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Research Note

STATUS OF PULSES VARIETIES ADOPTION IN BANGLADESH: A FARM LEVEL STUDY

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ABSTRACT

The study was conducted in pulse growing areas of Bangladesh during November 2003 to April 2004 for assessing the farm level adoption status of improved pulse varieties with farmers' attitudes toward pulse production. The overall adoption of pulse varieties was very encouraging since 44% of the farmers adopted improved pulses, and 52% of the total pulse area was devoted to its production. The highly adopted varieties were BARI Mash 1, 2 and 3; BARI Lentil 4 and BARI Mung 4 and 5. Indigenous mungbean had completely been replaced by improved varieties in the study areas. The adopters plowed lands and sowed seed according to the recommendation, but could not follow the recommended sowing method and fertilizer doses. The significantly higher probability of adopting improved pulse varieties exists in extension services, influence of family member and encouragement of neighbour. Farmers' attitude toward improved pulse production was very positive since 63% of the adopters wanted to increase their present area for improved pulse production in the next year. On the other side, various agro-socio-economic constraints made many farmers pessimistic toward pulse production. The scarcity of improved pulse seed was identified as a crucial problem for its higher adoption at farm level.

I. INTRODUCTION

Bangladesh has climatic conditions favorable for growing a diverse array of crops including pulse. Many varieties of pulses are grown in different parts of Bangladesh. Pulses have traditionally been called the *poor man's meat* since these are the cheapest source of protein in the daily diet of the most people in Bangladesh. For this reason, about 7.3 lakh hectare of land (9% of the net cropped area) of the country is devoted to pulse cultivation (BBS, 1999). Among the pulses grown extensively in the country, kheshari occupies the largest area and highest production, followed by lentil, chickpea and blackgram (BBS, 2000). Although many hectares are dedicated to its production, the per capita consumption of pulse in Bangladesh is only 12 gm/day which is much lower than the recommended daily consumption of 80 gm/day (BBS, 1998). Pulses are not only an essential source of protein but also add nitrogenous fertilizers to soils, and provide a significant amount of fodder for farm animals.

A number of indigenous low-yielding pulses, traditionally cultivated in different parts of the country, are highly susceptible to diseases and insect-pests. Considering these factors, the

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scientists of Bangladesh Agricultural Research Institute (BARI) launched a pulse research programme in 1991. Since that time they have developed 26 improved pulse varieties along with their crop management technology for farm level production.

Adoption of crop technologies is viewed as an essential component of agriculture-led development strategies for third world countries. Technological advances have been utilized in anti-poverty programs in order to stimulate productivity, promote economic growth and raise income levels (Campbell 1990, Gee 1981, Link 1981, Preece 1989). Through its crop diversification program the Department of Agricultural Extension (DAE) has been involved in various supportive programmes for the development and dissemination of pulse crops. Improved pulse varieties have also been disseminated in farmers' fields through different agencies such as NGOs, research institutes, BADC and universities. Although these varieties have been found to be suitable for farmers, for various unknown reasons, a majority of the farmers in the country are still reluctant to adopt these new innovations. Since many farmers have not adopted these varieties the level of pulse production remains far below its potential. Therefore, the factors contributing to lower levels or non-adoption of pulse varieties must be identified so that necessary action can be taken. In order to address this problem, the study was undertaken to: (i) know the status of adoption of improved pulse varieties in the farmers' field; (ii) explore factors affecting adoption and non-adoption of improved pulses varieties; and (iii) know farmers' experience with and attitudes toward pulse production.

II. DATA AND METHODOLOGY

Study area, sampling design and sample size

The study was conducted in six different types of pulse growing districts in Bangladesh. The study selected one district from a highly concentrated pulse growing areas, one district from a moderately concentrated area, and one district from a low concentrated area for each sample pulse. Jhenaidah district was chosen as highly concentrated mungbean and lentil growing area, and Chapainababgonj as blackgram growing area. On the other hand, Barisal, Rajbari and Kustia districts were selected as moderately concentrated mungbean, lentil and blackgram growing areas, respectively. Kustia district was considered as low concentrated area for mungbean and lentil production, and Rajbari for blackgram production. In each district two *Upazilas* (administrative unit) were selected for study and from each *Upazila* one or two village(s) were selected for gathering farm level data and information. The *Upazilas* and villages were chosen in consultation with Agricultural Extension Officer and local scientists involved in the LBMDP project.

A complete list of pulse growing farmers in each village was prepared and sample farmers were selected randomly from the list. For each type of pulse a total of 25 farmers, 20 adopters of the technology and 5 non-adopters were selected from the different *Upazila* for interview. In the case of adopters, three types of pulse farmers, namely lentil, blackgram and mungbean farmers were selected for interview. Non-adopters were selected for interview if they grew traditional pulse varieties. The researchers did not find any farmer growing indigenous mungbean in the study areas. The total number of sample farmers is 420. Data were collected during November 2003 to April 2004. Detailed sampling procedure and sample size is shown in Table 1 below.

Table 1. Distribution of sample pulse growing farmers in the study areas

Study area	Lentil		Blackgram		Mungbean		All pulses	
	Adopter	Non-adopter	Adopter	Non-adopter	Adopter	Non-adopter	Adopter	Non-adopter
1. Jhenaidaha								
Sadar	20	5	-	-	20	-	40	5
Kotchandpur	20	5	-	-	20	-	40	5
2. Kustia								
Sadar	20	5	20	5	20	-	60	10
Daulatpur	20	5	20	5	20	-	60	10
3. Rajbari								
Sadar	20	5	20	5	-	-	40	10
Pangsha	20	5	20	5	-	-	40	10
4. Chapai Nawabgonj								
Sadar	-	-	20	5	-	-	20	5
Shibgonj	-	-	20	5	-	-	20	5
5. Barisal								
Sadar	-	-	-	-	20	-	20	-
Banaripara	-	-	-	-	20	-	20	-
All Area	120	30	120	30	120	-	360	60

Trained enumerators and researchers collected primary data using a pre-tested interview schedule. Secondary data on area and production relating to pulse were also collected and used to supplement the information collected through field survey.

Analytical Techniques

In most cases, tabular method of analysis supported with appropriate statistical parameters was used to present the results of the study. The status of adoption of improved pulse varieties was measured by computing adoption scores for recommended practices. The score given to each practice varied from 1 to 3 according to the adoption of the recommended package of technologies. Based on the score earned by the farmers, the levels of adoption were categorized as high, medium and low respectively. Nevertheless, different variables closely associated with adoption were also identified and measured by computing scores. Pearson's Correlation Coefficient was used to estimate the degree of relationship between the adoption and different socioeconomic factors of the adopters. On the other hand, Probit Model was used for analyzing the probability of adoption of improved pulse varieties. The theoretical and empirical Probit Model is discussed below.

Theoretical Model: Qualitative Response Models (i.e. Probit model, Logit model) have been used extensively by agricultural production and farming systems economists for studying and analyzing farmer adoption and diffusion of agricultural interventions. Probit model is based on a cumulative normal distribution function which is symmetric around zero with variance equal to 1. In Pakistan, Malik *et al.*, (1991) used Probit model to examine the role of credit in agricultural development and Heisey *et al.* (1990) used it to identify the determinants of farmers' awareness and adoption of wheat varieties. Traxler and Byerlee (1992) also used this analysis to identify the characteristics of insecticide farmers. The following Probit model was used to identify the factors and their probabilities for adoption of improved pulse varieties in the farmers' field. $\text{Log } P = \alpha + \beta iXi$ (1) Where, P = Adoption (1 for adoption, 0 for non-adoption), Xi = Explanatory variables (i = 1, 2, 3.........n); α = Constant term; and βi = Coefficients (i = 1, 2, 3.........n). Relative change in P with a constant increase in Xi can be measured by the above model. When P approaches 1, a relative change in P can be obtained with a constant increase in Xi by equation (2); here 1-P is used. $\text{Log } (1-P) = \alpha + \beta iXi$ -------------------------- (2) When Equations (1) and (2) are combined, we get Equation (3) that can be transformed into Equation (4).

$$\text{Log } P - \text{Log } (1-P) = \alpha + \beta iXi \quad \text{------------------------------} \quad (3)$$

$$\text{Log } \{P/(1-P)\} = \alpha + \beta iXi \quad \text{-----------------------------} \quad (4)$$

The ratio of P/(1-P) is called the odd ratio and log {P/(1-P)} is called the log odds or Logit/Probit (Wonnacott and Wonnacott, 1979). Equ. (4) can be rearranged and solved for P;

$$P = [1/(1 + e^{-(\alpha + \beta iXi)})] \quad \text{------------------------------} \quad (5)$$

The probability function used in Equation (5) is called the logistic distribution function and ensures that the predicted value (P) of the relative frequency of the independent variable is always between 0 and 1. The Equation (5) is used to analyze the determinants of farmer adoption of an intervention. Equation (5) is expanded to use more variables as depicted in Equation (6).

$$P = [1/(1 + e^{-(\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_n X_n)})] \quad \text{-------------} \quad (6)$$

Empirical Model: In order to ascertain the probability of adoption of improved pulse varieties, the following empirical Probit model was carried out. The dependent variable of this model was adoption of improved pulse variety. Since the dependent variable is dichotomous, OLS cannot be used. The model is as follows-

$$A_i = \alpha + \beta_i X_i + \ldots\ldots U_i$$

Where,

Ai = Farmers adopting improved pulse varieties in terms of hectare; (If, Yes = 1; Otherwise = 0)

α = Intercept

Xi = Independent variables (Socio-economic characteristics)

Ui = Error term; and

X_1 = Topography (Medium high = 1, Otherwise = 0)

X_2 = Soil type (Sandy loam =1, Otherwise = 0)

X_3 = Age of the respondent (year)

X_4 = Education (Year of schooling)

X_5 = Training received on agriculture (No./lifetime)

X_6 = Farm size (in acre)

X_7 = Time spend in agriculture (hours/week)

X_8 = Organizational participation (Score)

X_9 = Cosmopolites of the farmer (Score)

X_{10} = Involvement in innovative activities (Score)

X_{11} = Awareness in seed collection (Score)

X_{12} = Extension contact (Score)

X_{13} = Influence of family members (Score)

X_{14} = Influence of neighbouring farmers (Score)

Variables used in the model and their measurement

For the probit model, the variable 'Adoption' was used as the dependent variable that takes on the value 1, if farmers adopted improved pulse technology; value 0, if they used indigenous pulse variety. In the study areas, adoption of improved pulse varieties is likely to be influenced by three sets of independent variables; agro-climatic, socio-economic and information sources. The procedures of measuring the scores of some variables included in the model are discussed in the following subsequent sections.

Cosmopoliteness: This variable was measured based on the frequency of the respondent's visit to five different places outside his own village. The respondents were asked to mention the number of visit made to different places on a monthly and yearly basis. Different values were assigned, based on importance, for different places of visit. The actual score was then calculated by adding all the values. Possible scores ranged from 0 to 15.

Organizational participation (OP): This variable measures the nature and duration of the respondent's participation in different organizations. A respondent's overall OP score is obtained by adding his individual scores in all the organizations. An OP score of zero would indicate no participation in any organization. The score of OP is computed in the following manner.

$$\text{OP score} = \sum(\text{Participation score} \times \text{Duration score}).$$

Extension contact: The respondents were asked to mention the number of contacts they had with different individuals, media and television on a weekly, monthly and yearly basis.

Twelve different extension Medias were considered in this study. All these Medias were assigned different values according to their importance. The actual score was measured by adding all the values. The scores for extension contact were ranged from 0 to 48.

Innovativeness: The respondents were asked to mention the number of innovative works in which they were involved and the total number of times they engaged in these activities. The frequency of involvement in different innovative works was summed up in to obtain an overall score.

Awareness in collecting seed: The respondent adopters collected or bought pulse seed from five different sources. The sources of seed were assigned different values ranging from 1 to 5 and these values were considered as score for innovativeness of the farmers.

Influence of family member/neighbou: The strengths of influence of family members, neighbours or DAE personnel in adopting improved technologies were classified into five categories: very high, high, moderate, not much and no influence. All these influences were given a value which was ranged from 0 to 4.

III. LEVEL OF ADOPTION OF IMPROVED PULSES VARIETIE

Adopters of improved pulses varieties

It was observed that more than 63% of farm families in the study areas were engaged in cultivating different types of pulses. Among pulse growing farmers, the highest percentage of farmers in Nowabganj (57%), Faridpur (81%) and Jhenaidah (98%) adopted improved varieties of Blackgram, Lentil and Mungbean respectively. In all areas, the percentages of adopters of Blackgram, Lentil and Mungbean were 28.15, 57.87 and 45.72% respectively (Table 2).

Table 2. Adopters of improved pulses varieties in the study areas

Study area	Sample size	Farmers growing pulses (%)	Pulse growing far ers adopt improved variety (%)		
			Blackgram	Lentil	Mungbean
Barisal	40	36.40	10.08	32.84	61.83
Rajbari	75	61.87	25.19	66.88	15.40
Faridpur	25	67.28	22.17	80.78	24.84
Jhenaidah	94	78.73	10.21	79.44	97.70
Kustia	141	58.83	37.67	58.22	38.98
Nowabgan	50	69.93	56.87	11.38	10.08
J	425	63.46	28.15	57.87	45.72
All area					

Adoption of improved pulses varieties in terms of area coverage

Table 3 shows that 57.3% of the total cultivated land is under pulse production and about 52% of the total pulse area is devoted to improved pulse production. The percentage share of pulse land devoted to cultivating improved Blackgram, Lentil and Mungbean was found to be nearly equal in the study areas.

Table 3. Acreage under improved pulses varieties in the study areas

Pulse variety	Sample size	Total cultivated area (acre)	% area under pulse production	% area under improved pulse production
Blackgram	120	3.17	53.11	51.66
Lentil	120	3.37	51.61	51.46
Mungbean	125	2.86	64.49	52.08
All pulse	425	3.06	57.30	51.74

Adoption of different improved pulses varieties

The level of adoption of pulse variety mostly depended on the dissemination process used by LBMD pilot project of BARI in association with the DAE. The scientists of BARI have developed and disseminated about 26 improved pulse varieties to the farmers since 1991. It was found that BARI Mash 1, 2 and 3; BARI Lentil 4; and BARI Mung 4 and 5 were the most highly adopted varieties by the farmers in the study areas (Table 4).

Table 4. Adoption of improved pulses varieties by the sample farmers in the study areas

Pulse variety	Percent farmers responded		
	Blackgram	Lentil	Mungbean
BARI-1	26.7	-	-
BARI-2	30.8	0.8	6.4
BARI-3	25.8	2.5	9.6
BARI-4	0.8	96.7	37.6
BARI-5	15.8	-	42.4
BINA- 2	-	-	1.6
BINA-5	-	-	2.4
All variety	100	100	100

Level of adoption of improved crop management technologies

In order to determine the level of adoption of improved crop management technologies, the study classifies adopters into three categories. The categories were developed based on the mean scores of the farmers with respect to each technology. The adoption categories are furnished in Table 5. A higher score indicates a higher level of adoption of a technology while a lower score indicates a lower level of adoption of a technology.

The highest level of adoption was found in land plowing and in the time of seed sowing for all types of pulses. The time of seed sowing was highly adopted because farmers found it convenient to sow during the available range of time (Table 5). The use of TSP fertilizer was the only practice to receive a medium level of adoption. The study also found that farmers often do not follow recommendations for applying Urea and MP fertilizers. Farmers tended to either use fertilizers in excess or in very small quantities. Many farmers did not use any fertilizer causing the findings for fertilizer level of adoption to be very low. Low levels of adoption also occurred in sowing method and seed rate. Low levels of adoption in these practices occur because line sowing generally requires more labour and care. Scarcity of improved seed in the study areas might be another reason for these practices receiving low adoption scores.

Table 5 Level of adoption of improved crop management technologies for pulse production

Technology	Recommen-dation	Percent farmers responded			
		Blackgram	Lentil	Mungbean	Adoption level
1. No. of plowing					High
0-1	-	5.8	2.5	0.8	
2-3	Recommended	84.2	55.8	46.4	
3-4	Recommended	53.4	55.8	53.6	
5 & above	-	5.8	28.3	27.2	
2. No.of harrowing					Medium
1-3	-	88.9	71.7	66.4	
4-5	Recommended	8.6	17.5	23.2	
6 & above	-	2.5	10.8	10.4	
3. Sowing method					
Broadcast	-	100	92.5	72.0	Medium
Line	Recommended	-	7.5	28.0	Low
4. Sowing time					
4th week of July	-	5.0	-	-	
1st Aug -1st Sept.	Kharif-2	76.7	-	-	High
2nd - 4th September	-	18.3	-	-	
4th Jan. - 2nd Feb.	Late Rabi	-	-	46.6	High
2nd Feb.- 1st March	Kharif-1	-	-	43.2	
2nd - 4th March	-	-	-	10.2	
3rd October	Recommended	-	28.3	-	High
4th Oct- 1st Nov.	Recommended	-	50.0	-	
2nd November	Recommended	-	18.3	-	
3rd Nov-2nd Dec.	-	-	3.3	-	
5. Seed rate (kg/ha)	45-50 (Bla/mug) 35-40 (lentil)	23.42	32.80	31.93	Low
6. Fertilizer dose	Blackgram/Mungbean				
Urea	45 kg/ha	53.96 (52)	54.34 (64)	54.16 (86)	Low
TSP	100 kg/ha	69.19 (77)	83.09 (94)	73.59 (89)	Medium
MP	58 kg/ha	42.73 (64)	42.55 (76)	43.26 (80)	Low
Dung	-	52.24 (2)	186.02 (19)	121.32 (36)	-

Note: (i) Recommended fertilizer dose for Lentil: Urea- 45 kg/ha; TSP- 85 kg/ha; and MP- 35 kg/ha

(ii) Figures in the parentheses are fertilizer using farmers.

(iii) Adoption level was categorized for mean score ≥3 as high, ≥2 as medium, and ≥1 as low

Relationship between farmer's characteristics and adoption

The Pearson's Correlation Co-efficient (r-value) indicates that the adoption of improved pulse varieties was significantly related to the farmers' characteristics like age, literacy, training received, experience in farming, organizational participation, cosmopoliteness, innovativeness, level of extension contact, and awareness in seed collection. Adoption of improved pulse varieties were also significantly related with the influence of family members, neighbor and extension personnel in adopting new variety in the study areas (Table 6).

Table 6: Correlation between farmer's characteristics and their adoption of practices

Variables	r-value	Variables	r-value
1. Age (year)	0.133**	9. Innovativeness (Score)	0.356**
2. Literacy level (schooling year)	0.406**	10. Extension contact (Score)	0.586**
3. Experience in farming (year)	0.117*	11. Awareness in seed collection (score)	0.467**
4. Family member (No.)	0.073^{ns}	12. Influence of family member (Score)	0.418**
5. Time spend in farming (Hr/week)	-0.041^{ns}	13. Influence of neighbor (Score)	0.741**
6. Training on agriculture	0.268**	14. Farm size (ha)	0.057^{ns}
7. Organizational participation (Score)	0.160**	15. Family Income (Tk/year)	-0.003^{ns}
8. Cosmopolitans (Score)	0.527**		

Note: ** and * indicate significance at the 1% and 5% levels, respectively. ns = Not significant.

Probability of adoption of improved pulses variety

Improved pulse varieties were adopted in the study areas under the initiative of BARI and DAE collaborative project. Most adopters were provided training and other supports in terms of seed and fertilizers. Other adopter farmers mostly influenced by the demonstration effect of the project. The improved pulses varieties were likely to be adopted in the study areas by the influenced of three sets of variables; agro-climatic, socio-economic and informative.

It can be found that the agro-climatic variables had negative effect on the probability of improved pulses adoption. Improved pulses were cultivated not only on the medium high land with loamy soil, but also on high, medium-low, and low land with clay, sandy, and sandy-loam soils. Therefore, there were 6 to 7% probabilities of non-adoption of improved pulses due to agro-climatic factors. Among different socio-economic variables in the second group, two variables namely farmers' age and longer farming experience have significant probabilities on adoption of improved pulses in the study. On the contrary, adoption will not be dependent on farm size and awareness in seed collection. Information variables played an important role in the adoption of improved pulses at farm level. Adoption was significantly influenced by extension contact of DAE personnel, influence of family member, and influence of neighbouring farmer in the study areas. The probability of adoption of improve pulses will be the highest in extension contact followed by family influence (Table 7).

Table 7. Probit estimates for adopting improved pulse technology in selected pulse growing areas of Bangladesh

Variables	Coefficients	t-value
Constant	-1.6578***	-38.0409
Agro-climatic Variables		
Topography (Medium high =1, Otherwise 0)	-0.0628***	-3.8476
Soil type (Sandy loam =1, Otherwise 0)	-0.0706***	-4.8212
Socio-economic Variables		
Age of the respondent (year)	0.0011*	1.5848
Education (Year of schooling)	0.0005	0.2312
Training received on farming (No./lifetime)	-0.0006	-0.1455
Farm size (acre)	-0.0002***	-5.4900
Time spend in farming (hours/week)	0.0032***	14.5664
Organizational participation (Score)	0.0009	1.0181
Cosmopolites of the farmer (Score)	-0.0015	-0.3865
Involvement in innovative activities (Score)	0.0003	0.2751
Awareness in seed collection (Score)	-0.0201***	-2.9109
Information Variables		
Extension contact (Score)	0.0204***	2.7885
Influence of family members (Score)	0.0151**	2.0519
Influence of neighbouring farmers (Score)	0.0139**	1.8519

Note: The dependent variable was Adoption (1= adopters; 0 = otherwise)
***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

IV. FARMERS' ATTITUDES TOWARD PULSE PRODUCTION

Length of experience in pulse production

Farmers in the study area who adopted improved pulses varieties began cultivating indigenous pulses as many as 19 years ago. These adopters began cultivating improved pulses as recently as one year ago and as far back as seven years ago (Table 8). The range of cultivating indigenous pulses for non-adopters was 5 to 45 years. The average cultivation period of improved pulses for adopters was 3.15 years.

Table 8. Length of pulse cultivation by the pulse farmers

(Figures in year)

Types of farmers	Indigenous pulses			Improved pulses		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
A. Adopters						
Blackgram	3	60	19.13	1	5	2.65
Lentil	5	50	20.28	1	7	3.25
Mungbean	2	50	18.28	1	7	3.54
All types	2	60	19.22	1	7	3.15
B. Non-adopters						
Blackgram	5	35	16.17	-	-	-
Lentil	1	45	18.67	-	-	-
Mungbean	-	-	-	-	-	-
All types	5	45	17.42	-	-	-

Trend of improved pulses production

Figure 1 clearly indicates an increasing trend in the size of the area devoted to improved pulse production. The opposite scenario occurs when looking at the trend of area devoted to cultivating indigenous pulses (Fig. 2). As mentioned earlier, this increasing trend of production is attributed to the successful dissemination strategy developed by the LBMD pilot project of BARI in association with DAE.

Willingness to cultivate improved pulse varieties

The adopting farmers were asked to mention the possibility of expanding their cultivated area for improved pulse production. About 63% adopters indicated that they will increase pulse area with improved pulse production in the coming year (Table 9). Among all pulse growers, Mungbean farmers showed the highest level of interest in increasing their pulse area, followed by Blackgram and Lentil farmers. According to farmers, the average amount of land would be devoted to improved pulse production is 0.42 acre.

Table 9. Willingness to cultivate improved pulse variety in the next year

Farmers type	% adopters want to increase pulse area?		Amount of land (in acre) will be increased		
	Yes	No	Minimum	Maximum	Mean
Blackgram	62.5	37.5	0.10	1.84	0.42
Lentil	58.3	41.7	0.10	1.66	0.44
Mungbean	68.0	32.0	0.05	1.75	0.40
All types	63.0	37.0	0.05	1.84	0.42

The farmers who adopted improved pulse varieties mentioned various reasons for expanding their pulse areas for the next year. The most important reasons mentioned by farmers was because pulse is a profitable crop, in addition to pulse having low production cost, higher yield, improving soil health, and requiring less time and labour for its cultivation (Table 10).

Table 10. Reasons for expanding areas for growing improved pulses in the next year

Type of reasons	Number of respondents	% farmers responded
1. Profitable crop	214	58.6
2. Lower production cost	147	40.3
3. Higher yield	78	21.4
4. Improve soil health	73	20.0
5. Cultivation requires less time & labour	56	15.3
6. Nutritious/preferred by family members	46	12.6
7. Utilization of fallow land	13	3.6
8. Other reasons	27	7.4

Figure 1: Adoption of improved pulse varieties

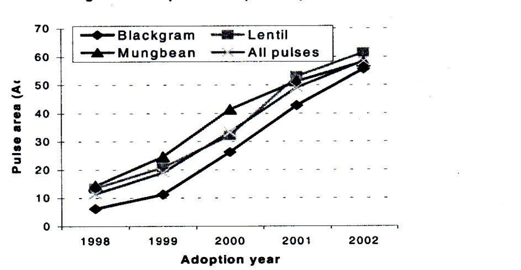
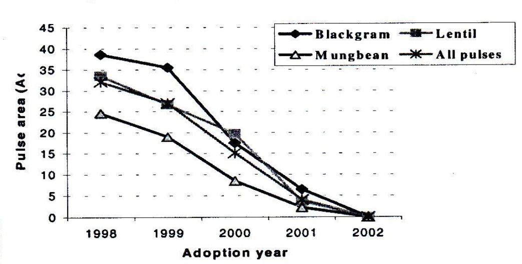


Figure 2: Adoption of indegenous variety of pulses



Some of the adopters (37% of the total adopters) also mentioned various reasons for not expanding their pulse areas for the next year. The most important reasons were lack of suitable land, the need to grow other crops, and the plants susceptibility to disease, insect-pest and the environment. A few adopters also mentioned lack of labour during crop harvesting, insect-pest infestation and emergence of excessive weeds in the pulse field as their constraints for not growing improved pulses (Table 11).

Table 11. Reasons for not expanding pulse area in the next year

Causes of not increasing	Number of respondents	% farmers responded
1. Lack of suitable land	76	20.8
2. Need to grow other crops	57	15.6
3. Susceptible to environment	49	13.4
4. Lack of labour	11	3.0
5. Insect-pest infestation	9	2.5
6. Emergence of excessive weeds	6	1.6
7. Lack of operating capital	5	1.4
8. Others	13	3.6

Causes of non-adoption of improved pulse technologies

The non-adopters in the study areas were asked to mention reasons for their non-adoption the improved pulses varieties. In this respect, most farmers (75% of the non-adopters) opined that the improved pulse technology was unknown to them. Many farmers were found to be aware of the improved pulse varieties, but could not adopt those varieties for reasons such as, lack of seed availability, low market demand, and low price (Table 12).

Table 12. Causes of non-adoption of improved pulse technologies in the study areas

Causes of non-adoption	Types of non-adopters		
	Blackgram	Lentil	All type
1. Improved pulse technology is unknown	83.4	66.7	75.0
2. Lack of improved variety seed	93.4	90.0	91.7
3. Market demand is less then the local variety	36.7	46.7	41.7
4. Low price than the local variety	26.7	53.3	40.0

Facilities demanded for higher adoption

Both adopter and non-adopter mentioned that various facilities need to be created for them to expand of their pulse areas in the future. All of their demanded needs are displayed in Table 13. The important resource improvements raised by pulse growers were availability of improved pulse seed, introduction of disease resistant variety, provision of training on pulse production, and assurance of quality fertilizer and insecticides.

Table 13. Facilities demanded by pulse growers for expanding their pulse area for the next year

Types of facilities	Types of farmers			
	Blackgram	Lentil	Mungbean	All type
A. Adopter	*n = 120*	*n = 120*	*n = 125*	*n = 365*
1. Making improved seed available	65.8	55.8	59.2	60.3
2. Introducing disease tolerant variety	17.5	21.7	28.0	22.5
3. Making credit facility easy	20.8	18.3	18.4	19.2
4. Providing training on pulse production	19.2	10.0	24.8	18.1
5. Ensuring fertilizer/insecticide quality	10.8	11.7	21.6	14.8
6. Ensuring extension services	13.3	8.3	12.8	11.5
7. Ensuring higher price for their produce	5.8	8.3	4.0	6.0
8. Other facilities	15.0	15.0	17.6	13.1
B. Non-adopter	*n = 30*	*n = 30*		*n = 60*
1. Making improved seed available	76.7	83.3	-	80.0
2. Introducing disease tolerant variety	13.3	40.0	-	26.7
3. Making credit facility easy	33.3	16.7	-	25.0
4. Providing training on pulse production	13.3	30.0	-	21.7
5. Ensuring extension services	20.0	16.7	-	18.3
6. Ensuring fertilizer/insecticide quality	10.0	10.0	-	10.0
7. Other facilities	23.3	16.7	-	11.7

Problems encountered during pulse production

The pulse farmers in the study areas mentioned numerous problems and constraints regarding pulse production which were ranked according to the importance of problem and are presented in Table 14.

Table 14. Problems encountered by adopter and non-adopters of improved pulses

Types of problems	Types of farmers			
	Blackgram	Lentil	Mungbean	All type
A. Adopter	*n = 120*	*n = 120*	*n = 125*	*n = 365*
1. Susceptible to environment	43.3	50.8	28.0	40.5
2. Insect-pest infestation	37.5	40.0	33.6	37.0
3. Heavy rainfall	29.2	35.0	31.2	31.8
4. Adulation of seed	7.5	8.3	5.6	7.1
5. Vegetative growth of crop	4.2	8.3	9.6	7.4
6. Lack of daily labourers	1.7	4.2	12.0	6.0
7. Lack of quality fertilizer/ insecticides	4.2	5.8	6.4	5.5
8. Other problems	8.3	13.3	19.2	13.7

Table 14. Contd.

B. Non-adopter	*n = 30*	*n = 30*	*n = 0*	*n = 60*
1. Lower yield	83.3	73.3	-	78.3
2. Insect-pest infestation	66.7	70.0	-	68.3
3. Heavy rainfall	46.7	43.3	-	45.0
4. Susceptible to environment	40.0	46.7	-	43.3
5. Other problems	20.0	16.7	-	18.3

Pulse crops are highly susceptible to disease, insect-pest and the environment. For this reason, about 41% of the adopters and more than 43% of the non-adopters mentioned environmental susceptibility as a crucial problem. Lentil farmers where found to be the most likely to face the effects of this problem. Insect-pest infestation was another constraint faced by 37% of the adopters and 68.3% of the non-adopters in the study areas. Heavy rainfall or water logging was also found to be very harmful to the pulse production that was encountered by both adopters and non-adopters. The other important problems faced by adopters were low seed quality, vegetative growth of crop, and low quality fertilizers and insecticides. On the other side, the most crucial problem of non-adopters was low yield.

V. CONCLUSION AND POLICY IMPLICATIONS

The status of adoption of improved pulses varieties is very encouraging since a large number of pulse farmers adopt improved pulses, and a plenty of area is devoted to improved pulse production. The highly adopted varieties are BARI Mash 1, 2 & 3; BARI Lentil 4 and BARI Mung 4 & 5. The adopters have followed the recommended number of plowing and time of sowing, but did not adhere to the recommended sowing method and fertilizer doses. Adoption of improved pulse varieties is found to be significantly related with various farmers' characteristics and the influence of family member, neighbour and DAE personnel. The probability of higher adoption is significantly depended on strong extension contact, family encouragement and field demonstration of improved pulses. Farmers' attitude toward improved pulse production is very positive because most adopters wanted to increase their pulse area for improved pulse production in the next year. The increasing trend of improved pulse area over time makes their statement authentic. Although pulse is a profitable crop, due to various setbacks and socio-economic constraints many farmers have showed negative attitude toward pulse production. The non-adopting farmers have mostly claimed that they are not familiar with the new variety and its recommended technology packages. Moreover, the lack of seed availability is also found to be a barrier to the adoption of improved pulse technologies.

Based on study findings and field experience, the following recommendations are put forward for wider adoption of pulse varieties.

- The existing LBMD-DAE pilot project should be extended to five years to cover more areas under improved pulse production.

- Seeds of improved pulse varieties should be made locally available to the farmers. For this reason the government should encourage private seed companies to come foreword for improved pulse seed production.
- Collaboration between private companies and government organizations may help increase the availability of improved pulse seeds to the farmers
- Motivational campaign through providing training, booklets and other supporting materials to farmers should be continued.
- Existing extension services and field demonstration of pulses should be strengthen for higher diffusion of improved pulses varieties.
- More intensive research should be undertaken by research institutes and other organizations to develop disease and insect-pest resistant pulse varieties in the near future.
- Ensure higher prices for improved pulses, especially the price of lentil.

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APPENDIX

Table 1. Area and production for different pulses; 10 years average;1991-2000

Pulse type	Area (ha)	Production (MT)	Yield (ton/ha)
Kheshari	233299 (35)	178662 (36)	0.766
Lentil	203223 (30)	160540 (32)	0.790
Chick pea	73655 (11)	53372 (11)	0.725
Black gram	59050 (9)	44813 (9)	0.759
Mungbean	55044 (8)	32731 (7)	0.595
Motor	18370 (3)	13873 (3)	0.755
Other pulses	26890 (4)	14865 (3)	0.553

Figures in the parentheses are percentages of total

Source: BBS, 2000