Farm Economy *ISSN: 2789-3502*
The Journal of the Bangladesh Agricultural Economists Association
June 2022, Volume XVII, Page: 91-102

DETERMINANTS, CHALLENGES AND OPPORTUNITIES OF PULSES CROP IN SOUTHERN CHAR LAND AREAS OF BANGLADESH

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Abstract

Assessing the determinants, challenges and opportunities of pulses crops in southern char land areas like -Madaripur, Shariatpur and Barishal was made through an extensive field survey during 2018-2019. The study showed that education, family members, farm size, experience, and training are the significant determinants of willingness to cultivate more pulses crop. The study revealed that pulses production is becoming challenging due to losses of agricultural char land, adverse climatic condition, lack of technological knowledge, attack of insect and diseases, lack of quality seeds, problems regarding marketing of pulses crop. But still there are lots of opportunities to grow more pulses with the fulfillment of the following criteria like proper utilization of fallow char land, use of flood or salt tolerant varieties, use of quality seed, adoption of new technology, and ensuring fair price of pulses crops.

Keywords: Determinants, Challenges, Opportunities, Pulses, Southern Char Land.

1. Introduction

Pulses are important food crops in Bangladesh. Being rich in proteins, vitamins, and minerals, pulses are an important part of the diet of South Asian people (Mandal *et al.*, 2021). Growth duration, photo-thermal response, and response to low input make pulse crops the best fit for the rice-based cropping system in Bangladesh. About a dozen of pulse crops are grown in Bangladesh of which lentil, grass pea, mungbean, cowpea, chickpea, and black gram are the major ones (Depenbusc *et al.,* 2021). Pulses are grown almost throughout the country and their cultivation is mainly concentrated in the Gangetic floodplain. However, the productivity of these crops, in general, is much lower compared to yields obtained in many other pulse growing countries in the world due to various biotic, abiotic, and socio-economic factors (Farnworth *et al.,* 2020). In Bangladesh, 80 % of pulses produce during the Rabi season along with 16 % in Kharif and 4 % in late rabi. In the case of pulses production, grass pea occupied the highest percentage of the land area followed by lentil 24%, mungbean (23%), black gram (7%), cowpea (7%), chickpea (1%), and field Pea (1%) (AIS, DAE, 2014-15). In Bangladesh

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daily requirement for pulses is about 45g/day/person whereas consumption is only 14g/day/person. The annual demand for pulses crop is about 25 lakh metric tons against the annual production of 8.24 lakh metric tons which shows an annual deficit of around 16 lakh metric tons (AIS, DAE, 2014-15). With the increasing population, Bangladesh is trying to use all types of unused land for agriculture. Char land is players a very important role in the agriculture sector. Char is a tract of land surrounded by the waters of an ocean, sea, lake, or stream; it usually means, any accretion in a river course or estuary. It includes all types of bars including both lateral (point-bars) and medial (braid-bars). In the dynamics of erosion and accretion in the rivers of Bangladesh, the sand bars emerging as islands within the river channel (island chars) or as attached land to the riverbanks (attached chars), often create new opportunities to establish settlements and pursue agricultural activities on them. There is a little distinction between island chars, which are surrounded by water year-round, and attached chars, which are connected to the mainland under normal flow. Once vegetated such lands are commonly called chars in Bangladesh. It is estimated that in 1993 the total area covered by chars in Bangladesh was 1,722 sq km. Bangladesh Bureau of Statistics (BBS) report of 1997 suggests that in the lower reaches, where land is more fertile, cropping intensity in the chars appears to be between 150 and 185, which is quite similar to the average intensity of 165 for the entire country. However, the island and attached chars appear to be less productive than adjacent mainland areas. The major reasons for this are the relatively less favorable soil conditions in some of the chars, uncertainties caused by erosion, and frequent floods. Although both river water and groundwater are abundantly available in chars, irrigated crops are scarce in many of the chars except for the ones within the upper Meghna river. Pulses crop in char land has some problem and as well as lots of opportunities. So the study is undertaken to identify the determinants, challenges and opportunities of pulses crop on char land and make some policy recommendation on the basis of the study.

2. Materials and Methods

The study was conducted in three southern districts namely Madaripur, Shariatpur, and Barishal from October, 2018 to May, 2019. Zanjira and Bhedarganj upazila from Shariatpur, Madaripur sadar and Shibchar upazila from Madaripur district and Babuganj and Barishal sadar from Barishal district were selected for the study. A total of 150 farmers taking 50 from each district were selected through simple random sampling. Necessary information was collected through the survey method with the help of a pre-tested interview schedule by field investigators in collaboration with DAE personnel under the direct supervision of the researchers. Collected data were summarized, analyzed, and tabulated. Statistical tools like average, percentage and ratio, and logit model were used in presenting the results.

Logit model for the determination of pulses crop production

The logit regression model was used to find out the determinants of the willingness of the farmers to cultivate pulses crops in the future time. The logit regression model is one of the binary choice regression models in which a dichotomous regression variable is considered as the dependent variable. The logit model was chosen for this study because it guarantees that the estimated probability lies between 0-1 and they are not linearly related to the explanatory variables. The logit model is based on the cumulative logistic distribution function expressed below

P_i= E(Y= $\frac{1}{X_i}$) = $\alpha + \beta_i$ ….. ……. (1)

P_i= E(Y= $\frac{1}{X_i}$) = $\frac{1}{1+e^{-z}}$ ….. ……. (2)

For ease of exposition

$Z_i = \alpha + \beta_1 X_1 + \beta_2$ …… X_n

Where Pi = Probability of willingness to cultivate pulses crops

The log of odd ratio or logit is

Logit Li = (Probability of not willingness to cultivate pulses crops / Probability not to cultivate) = Zi+Ui

In order to obtain the Zi there need a dichotomous response variable Yi (dependent variable). If the dependent variable is 1 then the farmer is willing to cultivate pulses crop and when it is zero then the farmers will not cultivate.

Seven (7) explanatory variables were included in the model to find out the determinants of willingness to cultivate pulses crops. The independent variables are specified as follows:

X_1 = Age

X_2 = Education

X_3 = Family members

X_4 = Farm sixe

X_5 = Experience

X_6= Alternative income sources

X_7= Training

U = Error term

According to Gujrati (1995) the marginal probabilities of factors determining the willingness and the elasticity of probability of willingness were estimated based on expressions derived from the logit model is

$\frac{dp}{dx} = \beta_i[P\ (1 - p_i)]$

$E_p = \beta_i \overline{X_\iota}$ (1-P_i)

Where,

β_i = Estimated logit regression coefficient with respect to the ith factor

Pi = Estimated probability of willingness to cultivate

$\overline{X}_i$ = Arithmetic mean

E_p = Elasticity of probability of willingness to cultivate

The method section does not specify which model the author used to measure the challenges of pulse production.

3. Results and Discussion

Socioeconomic characteristics of responded household

Age of the farmers: It was found that the highest percentage (37 %) of farmers was in the age group of 31-45 years followed by age group up to 30 years (23%) and 46-60 years (34%) and age group above 60 years has the lowest percentage (7 %) (Table-1).

Table 1. Socioeconomic characteristics of the farmers (% of farmers responded)

Characteristics	Madari-pur	Shariat-pur	Barishal	All areas
Farmers Age (% of farm household responded)				
Up to 30 years	35	22	12	23
31-45 years	31	38	41	37
46-60 years	29	33	39	34
Above 60 years	5	7	8	7
Education level (% of farm household responded)				
Illiterate	25	26	41	31
Primary	43	51	39	44
Secondary	18	13	9	13
SSC	9	8	8	8
HSC	4	2	2	3
HSC and above	1	0	1	1
Land ownership pattern (ha)	1.39	1.77	2.17	1.78
Farmers category according to Farm size (% of farm household responded)				
Small (0.02-1.0 ha)	68	71	68	69
Medium (1.01-2.0 ha)	30	22	26	26
Large (2.01 ha-above)	2	7	6	5
Family members description (No.)				
Family members	5.10	5.30	4.65	5.02
Men	2.15	2.80	2.20	2.38
Women	1.90	1.20	1.34	1.48
Marital Status (%)				
Unmarried	44	31	27	34
Married	56	69	73	66

Source: Author's calculation

Education level: On an average, 31% farmers were illiterate and others having variable levels of academic background. Among the educated farmers 44 % had primary level of education, 13 % had secondary level and 8% had education at SSC and 3% had education at HSC and 1 % had education at above HSC (Table 1).

Farmer's category and farm size: Average farm size is 1.78 ha where the highest (2.17 ha) in Barishal and the lowest (1.39 ha) in Madaripur. On an average small farmers was 69%, medium was 26 % and large was 5 %.(Table 1).

Family size and marital status: Average family size was 5.02 persons. In Madaripur it was 5.10 and in Shariatpur it was 5.30 and in Barishal it was 4.65. Number of male members (2.38) was higher than female members 1.48. Among the responded farmers 65 % were married and 36 % were unmarried (Table 1).

Table 2. Coefficient of logit model for determination of willingness to cultivate Pulses crop

Determinant	Coef.	Std. Err.	Z	P>z	Marginal effect
Age (X_1)	0.044	0.036	1.24	0.215	0.010
Education (X_2) ***	0.903	0.241	3.74	0.000	0.208
Family members (X_3) ***	0.919	0.341	2.70	0.007	0.213
Farm size (X_4) **	0.017	0.007	2.44	0.015	0.004
Experience (X_5) ***	2.411	0.818	2.95	0.003	0.525
Alternative income sources (X_6)	-1.186	0.762	-1.56	0.120	-0.274
Training (X_7) *	4.185	1.012	4.13	0.000	0.778
Constant	-21.30501	4.99	-4.27	0.000	-
Number of observations	150	-	-	-	-
LR chi^2 (7)	149.10	-	-	-	-
Prob > chi^2	0.000	-	-	-	-
Pseudo R^2	0.7203	-	-	-	-
Log likelihood	-28.94	-	-	-	-

Sources: Author's analysis

Factors for the determination of pulses crop production: The factors which determine the willingness to cultivate pulses crop is shown in Table-1. The result shows that education, family members, farm size, experience, and training were the significant determinant. Education, family members and experience is significant at 1% level. Farm size and training are significant at 5 % and 10 % level, respectively. The value of marginal effect for education was 0.010 which indicates that probability of willingness to cultivate pulses crop will increase with the increase in education level. The value of marginal effect for family members was 0.208 which indicates that the probability of willingness to cultivate pulses crop will increase with the increased number of family members. The value of marginal effect for farm size is 0.004 which indicates that the probability of willingness to cultivate pulses crop will increase with the increase of farm size. The value of marginal effect for experience was 0.525 which indicated that the

probability of willingness to cultivate pulses crop would increase with the increases of experience. The value of marginal effect for training was 0.778 which indicates that the probability of willingness to cultivate pulses crop would increase with the increase of training. Age and alternative income sources have no significant impact (Table-2).

Challenges of pulses crop production

Losses of agricultural char land: Bangladesh has lost about 1 million ha of productive arable land from 1983 to 1996 (BBS, 1999). That is about 80,000 ha of agricultural land per year are going out from crop production. Besides, this every year agricultural char land was going under water due to river erosion, which is hampering the production of pulses along with others crops. About 52 % of the total farmers responded that some part of their land has lost due to river erosion in the last two decades. Major factors responsible for land loss are human settlement and river erosion.

Adverse climate conditions: Adverse climate condition hampers the pulses production dramatically. On an average 87 % of the total farmers replied that heavy rainfall during the production period of pulses seriously hampers the production. About 57 % of farmers of Barishal said the problem of an early flash flood along with 18% and 22% of farmers' of Madaripur and Shariatpur, respectively. Nearly 76 % of farmers of Barishal said that they can't cultivate pulses at the right time due to late joe (optimum condition of soil for plant growth) condition in the same way 59 % and 53 % of farmers of Madaripur and Shariatpur responded on the same. The highest percentage (91 %) of farmers of Barishal said that foggy weather hampered the pulses seedling which in turn contributes to low yield and in Madaripur and Shariatpur it was about 79% and 87 %, respectively (Table-3).

Production problem: About 92 % of farmers of Shariatpur said that they had no idea about modern pulses variety even though they had never tried to know the availability of a modern variety of pulses crop. In the same way, 88 % and 81 % of farmers of Madaripur and Barishal replied to this. Around 93 % of farmers of Barishal said they get low yield due to a lack of quality seed along with the Madaripur and Shariatpur farmers. The farmers of Shariatpur (72 %) replied that due to insect attacks they are reducing their chickpea land to other crops. 67% and 54 % of farmers of Madaripur and Barishal said about the problem of insect attacks (Table 3).

Improper use of chemical fertilizers and low management Practices: Organic matter content of soils is much below the critical level of 1.5% (Karim, Z. 1997). Our responded farmers normally use urea more or less in recommended doses. Because of high prices, they can not apply other fertilizers at the recommended amount. Chemical fertilizers are not normally integrated with organic manures. It

is thus evident that farmers virtually do not use balanced fertilizers that are necessary for high productivity. The table shows all the farmers in all areas did not use recommended doses of fertilizers for pulses production (Table-4). Besides, low management practices like no weeding, as well as no intercultural operations also hamper the pulses production.

Table 3. Problems/challenges of pulses crop on the char land (%farmer responded)

Particulars	Madaripur	Shariatpur	Barishal	All areas
Adverse climate condition:				
Heavy rainfall	87	82	92	87
Early flash flood	18	22	57	32
Late joe condition	59	53	76	63
Foggy weather	79	87	91	86
Production problem:				
No idea about modern variety	88	92	81	87
Lack of knowledge of modern production technology	79	83	78	80
Lack of quality seed	76	87	93	85
Insect attack	67	72	54	64
Diseases infestation	74	62	79	72
Financial problem:				
Lack of capital	56	61	67	61
Lack of credit facilities	23	32	43	33
High price of input	78	69	85	77
High labour wage	83	79	84	82
Marketing problem:				0
Low produce price at harvest	96	93	95	95
Lack of storage facilities	34	45	58	46
Lack of knowledge about modern storage system	28	43	36	36
High transportation cost	23	29	39	30
High market toll	23	19	33	25

Source: Author's Calculation

Financial problem: About 67 % of farmers of Barishal responded to the problem of lack of capital in the initial stage of pulses production along with the farmers of Shariatpur (61%) and Madaripur (56%). On average, 33 % of farmers responded on the lack of credit facilities at easy terms from either GO or NGOs. About 77% of farmers of all areas said about the higher price of agricultural input and 82 % on high labour wage. It should also be noted here that about 90% of farmers of Bangladesh are small and marginal (below 2.5 acres). They are very often constrained by finance and thus they cannot afford cost for management. They have very limited access to institutional credit because of collateral requirement. At present, only 27% of farmers received institutional credit (BBS, 2007). The amount of credit again is quite inadequate and not advanced in time. They are also not eligible for microcredit from NGOs that deal mainly with landless farmers (Table-3).

Table 4. Level of input use pattern

Types of input	Madaripur	Shariatpur	Barishal	Average
		Lentil		
Human labour (no.)	63	61	59	61
Own	30	28	29	29
Hired	33	33	30	32
Seed (kg)	37	38	41	39
Fertilizers (kg)				
Urea	43	31	35	36
TSP	28	24	21	24
MoP	23	11	14	16
		Mungbean		
Human labour (no.)	-	59	63	61
Own	-	22	25	24
Hired	-	37	38	38
Seed (kg)	-	33	28	31
Fertilizers (kg)	-			
Urea	-	42	38	40
TSP	-	27	26	27
MoP	-	21	23	22
		Chickpea		
Human labour (no.)	58	66	68	64
Own	27	30	29	29
Hired	31	35	39	35
Seed (kg)	45	48	43	45
Fertilizers (kg)				
Urea	41	35	29	35
TSP	48	31	27	28
MoP	32	19	22	26
		Grasspea		
Human labour (no.)	51	47	48	49
Own	32	25	29	29
Hired	19	22	19	20
Seed (kg)	54	57	60	57
Fertilizers (kg)				
Urea	31	33	28	31
TSP	16	21	9	15
MoP	12	15	8	12
		Blackgram		
Human labour (no.)	44	-	-	44
Own	27	-	-	27
Hired	17	-	-	17
Seed (kg)	61	-	-	61
Fertilizers (kg)	-	-	-	-
Urea	27	-	-	27
TSP	16	-	-	16
MoP	7	-	-	7

Sources: Author’s estimation

Problems regarding marketing of pulses crop: Productive farmers of Bangladesh mainly belong to small and marginal categories. These farmers do not have any farmer's association or farmer's co-operative to bargain for fair prices for their produce. They are thus forced to sell their produce at low prices to intermediaries. Our responded farmers also responded on different marketing related problems like low price of produce during harvest (95%), lack of storage facilities (46%), lack of knowledge about modern storage systems (36%), high transportation cost (30%) and high market tool (25%) (Table 3).

Opportunities of pulses crop production

Protection and proper utilization of char land: Char land is the potential area for pulses production. Due to its slope structure rain water can't stand, and can't affect pulses crops, while in the main land rain water affect pulses crops as there are poor drainage system in many areas. So, it is essential to review the present char land use policy with the relevant experts, professionals, and farmers' representatives. The policy should also be put into operation immediately to stop further loss of arable land. Khas char lands that are arable should not be diverted for housing and other infrastructure without government plan. Such lands should be distributed to landless farmers and be used for agricultural purposes that would helpful for pulses production as well as other agricultural crops.

Adoption/mitigation to adverse climate condition: The pulses varieties should be introduced and disseminated in the char area after necessary testing. More diseases and insect resistant varieties of pulses need to be developed. It is also necessary to use biotechnology or gene transfer technology to develop varieties tolerant to salinity, flood, and drought. There is also a need to develop and disseminates of HYVs in pulses and technologies in these areas.

Research and expansion of alternative cropping pattern: In the study areas as well as other areas there are lots of opportunities for some pulses to adapt along with other crops and hence can increase the cropping intensity. Research should be conducted on location wise varietal development as well as cropping pattern. The potential pulse based cropping pattern in Madaripur is 1. Lentil+B. Aus+Blackgram 2. Lentil+Mungbean+B.Aus 3. Garlic/others robi crops+Mungbean+B.Aman. In Shariatpur the potential pulse based cropping pattern is 1. Wheat+B. Aus+ Blackgram, 2. Lentil/Rabi crops+Mungbean+B.Aus. In Barishal, the major potential cropping pattern is 1. lentil+Mungbean+Aman, 2. Khesari+Aman+Blackgram. More locationwise research on cropping patterns would be more helpful in this case.

Fertilizer management as well as proper intercultural operation: Farmers should encourage the use of balanced fertilizers, chemical fertilizers must be integrated with organic manures. Farmers should gradually reduce their dependence on the use of chemical fertilizers to maintain soil fertility. Besides they are not aware of

the proper intercultural operation. The proper intercultural operation would increase the pulses yield.

Pest and diseases management properly: In Bangladesh, different insects and pests are becoming resistant to respective chemicals. More resistant varieties should be developed using both conventional breeding and biotechnology to control the pests. Besides, this different prevention and controlling measures should be developed. It is also necessary to expand biotechnology and IPM practice to the economic crops like pulses.

Strengthening quality seed production at farmers as well as institution level: In the study areas, most of the farmers were not aware of modern pulses varieties and quality seed. To meet the quality pulses seed requirement BADC's current seed production programme needs to be strengthened. To achieve this, the present breeder's seed programme of NARS institutes should be expanded. Besides, private sector and NGOs are to be supported by the government for the production of quality seeds by providing credit on easy terms. Likewise, farmers need to be motivated to produce quality seeds. For this, they should be given massive training on seed production, preservation, and processing.

Ensure credit facilities: During the pulses cultivation season, farmers usually tend to take a loan from the village mohajon at high interest rate instead of the financial institution because of its complexities. In the National Agricultural Policy (1999), Ministry of Agriculture proposed an institution named "Agricultural Credit Foundation" the following the model of "Palli Karmo Sahayak Foundation" (PKSF). Major objective of the foundation was to meet the demand for credit by marginal and small farmers. The foundation was supposed to be established during the Fifth Five-Year Plan. Unfortunately, the institution has not been established even 8-9 years after the implementation of the national agricultural policy. Under the circumstances, a new Institution/Foundation following the model of PKSF should be established along with necessary manpower and other facilities to cater to the needs of these farmers. They must have an access to the credit of the institution without any collateral requirement. The credit should be disbursed before planting time and realized at the end of the cropping season or after the harvest of the crops. The institution must have an in-built provision for a strong monitoring unit to monitor the use of credit at regular intervals by its staff.

Fair price of produces: In most cases pulses as well as other crop's price is volatile. Sometimes farmers get return which could not cover cost of cultivation. Government is urged to procure the produces directly from the farmers raising the present ceiling to at least 10% of the total production. Storage facilities may at the same time be established in rural areas. Alternatively, government might encourage establishing farmers' cooperatives to ensure fair price of their crop produces. To make the cooperatives successful, traditional top-down approach must be avoided. The cooperatives should not be run as a commercial profit-

making entity. Formation of "Agricultural Prices Commission" by the government is also suggested for fixing the prices of farmers' produces which would ensure fair price and hence improve the livelihood of the farmers, besides different value added services in pulses would be helpful to get a fair price.

4. Conclusion and Recommendations

Pulses are the important winter season crop. Besides, mungbean grow well in Kharif -1 and Blackgram grow well in Kharif-2. Education, family members, farm size, experience, and training were the significant determinant of the willingness of the farmers to cultivate more pulses crops. Bangladesh is showing a deficit in pulses production. Bangladesh has to import two third of the total pulses requirement which need huge foreign currency. It became an urgent need to increase the production of pulses crops. There are lots of challenges to increase the pulses yield like losses of agricultural char land, adverse climatic conditions, lack of technological knowledge of pulses production, imbalance fertilizers use and low management practices and marketing problems were the major challenges. But yet there are lots of opportunities like proper utilization of fallow char land, use of flood or salt tolerant varieties, use of quality seed, adoption of new technology, and ensuring fair price of pulses crops. The following recommendations can be helpful to increase the pulses yield. Special policy need be formed and should be enacted and put into operation immediately to stop further loss of arable land. Khas lands that are arable should not be diverted for housing, ensure fair price of pulses crop through fixing the floor price, encourage the use of balanced fertilizers, chemical fertilizers integrating with organic manures. Besides these, it is important to ensure quality seed to the farmer's level, facilitate community based training system of improved pulses production technologies, strengthen research on the development of different stress tolerant variety of pulses, and develop location-wise appropriate pulse based cropping pattern. Encourage the farmers to cultivate pulses crops through cooperatives which would minimize the cost of pulse production along with strengthening the bargaining power of the farmers for their product through forming cooperatives. Upazila Agricultural Office could be a medium to form these types of cooperatives.

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