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FARMERS' PERCEPTION AND FACTORS AFFECTING ADOPTION OF MUNGBEAN IN PATUAKHALI DISTRICT OF BANGLADESH

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Abstract

Mungbean is an important pulse crop in Bangladesh for nutrition, the economy, and food security, as well as a source of protein for the majority of the people. The study was carried out to better understand farmers' views toward mungbean production, the factors affecting mungbean adoption, and the financial profitability of mungbean cultivation. A structured and pre-tested interview schedule was used to interview 90 mungbean farmers that were randomly selected from different villages in Patuakhali Sadar Upazila, Patuakhali district for collecting field level data. A combination of descriptive, mathematical and statistical techniques was used to analyze the data. Profitability analysis showed that mungbean production was profitable because the net return of its cultivation was Tk. 21,959/ha and BCR was more than unity (1.73). The study revealed that short duration crop, sharing work within household members, crop diversification, minimum tillage, employment creation, and income generation significantly influenced farmers to cultivate mungbean than any other crop. Problem facing index pointed out high price of seed and fertilizer, lack of good quality seed and fertilizer, inadequate extension service as a production related problem and lack of value added product development and transport facility, low market price of output and lack of storage facilities were identified as a major marketing problem of mungbean cultivation.

Keywords: Perception, adoption, profitability, mungbean, Bangladesh.

Introduction

Bangladesh is a small country with a large number of populations where the agriculture sector plays a vital role in accelerating its economic growth. However, pulse crops are vital for nutrition and food security in Bangladesh. It is an important protein source for the majority of people. It contains protein about twice as much as cereals. Pulse is known as the poor men's' meat in Bangladesh as it is the major and cheap source of protein in the daily diet of its people. Apart from these, the ability to fix nitrogen and the addition of organic matter to the soil are important factors in maintaining soil fertility (Mann *et al.*, 2020). Around 3,64,859 hectares of land were taken under pulses cultivation which produces 3,87,355 metric tons of pulses with a per capita availability of 56 gm/day (BBS, 2017).

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Pulses can be cultivated in relatively low-quality land with low input cost and less time (Jain and Singh, 1991). Among the pulses grown, lentil, grass pea, mungbean, chickpea, and black gram are the major and they contribute more than 95% to the total pulses production in the country (Rahman, 1998). Mungbean is in the third position among the pulses according to area and production but first in market price. It is one of the most important pulse crops in Bangladesh which is rich in protein. Mungbean grain contains approximately 20-25% protein and 50-55% carbohydrate (AVRDC, 1988; Lisa *et al.*, 2018). It contributes to providing different types of minerals and vitamins in the daily diet. It also contains amino acid lysine, which is generally a deficit in food grains (Jager *et al.*, 2019). A major area of mungbean is replaced by cereals (Abedin *et al.*, 1991). Mungbean is becoming a popular crop in different areas due to its short duration, profitability and nutrition for humans as well as for soil (Sadikhani and Zeinvand, 2016). It is being cultivated after harvesting *rabi* crops (Islam *et al.*, 2011). It covers 0.175 million ha with an average yield of 1.03 ton/ha (BBS, 2015). A large area remains fallow in the Aman rice-based cropping systems in the southern districts of Bangladesh. This fallow period can be utilized by short-duration mungbean varieties without disturbing the existing cropping pattern.

However, research on farmers' perception and adoption factors of mungbean farming in Bangladesh is rare and many policy-level questions remain unanswered. Considering such a research gap, the study may help the policymakers to get some ideas regarding nature and the extent of mungbean farming as well as farmers' perception of the expansion of this pulse crop. Thus, the present study will provide necessary information for the policymakers for formulating an appropriate policy for the widespread cultivation of mungbean in southern Bangladesh. The present study is linked with other studies conducted in Bangladesh to some extent which are: Haque *et al.* (2014) studied on the adoption of mungbean technologies and technical efficiency of mungbean farmers in selected areas of Bangladesh. Islam and Miah (2014) performed a study on the suitability of short-duration mungbean variety in char land areas of Mymensingh District in Bangladesh. Islam *et al.* (2011) studied on analysis of mungbean cultivation in some coastal areas of Bangladesh. Islam *et al.* (2008) estimated the profitability level of mungbean cultivation in some selected sites of Bangladesh. Hossain *et al.* (2014) performed research on the impact of mungbean research and extension in Bangladesh and found that improved varieties of mungbean dramatically increased the area and production rates but growth rates were not satisfactory for various reasons. Ali *et al.* (2010) conducted a study on seed quality and performance of some mungbean varieties in Bangladesh. Mandal *et al.* (2021) also assessed the value addition of different actors in the mungbean value chain in Bangladesh. Research on the farmers' perceptions of mungbean production, profitability, and adoption factors of

mungbean cultivation in Bangladesh is rare, and many policy-level questions remain unaddressed. This study was designed to assist policymakers in gaining some insight into the aforementioned research gap. Therefore, the researchers estimated the financial profitability as well as the factors influencing producers' of mungbean production decision and identified issues related to mungbean production and marketing in Bangladesh.

Materials and Methods

Study area and sample size

The study was conducted at different villages of Sadar Upazila under the Patuakhali district. The study area was selected purposively from the southern part of Bangladesh based on the intensity of the mungbean growing area. This study is based on primary data collected from 90 farmers through direct interviews. A pre-tested, semi-structured questionnaire was used to collect primary-level data from the sample respondents. The secondary information was used only to compare and validate the research findings. Secondary data were gathered from different published sources such as: Bangladesh Bureau of Statistics (BBS), Upazila Agricultural Office (UAO), Department of Agricultural Extension (DAE), and many other sources.

Collection of data and information

A simple random sampling technique was used to select the respondents. Focus group discussion (FGD) was also conducted to collect group information and cross-check the data and information. The survey schedule was constructed and pre-tested for necessary modifications before starting the data collection. The primary data were collected during 2021. Besides, secondary information sources in the form of handouts, reports, publications, notifications, etc. having relevance and similarity with this study were also considered.

Analytical techniques

After gathering the relevant data and information via field surveys, interviews, communications, and interactions, the data and information were classified, edited, and coded. To meet the aims and provide relevant results, a combination of descriptive, mathematical, and statistical techniques was employed for data analysis. Descriptive statistics (i.e., sum, average, percentages, ratios, and so on) were to explain the nature and extent of mungbean production in the research area.

Profitability of mungbean cultivation

The financial profitability of mungbean production from the individual farmer's point of view was measured in terms of gross return, gross margin, net return,

and benefit-cost ratio (undiscounted). The formulas used for calculating profitability are discussed below:

$$TC = TVC + TFC \quad (1)$$

$$GR = Q \times P \quad (2)$$

$$GM = GR - TVC \quad (3)$$

$$NR = GR - TC \quad (4)$$

$$BCR = GR \div TC \quad (5)$$

Where,

TC = Total cost (Tk./ha)

TVC = Total variable cost (Tk./ha)

TFC = Total fixed cost (Tk./ha)

GR = Gross return (Tk./ha)

Q = Quantity of mungbean produced (kg/ha); and

P = Price of mungbean (Tk./kg)

GM = Gross margin (Tk./ha)

NR = Net return (Tk./ha)

BCR = Benefit cost ratio

Logistic regression model

Logit regression model was used to identify the determinants that affect the adoption of mungbean cultivation because the dependent variable was dichotomous in nature whether farmers adopt mungbean production or otherwise. Here the dependent variable that is adopting mungbean cultivation was coded 1 for farmers adopting mungbean cultivation, and it was '0' for otherwise. The logit model used in this study is given below:

$$Li = \ln (P/ (1-p)) \quad (6)$$

$$= \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + U \quad (7)$$

Where, P = Farmers will adopt mungbean production; 1-P = Farmers will not adopt mungbean production; X_1 = 1 for short-duration crops, 0 for otherwise; X_2 = 1 for sharing work within household, 0 for otherwise; X_3 = 1 for practicing crop diversification, 0 for otherwise; X_4 = 1 for use of fallow land, 0 for otherwise; X_5 = 1 for zero/minimum tillage, 0 for otherwise; X_6 = 1 for risk minimization, 0 for otherwise; X_7 = 1 for employment creation, 0 for otherwise; X_8 = 1 for income generation, 0 for otherwise; X_9 = 1 for poverty reduction, 0 for otherwise; β_0 = Intercept; β_1 to β_8 = Coefficients of the respective variables; and U = Error term.

Problem confrontation index (PCI)

Finally, to address the problems in relation to the production and marketing of mungbean, problem confrontation index (PCI) was used. For production related problems, fourselected items were computed. For problems related to marketing, seven items were calculated, using the following formula:

$$PCI = (Ps \times 3) + (Pm \times 2) + (P_l \times 1) + (Pn \times 0) \quad (8)$$

Where, Ps = Number of respondents with severe problems (weight assigned as 3); Pm = Number of respondents with moderate problems (weight assigned as 2); P_l = Number of respondents with low problems (weight assigned as 1); and Pn = Number of respondents with no problems (weight assigned as 0). The value of problem confrontation index (PCI) for any of the selected problem regarding input, production, and marketing could vary from 0 to 270.

Results and Discussion

Farmers' perception of mungbean cultivation

Different agronomic practices usually done by the farmers were presented in the table 1. It shows farmer's perception about cultivated varieties, soil and land types, land preparation, pest control and weeding, and fertilizer application of the mungbean cultivation.

Table 1. Farmers' perception of different agronomic practices of mungbean cultivation

Particulars	Description
Varieties cultivated	Most of the responded farmers in the study area generally used improved mungbean variety for production.
Soil and land type	50%, 47.8% and 2.2% of the farmers said that high, medium and low lands are suitable for mungbean production, respectively. In the study area, Loam soil is suitable for mungbean production.
Land preparation	Almost all the farmers in the study area used relay cropping for cultivation. Only 1% of the farmers used mixed cropping as their cultivation method. Broadcasting method was used for sowing mungbean seeds by the farmers. Only 1% farmers used line for sowing. Late of January or early of February is the ideal time for sowing seeds as mentioned by the farmers in the study area. 98% of the farmers in the study area depends on rain. Only 2% of the farmers have the facility for own irrigation system.
Pest control and weeding	All the farmers used insecticides for controlling pest. 26% of the farmers never apply weeding in their fields,

Particulars	Description
	59% of the farmers apply weeding only for once, 11% of the farmers weed twice and only 2% percent of the farmers weed three times before production.
Temperature and rainfall	Seve.nteen % of the farmers said that for mungbean production high temperature is beneficial while 82% of the farmers agreed to medium temperature and only 1% of the farmers said that low temperature is ideal for mungbean production. Rainfall plays a crucial part in mungbean production. 86% of the farmers said that medium rainfall is ideal for mungbean production while percentage of farmers who thought low or high rainfall was moderate for mungbean production was only 13 and 1% respectively.
Fertilizer	For producing mungbean, the farmers used both organic and chemical fertilizers. As organic fertilizer, they used cowdung and as chemical/inorganic fertilizers they used Urea, TSP, MP and Gypsum.

Source: Author's field survey, 2021

Factors influences the adoption of mungbean production

A set of particulars were used to understand farmers' perception towards mungbean production. Table 2 revealed that due to the enrichment of soil fertility, organic matter content and minimum tillage requirement, cent percent farmers were influenced towards mungbean cultivation. Fifty three percent of the farmers agreed that cultivation time also influenced mungbean production. Credit facilities, training facilities, change in cropping pattern, and extension services did not have much influence on mungbean production where the percentage of farmers disagreed were 76, 70, 89 and 80%, respectively.

Table 2. Factors affecting farmer's perception of mungbean production

Particulars	Agree	Disagree	% of farmers agreed	% of farmers disagreed
Credit facilities	22	68	24	76
Training facilities	27	63	30	70
Selection of time of cultivation	48	42	53	47
Cropping pattern change	10	80	11	89
Soil fertility	90	0	100	0
Soil organic matter content	90	0	100	0
Extension services	18	72	20	80
Minimum tillage	90	0	100	0

Source: Author's field survey, 2021.

Profitability of mungbean production

To determine the viability of mungbean production, it is necessary to analyze the profitability. The profitability of mungbean production was estimated in terms of gross return, gross margin, net return, and benefit-cost ratio. The per hectare cost of mungbean production is shown in Table 3. Human labor cost takes the highest portion of the total cost. Human labor was required from the beginning of the production process to the end of it. They are required for land preparation, planting, mulching, fertilizer application, manure application, weeding, and irrigation, harvesting, carrying, and drying. The cost of human labor per hectare mungbean production was Tk. 11,200. Farmers generally use four types of fertilizers such as Urea, TSP, MoP, and Gypsum. For producing one hectare of mungbean, the costs of fertilizers were Tk. 760, Tk. 1770, Tk. 350, and Tk. 120 for Urea, TSP, MoP, and Gypsum, respectively. Cow dung is used as manure for producing mungbean which is spent Tk. 2,200 for per hectare. Irrigation is generally required if there is late in monsoon rain. The cost of irrigation per hectare was Tk. 2,300. The power tiller is used for land preparation which saves time and money. Power tiller cost for producing one hectare of mungbean was Tk. 1,600. The cost of seedlings was calculated based on the actual market price. The total cost of seedlings was Tk. 1,000 per hectare. Farmers also use pesticides for mungbean production. The per hectare cost of pesticide was Tk. 800 The land-use cost was Tk. 6090 which shared 20% of the total cost. Interest on operating capital was calculated at Tk. 1647 (6% of total cost) for per hectare mungbean production. Finally, the per hectare total cost of mungbean production was estimated at Tk. 29,837 (Table 3).

Table 3. Per hectare cost of mungbean production in the study areas

Cost items	Amount of cost (Tk./ha)	% of total cost
Human labour	11200	38
Manures and fertilizers		
Cow dung	2200	7
Urea	760	3
TSP	1770	6
MoP	350	1
Gypsum	120	0.4
Irrigation	2300	8
Power tiller	1600	5
Seedlings	1000	3
Pesticides	800	3
Total variable cost (TVC)	**22100**	**74**
Land use cost	6090	20
Interest on operating capital	1647	6
Total fixed cost (TFC)	**7737**	**26**
Total cost (TVC+TFC)	**29837**	**100**

Source: Authors' estimation, 2021.

The average farm size of the farmers was 0.17 ha. On average, respondent farmers received 563 kg/ha mungbean . Table 4 showed that the gross return and gross margin of received from one hectare of mungbean production were Tk. 51796 and Tk. 29696, respectively which were higher than the previous year due to the technological progress (Islam *et al.,* 2008). Net return is the actual amount of money that farmer gets after subtracting all the cost items from the total return. The respondent farmers received Tk. 21,959 as net return from per hectare mungbean production. Benefit-cost ratio is the ratio of gross return to gross cost. The benefit cost ratio (BCR) for mungbean production was 1.73 which indicated that mungbean production was profitable. However, Islam *et al.* (2011) estimated BCR in their study as 2.19 which was much higher than the BCR calculated in the present study. The reason of lower BCR was due to higher input cost as well as higher production cost in the recent (Islam *et al*., 2011).

Table 4. Profitability of mungbean production

Particulars	Amount (Tk./ha)
Total fixed cost (TFC)	8237
Total variable cost (TVC)	22100
Total cost (TC)	29837
Total production (kg)	563
Price (Tk./kg)	92
Gross return (GR)	51796
Gross margin (GM)	29696
Net return (GR-TC)	21959
BCR	1.73

Source: Authors' estimation, 2021.

Factors of adoption of mungbean production

A dichotomous logit regression model was used to analyze the factors influencing the adoption of mungbean production technology by the farmers in the study areas. It may be mentioned that the explanatory variables used in the regression model were dichotomous where a score of 1 was assigned to the positive response while a score of 0 was assigned to the negative outcome. Nine independent variables were identified as major determinants of adopting mungbean production by the farmers. Six out of nine independent variables included in the model were found to have positive and significant influence in adopting mungbean production by the farmers which were: short duration crops, sharing work within household members, practicing crop diversification, zero/minimum tillage, employment creation, and income generation (Table 5).

***Short duration crops*:** Short duration nature of mungbean cultivation positively and significantly influences the adoption of mungbean cultivation. The odds ratio of short duration crops is 4.538 suggesting that farmers are 4.538 times more

likely to adopt mungbean production because it takes lesser time to cultivate. Mungbean fits well in existing cropping systems due to its short duration, minimal input, low maintenance, and drought tolerance (Islam *et al.,* 2013).

***Sharing work within household members*:** It can be seen from Table 5 that the odds ratio for sharing work within household members is 2.872 which means that farmers who can use their family labor and reduce cost on hired labor are 2.872 times more likely to adopt mungbean production.

***Practicing crop diversification*:** The coefficient of practicing crop diversification is positive and significant at a 10% level which indicated that mungbean cultivation is positively related to crop diversification practice. The estimated odds value for practicing crop diversification is 21.382 which indicates that farmers who prefer diversification of access are 21.382 times more likely to adopt mungbean production.

***Zero/minimum tillage*:** Zero tillage or minimum tillage is one of the important factors that positively and significantly influence the farmer's decision to adopt mungbean cultivation. Table 5 showed that the odds ratio for zero or minimum tillage is 1.358 which means that farmers are 1.358 times more likely to adopt mungbean production because it requires minimum tillage.

***Employment creation*:** Employment creation is positively and significantly related to mungbean cultivation. In the case of employment creation, the odds ratio is 3.812 suggesting that farmers are 3.812 times more likely to adopt mungbean production because it generates more employment opportunities (Yanos and Leal, 2020).

Table 5. Estimated coefficients and related statistics of logit regression model

Variables	Coefficients	Standard Error	P value	Odds ratio
Constant	-0.107	0.675	0.928	0.809
Short duration crop	1.705**	1.037	0.011	4.538
Sharing work within household members	1.276**	0.947	0.013	2.872
Practicing crop diversification	2.005*	1.023	0.009	21.382
Use of fallow land	-0.607	1.159	0.640	0.455
Zero/minimum tillage	0.233**	0.075	0.034	1.358
Risk minimization	-0.174	0.832	0.341	0.673
Employment creation	1.526**	1.021	0.023	3.812
Income generation	0.223**	0.064	0.023	1.427
Poverty reduction	-1.163	0.982	0.327	0.541

Source: Authors' estimation, 2021.

Note: * and ** indicate significant at 1% and 5% probability level, respectively.

***Income generation*:** Table 5 reveals that the odds ratio for income generation is 1.427 which means that farmers are 1.427 times more likely to adopt mungbean production because it increases their income. These findings are conforming to

Yanos and Leal (2020) who stated mungbean is a source of income among farmers. Besides these factors, farmers' age, family size, sex, access to market, and market information would also have a significant influence on farmers' decision of adopting mungbean production.

Problems of mungbean cultivation

The problems faced by the respondent farmers related to the production and marketing of mungbean were measured using problem facing index (PFI) and arranged in rank order according to the PFI score (Table 6). The PFI score was in a range between 0 and 270 for production and marketing related problems. Among the three identified problems related to mungbean production, the high price of seed and fertilizer had the highest PFI value of 187 and ranking as 1st. Inadequate extension services were the least severe problem faced by the farmers, with a PFI score of 110. The lack of facilities to develop value-added products had a PFI score of 196 which was highest among all the five identified problems related to mungbean marketing and had a rank order of 1st. Lack of transport facility and low market price of output was ranked as the 2nd and 3rd marketing problem faced by the stakeholders with the PFI value of 186 and 185 respectively. Other marketing-related problems included lack of grading knowledge and lack of storage facilities during harvesting (ranked as 4nd and 5rd with PFI scores of 151 and 109, respectively) (Table 6).

Table 6. Problem facing index of mungbean cultivation

Particulars	Extent of problems				PFI	Rank order
	Severe (3)	Moderate (2)	Low (1)	Not at all (0)		
Production-related problems						
1. High price of seed and fertilizer	38	29	15	8	187	1
2. Lack of good quality seed and fertilizer	12	29	33	16	127	2
3. Inadequate extension services	20	17	16	37	110	3
Marketing-related problems						
1. Lack of facilities to develop value-added products	45	19	23	3	196	1
2. Lack of transport facility	27	42	21	0	186	2
3. Low market price of output	43	18	20	9	185	3
4. Lack of grading knowledge	17	27	46	0	151	4
5.Lack of storage facilities during harvesting	11	20	36	23	109	5

Source: Field survey, 2021.

Conclusion and policy recommendations

The study estimated the financial profitability and identified the factors of adoption of mungbean production in selected villages of the Patuakhali district. Production of mungbean in the study areas was acceptably profitable and human labor cost was the highest among all the input costs. Cultivating short-duration crops, sharing work among household members, practicing crop diversification, zero or minimum tillage, employment creation, and income generation were found to have a significant influence on farmers' decision of adopting mungbean production. The higher prices of seeds and fertilizer, low price of outputs, and lack of facilities to develop value-added products were the major problems related to production, and marketing of mungbean. To overcome the problems, the study recommended ensuring a reasonable price of the inputs along with better infrastructure and transportation facilities. Furthermore, the monitoring facilities of government and non-government organizations should be increased to improve the quality of mungbean and fixed output price. More storage facilities, processing, preservation and value addition activities should be made available during harvesting period. Moreover, education and training should be provided regarding production, marketing, grading, processing and quality control of mungbean.

References

Abedin, M. Z. and M. Anwarul. 1991. Prospects of increasing pulse production through improved cropping systems. In: Proceedings of the 2nd National Workshop on Pulses, BARI, Gazipur, 65-73.

AVRDC (Asian Vegetable Research and Development Centre), 1988. Mungbean, Proceedings of the First International Mungbean Symposium. Shanhua, Taiwan.

BBS. 2015. Bangladesh Bureau of Statistics, Statistical Yearbook of Bangladesh, Statistics Division, Ministry of Planning, GOB.

BBS. 2017. Bangladesh Bureau of Statistics, Statistical Yearbook of Bangladesh, Statistics Division, Ministry of Planning, GOB.

Jager, D., K.J. Borgonjen-van den Berg, K.E. Giller, *et al.* 2019. Current and potential role of grain legumes on protein and micronutrient adequacy of the diet of rural Ghanaian infants and young children: using linear programming. *Nutr J,* **18**(1):12.https://doi.org/10.1186/s12937-019-0435-5.

Hossain, M. I., Sattar, M. A., Miah, M.A.M. Begum, S. N., and Khan, M. S. K. 2003. Impact of mungbean research and extension in Bangladesh. *Pakistan Journal of Biological Sciences*, **6**: 1733-1740.

Islam, M. A. and M.A.M. Miah. 2014. Suitability of short duration mungbean variety in char land areas of Mymensingh district, Bangladesh. *Journal of Agricultural, Biological and Environmental Sciences*, 0**1**: 44-49.

Islam, Q. M. S., M. A. M. Miah, M. S. Rahman and M. S. Hossain. 2013. Adoption of BARI mungbean varieties and its constraints to higher production in southern region of Bangladesh. *Bangladesh J. Agril. Res.* **38**(1): 85-96.

Islam, Q. M. S., M. S. Rahman, M. A. Hossain and M. S. Hossain. 2011. Economic analysis of mungbean (*Vigna radiata*) cultivation in some coastal areas of Bangladesh. *Bangladesh J. Agril. Res*, **36**: 29-40.

Islam, Q.M.S., M.A.M. Miah, Q.M. Alam and S. Hossain. 2008. Profitability level of mungbean cultivation in some selected sites of Bangladesh. *Bangladesh J. Agril. Res*, **33**(4): 587-95.

Jain, K. K. and A. J. Singh. 1991. An economic analysis of growth and instability in pulse production in Punjab. *Agricultural Situation in India*, **46**(1): 3-8.

Haque, M. A., M.A.M. Miah, A.M. Ali and A. N. Luna. 2014. Adoption of mungbean technologies and technical efficiency of mungbean (*Vigna radiata*) farmers in selected areas of Bangladesh. *Bangladesh J.Agril. Res*, **39**(1): 113-125.

Lisa, P., A. Z. Zahir, M. Ahmad, S. Rani, R. Nair, R. Schafleitner, G. Cadisch and H. Thomas. 2018. Beans with benefits-the role of mungbean (*Vigna radiate*) in a changing environment. *American Journal of Plant Sciences*, 0**9** (07):1577-1600.

Mann, A., A. Kumar, S. K. Sanwal and P. C. Sharma. 2020. Sustainable production of pulses under saline lands in India. In (Ed.), Legume Crops - Prospects, Production and Uses. IntechOpen. https://doi.org/10.5772/intechopen.91870.

Mandal, A. K., M.A. Khan, M.S. Alamgir, M.S. Hoq, N.D. Kundu and M.M. Islam. 2021. Existing value chain assessment of mungbean marketing in selected areas of Bangladesh. *Journal of Bangladesh Agricultural University*, **19**(4): 521–527. https://doi.org/ 10.5455/JBAU.97136

Rahman, M. M. 1998. Technology information on lentil, black gram and mungbean. Lecture note, Training Workshop on Lentil, Blackgram and Mungbean at BARI, Joydebpur, Gazipur, February 22-23

Sabur, S. A. and M. Z. Haque. 1992. Resource use efficiency and returns from some selected winter crops in Bangladesh. *Economic Affairs*, Calcutta 37(3): 158-168

Sadikhani, M. R. and M. Zeinvand. 2016. Economic evaluation (quantitative) for mungbean (*Vigna radiata*) production in the Kamin region, Sadatshahr, Fars province. *International Journal of Medical Research & Health Sciences*, **5**(11): 257-260.

Yanos, M. H. A. and R. C. Leal. 2020. Mungbean (*Vigna radiata*) as a source of income among farmers. *J. Bus. Econ. Review*, **5**(1): 10-17. https://doi.org/10.35609/jber.2020.5.1(2).