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Adoption and relative profitability of groundnut cultivation in Jamalpur and Sherpur district of Bangladesh

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ABSTRACT

The study assessed the technological adoption and comparative profitability of BARI Chinabadam 8 and Dhaka 1 cultivation at farm level in some selected areas of Jamalpur and Sherpur districts. The total sample size was 120 farmers, 60 for BARI Chinabadam 8 and 60 for Dhaka 1. Descriptive statistics with Cobb-Douglas production function was applied for analyzing the data. It was found from the study that BARI Chinabadam 8 and Dhaka 1 were highly profitable from the view point of individual farmers. BARI Chinabadam 8 cultivation was more profitable than Dhaka 1. The study indicated that per hectare gross return was significantly influenced by the human labour, seed, insecticide and irrigation. These factors were directly responsible for influencing per hectare gross return of both varieties. The adoption level of seed rate and weeding were low, whereas seed sowing time was high and irrigation & pest control were medium. The lower adoption was mostly observed in fertilizer application. Farmers growing both varieties of groundnut were facing some problems and constraints in cultivating the groundnut in char areas of Jamalpur and Sherpur districts. These problems included lack of quality seeds, irrigation facilities and shortage of financial capital. The government, the researcher, different agencies, and NGOs should coordinately give more emphasis to increase the production of groundnut in Bangladesh.

Introduction

Groundnut (*Arachis hypogaea*) is an important crop in the char land of Bangladesh. Groundnut popularly known as peanut is an important food legume. It is an excellent source of vegetable oil (48-50%), protein (22-29%), carbohydrate (20%) and vitamin A and E. It is used as whole seed or as food. It can help in reducing the shortage of edible oil, food and fodder requirement of the country. Groundnut is a delicious food for confectionary purpose and its industrial use is increasing day by day. Its economic importance is also very high. The price of groundnut is 4-5 times higher than rice and 2-3 times higher than wheat.

Groundnut has been cultivating in the char area where soil type is mostly sandy to sandy loam. Groundnut can be grown in less fertile soil with minimum care. Its production cost is also low. It has the potentiality to fix atmospheric N_2 in the soil and help to maintain soil fertility. It is also draught tolerance crop and requires less amount of water. Sandy soil is suitable to cultivate this crop. The river erosion poor peoples have grown it. Groundnut farmers can purchase 4-5 kg of rice by selling one kg of groundnut. Bangladesh Agricultural Research Institute has released nine varieties of groundnut along with their management technologies. Although these technologies have been found to be suitable for farmers, for various unknown reasons a large number of farmers are still reluctant to adopt these varieties that need to be evaluated properly. Since many farmers have not adopted these technologies the level of groundnut production remains far below its potential. The groundnut production largely depends on its economic profitability. Therefore, it is essential to know the economic profitability and adoption of groundnut production at farm level. In view of this facts the present study was undertaken to make a comparative profitability of BARI Chinabadam 8 and Dhaka 1, determine the factors affecting economic return, to know the adoption of management technologies at the farm level and also to identify the problems and constraints and also make some recommendations for higher production

Materials and Methods

A multi-stage sampling technique was followed in this study to select study areas and sample farmers. In the first stage of sampling, two districts namely Jamalpur and Sherpur were selected. In the second stage, one upazila was selected from each district for sample survey. In the third stage, a total of 120 farmers taking 60 farmers from each district were

randomly selected for interview. Data were collected from the respondents during the period March to April 2015. Descriptive statistics with Cobb-Douglas production function was applied for analyzing the primary data. Adoption level was categorized into three: (70-100%) as high, (50-69) as medium and <50% as low level adoption (Miah, 2013). The collected data was coded, edited, summarized, tabulated and analyzed to fulfill the objectives of the study. The profitability was estimated using gross margin, net return and benefit cost ratio.

Analytical model

Gross return (GR) was calculated by multiplying the total volume of output by the average price in the harvesting period. The following equation was used to estimate GR.

$$GR_i = \sum_{i=1}^{n} Q_i P_i$$

Where,

GR_i = Gross return from i^{th} product (Tk/ha)
Q_i = Quantity of the i^{th} product (kg)
P_i = Average price of the i^{th} product (Tk)
i = 1, 2, 3,……, n

That is,

GM = TR – VC

Where,

GM = Gross margin
TR = Total return
VC = Variable cost

Net return was calculated by deducting all costs (variable and fixed) from gross return. To determine the net return the following equation was used in the present study:

$$\prod = P_Y Y - \sum_{i=1}^{n} (P_{xi} X_i) - TFC$$

Where,

$\prod$ = Net return (Tk/ha)
P_y = Per unit price of the product (Tk/kg)
Y = Quantity of the production per hectare (kg)
P_{xi} = Per unit price of i^{th} inputs (Tk)
X_i = Quantity of the i^{th} inputs per hectare (kg)
TFC = Total fixed cost (Tk)
i = 1, 2, 3, ……, n (number of inputs)

$\prod$ = Gross return – (Variable cost + Fixed cost)

Here,

$\prod$ = Profit per hectare

Gross return = Total production × per unit price

The BCR was estimated as a ratio of gross returns and gross costs. The formula of calculating BCR (undiscounted) is shown below:

$$\text{Benefit cost ratio} = \frac{\text{Gross benefit}}{\text{Gross cost}}$$

The following Cobb-Douglas production function was used to estimate the parameters. The functional form of the Cobb-Douglas multiple regression equation was as follows:

$Y = AX_1^{b1}X_2^{b2}$ .....$X_n^{bn}e^{ui}$

The production function was converted to logarithmic form so that it could be solved by least square method i.e.

Log Y = Log a+b_1 log X_1 + ... + b_n Log X_n + e^{ui}

The empirical production function was the following:

Log Y = Log a + b_1 LogX_1 + b_2 LogX_2 + b_3 logX_3+ b_4 LogX_4 + b_5 LogX_5 + Ui.

Where, Y = Total Return (Tk/ha)
X_1= Cost of human labour (Tk/ha)
X_2 = Cost of land preparation (Tk/ha)
X_3 = Cost of irrigation(Tk/ha)
X_4 = Cost of seed (Tk/ha)
X_5 = Cost of insecticide (Tk/ha)
X_6 = Cost of urea (Tk/ha)
X_7 = Cost of TSP (Tk/ha)
X_8= Cost of MoP (Tk/ha)
a = constant value
b_1, b_2..... b_5 = Co-efficients of the respective variables to be estimated.
U_i = Error term.

Results and Discussion

Socioeconomic profile of the respondents

The socio-economic parameters of groundnut growers were varied in the studied area (Table 1). Age is an important factor that influences farmer's production decision, efficiency and adoption of improved technologies. In the highest percent of BARI Chinabadam 8 farmers were in the age group of 30-39 years and the lowest percent of farmers were under the age group of 60 and above years. The highest percent of Dhaka 1 farmers were in the age group of 40-49 years and the lowest percent of farmers were under the age group of 50-59 years.

The study reveals that 35 percent BARI Chinabadam 8 farmers were illiterate, 47 percent had primary level education, 13 percent S.S.C level, 2 percent H.S.C level and 3 percent graduate and above. On the other hand 36 percent Dhaka 1 farmers were illiterate, 35 percent had primary level education, 25 percent S.S.C level and 2 percent H.S.C level and 2 percent graduate and above. So, the literacy rate of the BARI Chinabadam 8 and Dhaka 1 respondents were 65 % and 64% respectively whereas the national literacy rate is 58% (BBS, 2010). BARI Chinabadam 8 farmers (4.95 persons) belongs to lower family size than Dhaka 1 (5.50 persons) whereas the national average family size was 4.90 per farm (BBS, 2010).

Table 1. Socio-economic profile of the BARI Chinabadam 8 and Dhaka 1 farmers in the Jamalpur and Sherpur district of Bangladesh

Items	BARI Chinabadam 8			Dhaka 1		
	Jamalpur	Sherpur	All areas	Jamalpur	Sherpur	All areas
1. Age (% of farmers)						
20-29 years	27	7	17	17	14	17
30-39 years	23	33	28	20	23	21
40-49 years	13	23	18	27	40	34
50 -59 years	17	23	20	17	13	14
60 and above	20	13	16	20	10	15
2. Literacy level (%)						
Illiterate	43	27	35	43	30	36
Primary (Class I-V)	44	50	47	30	40	35
Secondary (Class VI-X)	5	20	13	23	27	25
Higher Secondary(HSC)	4	0	2	0	3	2
Degree and above	4	3	3	4	0	2
3. Length of experience						
Up to 3 years	77	84	81	13	0	7
4 and above	23	16	19	87	100	93
4. Family size (person)	4.8	5.1	4.95	5.2	5.7	5.5
5. Farm size (%)						
Small (0-1.00 ha)	73	57	65	60	57	58
Medium (1.01-3.00 ha)	27	40	33.5	40	40	40
Large (3.00 and above)	0	3	1.5	0	3	2

Surce: Field Survey, 2015

Table 2. Level of input used per hectare by the farmers for cultivating BARI Chinabadam 8 and Dhaka 1 in the Jamalpur and Sherpur district of Bangladesh.

Input Items	BARI Chinabadam 8					Dhaka 1				
	Jamalpur		Sherpur		All areas	Jamalpur		Sherpur		All areas
	Male	Female	Male	Female	Average	Male	Female	Male	Female	Average
Human labour (man days)	100	50	108	55	157	86	66	80	55	144
Family labour	74	34	69	40	109	66	36	52	36	95
Hired labour	26	16	38	15	48	20	30	28	19	49
Fertilizers (kg/ha)										
Urea	142		118		130	122		59		91
TSP	38		58		48	30		37		34
MP	19		32		26	20		13		17
Gypsum	35		25		30	12		0		6
Boron	1		1		1	0		0		0

Source: Field Survey, 2015

Table 3. Per hectare cost of BARI Chinabadam 8 and Dhaka 1 cultivation in the Jamalpur and Sherpur district of Bangladesh.

Cost Items	BARI Chinabadam 8			Dhaka 1		
	Jamalpur	Sherpur	All	Jamalpur	Sherpur	All
A. Variable cost (TK)	30917	27971	29444	26551	26007	26579
Hired labour	11200	11523	11362	10147	11267	10707
Land preparation	3833	3608	3721	3757	3705	3731
Seed	5894	5526	5710	7832	7583	7708
Fertilizer	5007	4010	4509	3075	2090	2583
Urea	2274	1890	2082	1952	941	1447
TSP	1873	1280	2027	650	820	735
MP	278	478	378	306	189	248
Gypsum	354	249	302	125	0	63
Boron	228	113	171	42	140	91
Irrigation	2102	1412	1757	137	280	209
Insecticide	2127	1210	1667	956	446	701
Interest on operating capital @ 12% for 4 months	754	682	718	647	636	642
B. Fixed cost (TK)	29958	26080	28019	29023	25025	27024
Land use cost	4280	4000	4140	4280	4000	4140
Family labour	25678	22080	23879	24743	21025	22884
Total cost/ Gross cost (A+B)	60875	54051	57463	55574	51032	53303

Level of input used

It was found that on an average BARI Chinabadam 8 farmers used 157 man-days whereas Dhaka 1 farmers used 144 man-days/ha of human labour (Table 2). The farmers of BARI Chinabadam 8 used 130 kg urea per hectare whereas farmers of Dhaka 1 used 91 kg urea per hectare. Farmers used higher amount of urea in BARI Chinabadam 8 than Dhaka 1 cultivation. BARI chinabadam 8 farmers used 58 kg TSP per hectare and Dhaka 1 farmers used 34 kg per hectare. Land preparation cost was almost similar for BARI Chinabadam 8 and Dhaka 1 cultivation.

Cost of cultivation

For calculating the cost of cultivation, all variable costs like human labour, land preparation, seed, fertilizers, irrigation, insecticide and interest on operating capital were calculated per hectare basis (Table 3). The fixed cost included cost of land use and family labour. The cost of land use was calculated on the basis of lease value of land. The total cost included variable and fixed costs. It is found that, human labour cost is the major cost item in groundnut production. It is estimated at Tk. 35241 and Tk. 33591 per hectare for BARI Chinabadam 8 and Dhaka 1 respectively. The cost of human labour is found higher in BARI Chinabadam 8 cultivation than Dhaka 1. Cost of seed and fertilizers was also higher in BARI Chinabadam 8 cultivation than Dhaka 1. Total cost of groundnut production is found higher for BARI Chinabadam 8 (Tk. 57463/ha) compared to Dhaka 1 (Tk. 53303/ha).

Profitability of groundnut cultivation

In this study, profit included returns from the yield minus all types of costs involved in the production of groundnut cultivation. Study found that the average yield of BARI Chinabadam 8 was 1966 kg/ha while it was 1458 kg/ha for Dhaka 1 (Fig. 1). Total return was much higher for BARI Chinabadam 8 than Dhaka 1 while net return received by the farmers was also higher for BARI Chinabadam 8 (Tk. 57140/ha) compared to Dhaka 1 (Fig. 2). Benefit cost ratio is 1.98 and 1.36 for BARI Chinabadam 8 and Dhaka 1, respectively (Fig. 3). It implies that one taka investment in groundnut production generated Tk. 1.98 and Tk. 1.36 for BARI Chinabadam 8 and Dhaka 1, respectively.

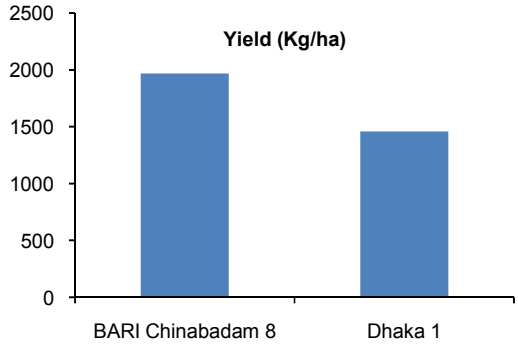

Fig. 1. Average yield of two groundnut varieties in the Jamalpur and Sherpur district of Bangladesh

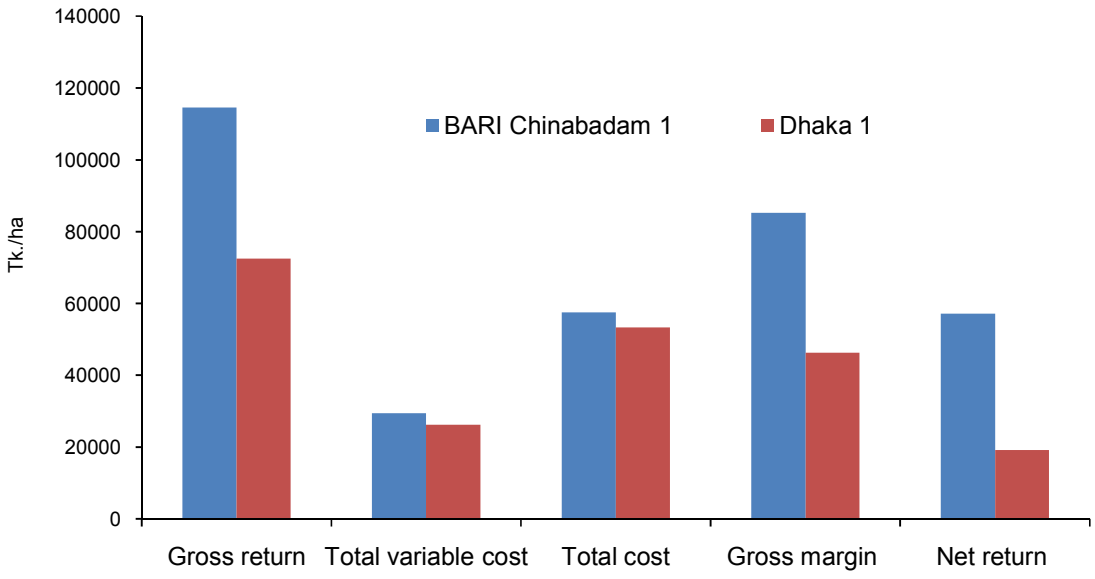

Fig. 2. Profitability of groundnut cultivation in the Jamalpur and Sherpur areas of Bangladesh

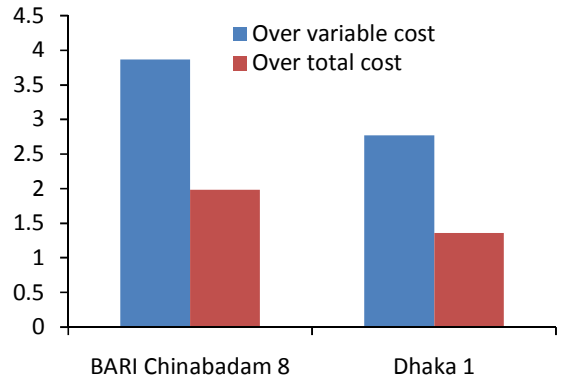

Fig. 3. Benefit cost ratios of groundnut cultivation in the Jamalpur and Sherpur areas of Bangladesh

Table 4. Estimated values of coefficients and related statistics of Cobb-Douglus production function.

Items	Coefficient	t- value	P- value
Intercept	11.38	10.20	0.0000
Human labour (x_1)	0.22***	2.74	0.0072
Land preparation cost (x_2)	-0.02	-0.97	0.3329
Irrigation (x_3)	0.02**	2.14	0.0345
Seed (x_4)	-0.26**	-2.44	0.0163
Insecticide (x_5)	0.03***	4.48	0.0000
Urea(x_6)	0.00	0.17	0.8658
TSP (x_7)	0.02	1.65	0.1011
MoP (x_8)	0.02	1.52	0.1321
R^2	0.59		
F- value	9.57		

Note: ***, ** and * indicate significant at 1%, 5% and 10% level

Input Output Relationship

The estimated value of the co-efficient of Cobb-Douglas production function and it is evident that the entire variable had significant effect on BARI Chinabadam 8 and Dhaka 1 production (Table 4). Co- efficient of irrigation (X_2), insecticide (X_4), and human labour (X_8) are positive and significant at 5% and 1% level respectively while co-efficients of seed (X_3) is negative and significant at 5% level. It indicates that the production of groundnut will decrease with increased use of seed keeping other factors constant. R^2 is found 0.59 implying 59% of the total variation in groundnut production can be explained by the variables included in the model.

Technology used in groundnut cultivation

The groundnut farmers in the study areas ploughed their lands with the help of power tiller (Table 5). On an average 8.33% farmers ploughed their land 4-5 times. Ploughing of land secured low level adoption in groundnut cultivation. Groundnut sowing started from the mid week of Kartik and continued up to first week of Agrahon. The highest percentage (72.50%) of farmers had sown seeds during the last week of Kartik. Therefore, the time of seed sowing secured higher level of adoption. The recommended seed rate was 95 to 110 kg/ha. 23.33% farmers used recommended seed rate. Seed rate secured low level of adoption. Irrigation secured medium adoption level. 92.50% farmers did not perform weeding. 55% farmers use xpesticide in groundnut cultivation. So, pesticide control secured medium level of adoption.

It is depicted that most of the sample farmers did not follow recommended fertilizer dose (Table 6). They tended to either use fertilizer in excess or in very small quantities. Sometimes they do not use any fertilizers that are recommended for cultivation. In groundnut cultivation, majority of the respondent did not apply TSP, boron and gypsum. Again most of them applied urea fertilizer in excess quantity and MoP fertilizer in lower quantity compared to their recommended doses. The lower adoption was mostly observed in fertilizer application.

Table 5. Percent of adoption of crop management technologies used in groundnut cultivation in the Jamalpur and Sherpur areas of Bangladesh

Technology	Jamalpur (n=60)	Sherpur (n=60)	All areas	Adoption level
Plowing and laddering (No)				
Recommended (4-5)	6.66(4)	10.00(6)	8.33(5)	Low
Below recommendation (2-3)	93.33(56)	90.00(54)	91.67(55)	
Above recommendation (>5)	--	--	--	
Seed sowing time				
Kartik (Recommended)	73.33(44)	71.67(43)	72.50(44)	High
After recommendation	26.66(16)	11.67(7)	19.17(12)	
Seed rate (kg/ha)				
Recommended (95-110)	23.33(14)	23.33(14)	23.33(14)	low
Below recommendation (<95)	6.67(4)	15.00(9)	10.84(7)	
Above recommendation (<110)	70.00(42)	61.67(37)	65.84(40)	
Irrigation provide				
Not provided	45.00(27)	63.33(38)	54.17(33)	Medium
Provided	55.00(33)	36.67(22)	45.84(28)	
Weeding				
Recommended (2 times)	8.33(5)	3.33(2)	5.83(4)	Low
Below	88.33(53)	96.66(58)	92.50(56)	
Above	3.33(2)	--	1.67(1)	
Pest control				
Do not use pesticides	28.33(17)	61.67(37)	45.00(27)	
Used pesticides	71.67(43)	38.33(23)	55(33)	Medium

Note: Adoption Level: 70-100% as high; 50-69% as medium; and <50% as low (Miah, 2008); Source: Field Survey, 2015

Table 6. Percent of farmers used fertilizer in groundnut cultivation in the Jamalpur and Sherpur areas of Bangladesh.

Technology	Jamalpur (n=60)	Sherpur (n=60)	All areas	Adoption level
Urea (kg/ha)				
Recommended (20-30)	--	--	--	---
Below recommendation	--	--		
Above recommendation	100(100)	100(100)	100(100)	
TSP (kg/ha)				
Recommended(150-170)	8.33(5)	3.33(2)	5.83(4)	Low
Below recommendation	91.67(55)	91.67(55)	91.67(55)	
Above recommendation	--	5.00(3)	2.50(2)	
MoP (kg/ha)				
Recommended (80-90)	13.33(8)	8.33(5)	10.83(7)	Low
Below recommendation	83.33(50)	85.00(51)	84.17(51)	
Above recommendation	3.33(2)	6.67(4)	5.0(3)	
Gypsum (kg/ha)				
Recommended (160-180)	3.33(2)	3.33(2)	3.33(2)	Low
Below recommendation	91.67(55)	96.67(58)	94.17(57)	
Above recommendation	5.00(3)	--	2.50(2)	
Boron				
Applied	10.00(6)	6.67(4)	8.34(5)	Low
Not applied	90.00(54)	93.33(56)	91.67(55)	

Note: Adoption Level: 70-100% as high; 50-69% as medium; and <50% as low (Miah, 2008); Source: Field Survey, 2015

Problems of groundnut cultivation

Farmers in the study areas faced some problems during groundnut cultivation (Table 7). In general, 92% and 89% farmers claimed that the lack of quality seed and lack of irrigation facilities were their major problems in groundnut cultivation. The lack of capital also mentioned as problem (87%) for groundnut cultivation in the study areas. In the study areas, most of the farmers were not trained about the technology of cultivation. That's why lack of training facilities as one of the important problem of the farmers. Attack of different insect pests and diseases was another problem of groundnut production. Farmers also opined that groundnut damaged by unsuitable weather, birds and rats.

Table 7. Problems of groundnut cultivation in the Jamalpur and Sherpur areas of Bangladesh.

Problems	% Responded		
	Jamalpur	Sherpur	All areas
Lack of quality seed	90	93	92
Lack of irrigation facility	86	91	89
Lack of capital	85	88	87
Unsuitable weather	70	83	77
Lack of scientific knowledge about modern cultivation	76	71	74
Incidence of insect	28	45	37
Infestation of diseases	35	38	37
Damage by birds and rats	26	27	27

Table 8. Facilities needed for groundnut cultivation in the Jamalpur and Sherpur areas of Bangladesh.

Type of Facility	% Responded		
	Jamalpur	Sherpur	All area
Availability of HYV groundnut seed	78	62	70
Timely supply and lower price of seed and fertilizer	85	77	81
Credit facility	91	95	93
Training on groundnut production	88	81	85
Others	42	37	40

Facilities Demanded for Groundnut Cultivation

The sample farmers mentioned some facilities that need to be created for them to expand groundnut areas in the near future (Table 8). The important resource improvement raised by groundnut growers were availability of HYV groundnut seed, timely supply and lower price of seeds and fertilizers, training on groundnut cultivation and the assurance of credit facility.

Conclusion and Recommendations

This study assessed the extent of adoption and the profitability of BARI Chinabadam 8 and Dhaka 1 cultivation at farm level. Among the farmers the level of technology employed in terms of Agronomic practices are much encouraging but discouraging in case of input use. The adoption level of seed rate and weeding were low, whereas seed sowing time was high and irrigation & pest control were medium. The lower adoption was mostly observed in fertilizer application. The average yield of BARI Chinabadam 8 is higher than Dhaka 1. BARI Chinabadam 8 cultivation at farm level is found to be profitable.

The farmers who cultivate BARI Chinabadam 8 receive higher net profit over Dhaka 1 variety. The intensity of extension contact or visit between extension personnel and farmers should be increased for getting knowledge and information regarding production technology. Regular training programme and other technologies should be organized for farmers, extension workers and private seed companies for efficient use of inputs and production technologies at farm level. The seed of BARI chinnabadam 8 should be made locally available to the farmers. So, government should encourage BADC and private seed companies to produce seed and supply those seeds to the farmers at reasonable price.

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