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

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 the concerned 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.

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

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

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

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

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

2. METHODOLOGY

2.1 Data Collection

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

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.

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).

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 0to 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.

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

121   (Md. Shiduzzaman et al., 2018)

122 2.3Data analysis

Data analysis was performed using the concerned software SPSS (Statistical Package for Social Science) version 20.0 computer package program. Statistical treatments such as range, means, standard deviation, maximum, minimum, rank order etc. were used to interpret data. 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. Five percent (0.05) level of probability was the basis for rejecting any null hypothesis throughout the study.

3. RESULTS AND DISCUSSION

3.1 Facts on the Selected Characteristics of the Respondents

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2 Extent of Adoption of Recommended Fertilizer Dose in Crop Field

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

3.3 Innovativeness of the Respondents

After observing adoption of the respondents a table of innovativeness of the respondents was made which could be revealed from Table 2. Among 120 respondents highest number (45) of respondents belong to early majority group followed by late majority (38). 17 respondents were laggard while only 20 respondents were early adopter. None of them belonged to innovator category. A comparison between research finding and Rogers's diffusion of innovation curve (Fig. 2) was done to justify the findings. Diffusion of innovations is a theory that seeks to explain how, why, and at what rate new ideas and technology spread. Rogers proposes that four main elements influence the spread of a new idea: the innovation itself, communication channels, time, and a social system. The categories of adopters are

innovators, early adopters, early majority, late majority, and laggards. According to the Rogers's diffusion of innovation (2008) curve 2.5% will be innovators, 13.5% will be early adopters, 34% will be early majority, 34% will be late majority and 16% will be laggard. According to the research findings none of the respondents were innovator, 16.67% were early adopter, 37.50% were early majority, 31.67% were late majority and 14.16% was laggards. From the Fig 2 it was seen that 31.67% and 14.16% were late majority and laggard respectively. These respondents should be motivated to adopt recommend fertilizer dose to increase yield.

3.4 Relationship of the Selected Variables

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

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

4. CONCLUSIONS

Based on the socio economic background of the respondents it could be concluded that the old aged respondents had less adoption on recommended fertilizer dose. Highest proportion of the respondents had secondary level of education. Majority of the respondent's belonged to small size of family. Maximum respondents had high farming experience and small farm size. However they had high annual income and low family size. On the basis of the finding it might be concluded that most of the respondents had low organizational participation, contact with extension agent, and facilities to agricultural training. Based on the correlation analysis it could be concluded that old aged and high farming experienced respondents are more innovative. Since maximum respondents had small family size, secondary level of

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education and high annual income they were limited in traditional process of fertilizer application that means they are less innovative. Education, farm size, annual family income, agricultural training and extension contact had positive significant relation with respondent's adoption of recommended fertilizer dose while organizational participation had negative relation with their adoption since maximum respondents had low organizational participation.

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	276878.80	195382.67	60000	1090000
	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 training (No. of training)	No	0	71	59.20	0.60	0.85	0.00	4
	Low	≤3	48	40				
	Medium	4-5	1	0.80				

Table 1. Distribution of the respondents according to selected characteristics

267   **Table 1. Continued…**

Parameter	Category	Score	Respondents (N=120)		Mean	SD.	Min.	Max.
			Number	**Percentage**				
Cosmopolitanism	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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270   **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	-.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

*: correlation is significant at the 0.05 levels (2tailed)   **: correlation is significant at the 0.01 level (2tailed)

r: Pearson's Product Moment correlation Coefficient   ρ: Spearman's Rank Order Correlation Coefficient
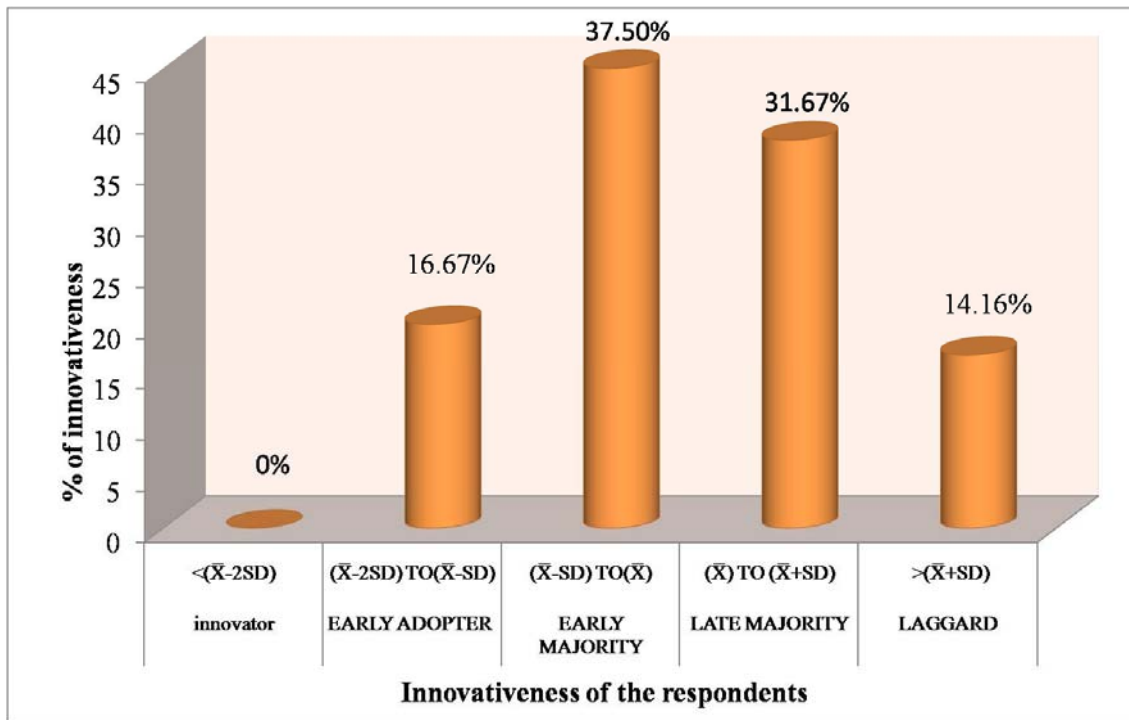
NS: Non significant

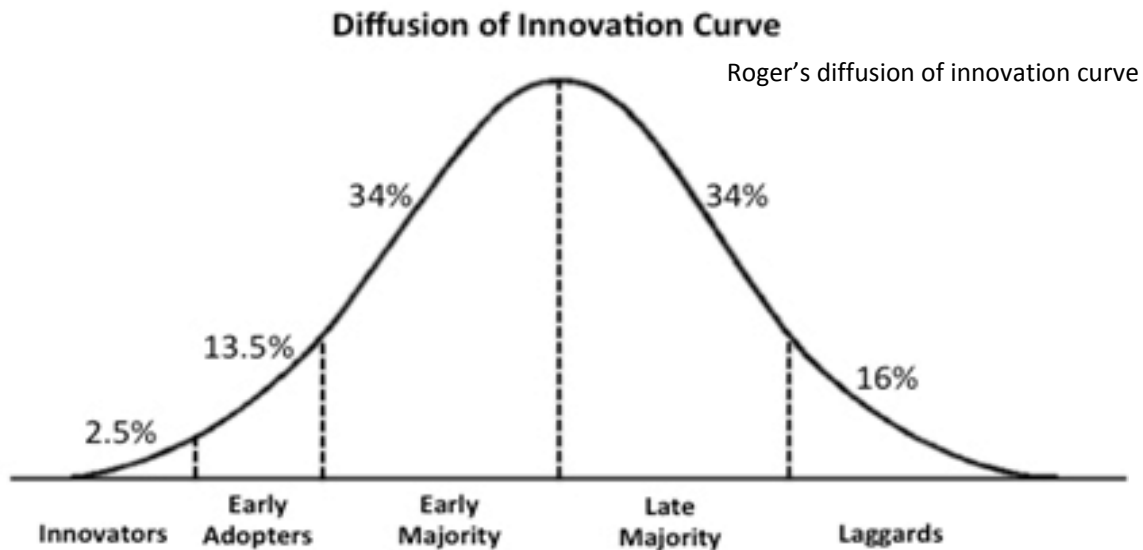**Fig.1. Extent of adoption of fertilizer in field**

Roger's diffusion of innovation curve

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

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