organizational participation.

Comment [H15]:

267 **RECOMMENDATIONS**

Comment [H16]: For all researches there must be recommendation (s) based on the findings. Absence of recommendations make the findings to be faulty and also raise question as to whether the objectives of the study are achieved or not.

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Parameter	Category	Score	Respondents (N=120)		Mean	SD.	Min.	Max.
			Number	Percentage				
Age (Years)	Young	≤35	28	23.30	48	14.54	23	102
	Middle	36-55	42	35				
	Old	>55	50	41.70				
Educational qualification (Schooling years)	Illiterate	0	1	0.80	6.62	3.98	0	16
	Sign	0.50	2	1.70				
	Primary	1-5	24	20				
	Secondary	6-10	11	9.20				
	HSC	11-12	68	56.70				
	BSc	13-16	12	10				
	MSc	>16	2	1.70				
Family size (No. of members)	Small	≤4	60	50	4.97	2.26	2	16
	Medium	5-7	49	40				
	Large	>7	11	10				
Farming experience (Years)	Low	≤10	25	21	20.79	11.94	2	70
	Medium	10-20	47	39				
	High	>20	48	40				
Annual income (BTD)	Low	≤120000	7	5.80	2768 78.80	1953 82.67	60000	1090 000
	Medium	120001-180000	33	27.50				
	High	>180000	80	66.70				
Farm size (ha)	Landless	<0.02	0	0	0.67	1.11	0.05	11.81
	Marginal	0.02-0.20	18	15				
	Small	0.21-1.0	92	76.67				
	Medium	1.01-3.0	8	6.67				
	Large	>3	2	1.66				
Organizational Participation	Low	≤6	53	44.16	2.97	3.05	0.00	12
	Medium	7-12	21	17.5				
	High	>12	46	38.34				
Agricultural	No	0	71	59.20				

training (No. of training)	Low	≤3	48	40	0.60	0.85	0.00	4
	Medium	4-5	1	0.80				

269 **Table 1. Distribution of the respondents according to selected characteristics**

270 **Table 1. Continued...**

Parameter	Category	Score	Respondents (N=120)		Mean	SD.	Min.	Max.
			Number	Percentage				
Cosmopoli tanism	Low	≤8	4	3.30	15.74	3.65	5.00	23
	Medium	9-16	69	57.50				
	High	>16	47	39.20				
Extension contact	Low	≤11	69	57.50	11.90	6.26	9	30
	Medium	12-22	45	37.50				
	High	>22	6	5				
Attitude	Low	≤28	4	3.30	37.96	3.99	8	47
	Medium	29-44	41	34.20				
	High	>44	75	62.50				
Practice	Low	≤10	0	0	31.52	5.12	19	42
	Medium	11-20	52	43.30				
	High	>20	68	56.70				

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273 **Table 2. Distribution of the respondents according to their innovativeness**

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Categories	Range	Score	Number	%	Roger's Curve %
Innovator	$<(\bar{x}-2sd)$	<0.8	0	0%	2.5%
Early adopter	$(\bar{x}-2sd)$ to $(\bar{x}-sd)$	0.8-6.5	20	16.67%	13.5%
Early majority	$(\bar{x}-sd)$ to (\bar{x})	6.6-12.2	45	37.50%	34%
Late majority	(\bar{x}) to $(\bar{x}+sd)$	12.3-18.7	38	31.67%	34%
Laggard	$>(\bar{x}+sd)$	>18.7	17	14.16%	16%

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Table 3. Relationship of the selected variables between innovativeness and adoption of recommended fertilizer dose of the respondents

Serial	Variables	Innovativeness	Adoption	Correlation Type
1.	Age	0.20*	0.07 ^{NS}	r
2.	Education	-0.005 ^{NS}	0.18*	r
3.	Family Size	-0.27 ^{NS}	0.05 ^{NS}	r
4.	Farming Experience	0.33**	0.05 ^{NS}	r
5.	Annual Income	-0.45 ^{NS}	0.45**	r
6.	Farm Size	-0.04 ^{NS}	0.97**	r
7.	Organizational Participation	0.04 ^{NS}	-0.07 ^{NS}	ρ
8.	Agricultural Training	0.01 ^{NS}	0.20*	ρ
9.	Cosmopolitanism	0.10 ^{NS}	0.10 ^{NS}	ρ
10.	Extension Contact	0.00 ^{NS}	0.29**	ρ
11.	Attitude	0.09 ^{NS}	0.13 ^{NS}	ρ
12.	Practice	0.11 ^{NS}	0.16 ^{NS}	ρ

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*: correlation is significant at the 0.05 levels (2tailed)

r: Pearson's Product Moment correlation Coefficient

NS: Non significant

** : correlation is significant at the 0.01 level (2tailed)

ρ: Spearman's Rank Order Correlation Coefficient

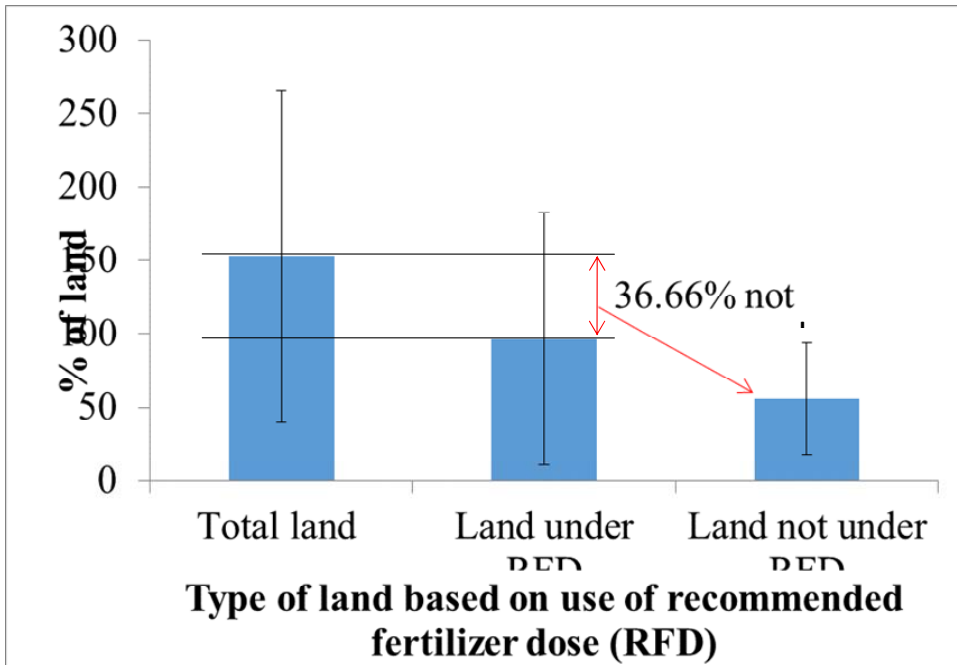
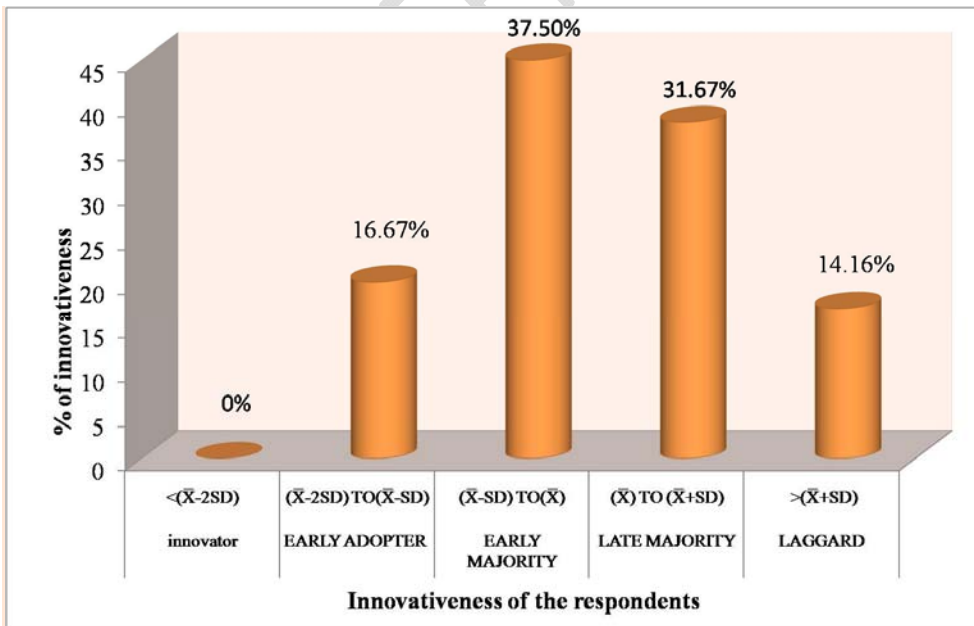
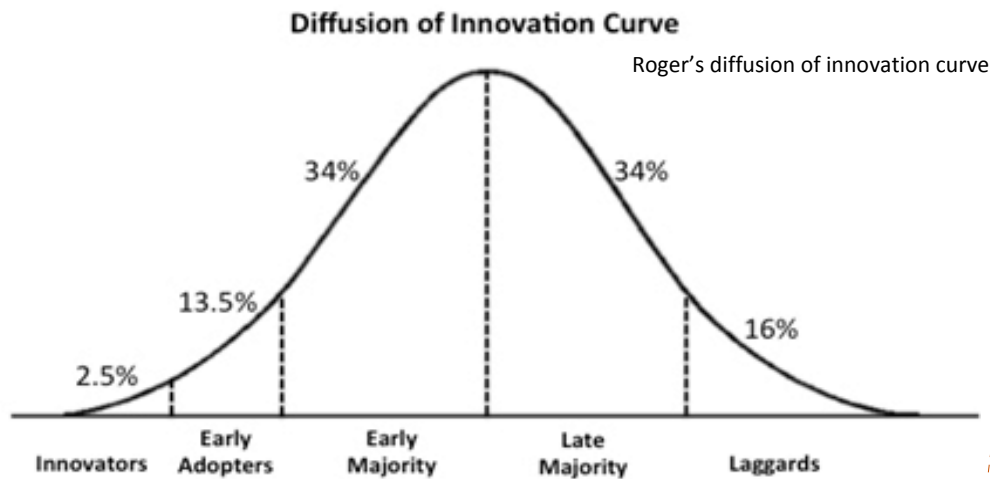


Fig.1. Extent of adoption of fertilizer in field



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Comment [H17]: All Tables and Figures should be placed immediately after their description and labelled appropriately.

295
296 **Fig.2. comparison between Roger's diffusion of innovation curve, and innovativeness of**
297 **the respondents according to findings**

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