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Analysis of Growth and Supply Responses of Selected Pulses in Bangladesh

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Abstract

The study estimated growth rates and supply response functions for various pulse crops in Bangladesh using time series data. Growth analysis revealed that the area indices for various pulse crops considering five years moving average showed an overall increasing trend over the period from 1982-1986 to 1992-1996. The production indices of different pulses also showed an increasing trend over the period from 1987-1991 to 2002-2006 with slight exception in the production of chickpea and blackgram during 2002-2006. The average growth rates of pulse area and production were 4.6 and 6.2 during pre-adoption period (1972-1991) and -5.6 and -5.0% during post-adoption period (1992-2006), respectively. The yields of all pulse crops registered positive growth rates during 1972-2006 due to adoption of improved technologies. Significant structural changes occurred in the area and production of various pulses during post-adoption period due to policy effect and autonomous production. Again, positive structural changes also registered in the yield of mungbean and khesari and negative structural changes occurred for minor pulses during post-adoption period due to adoption of improved variety. Supply response functions fitted for various pulses revealed that lagged area and relative yield risk significantly influenced farmers to allocate land for lentil and chickpea cultivation.

Keyword: Growth analysis, pulses

1. Introduction

Pulses are important crops in Bangladesh. These crops are grown to 4.486 lakh hectares of land (3.15% of the total cropped area) of the country (BBS, 2004). It plays an important role in sustaining the productivity of soils. They are generally grown without fertilizer since they can meet their nitrogen requirement by symbiotic fixation of atmospheric nitrogen in the soil (Islam, 1991; Senanayake *et al.*, 1987; Zapata *et al.*, 1987). It also supplies a substantial amount of nitrogen to the succeeding non-legume crops grown in rotation (Ahlawat *et al.*, 1981; Kurtz *et al.*, 1978).

Pulses have lost considerable amount of area across the country over the last two decades. A fall in the area under pulses has been observed in the country mainly due to the cultivation of HYV rice, wheat, tobacco, mustard and cotton (Miah, *et al.*, 1991); high susceptibility environment; low responsiveness to irrigation and fertilizer; and few number of HYV pulses. Before the introduction of high-yielding varieties of cereals in the mid-sixties, the growth performance of almost all crops was more or less uniform. However, in the post-green revolution period, pulses received mostly marginal lands and residual inputs. With more and more cultivation of cereals like rice and wheat, the area under pulses in Bangladesh declined substantially during 1971-1980 to 1981-2006. The continuously declining trend in area and production of pulses in the recent years has become a serious concern of the planners and policy makers.

Supply response functions provide us with useful information on the extent of farmers' response to price and other economic factors. Most of the supply response studies on food grains have been conducted to cereals only. For pulses, however, a few studies are available to test the supply-price hypothesis. Studies conducted by Krishna (1963) and Sud and Kahlon (1969) show rather the weak role of prices in influencing the supply of pulses. In Pakistan, Dhindsa and Sharma (1997) studied the role of yield differentials, which represented production technology, risk and irrigation, influenced the farmer's acreage adjustment behaviour particularly with respect to various pulse crops. No attempt has been made earlier to study the supply response behaviour of pulse crops in Bangladesh. Therefore, the present study attempts to analyse the growth behaviour and factors influencing the supply of various pulse crops in Bangladesh.

Objectives

(1) To study the growth of area, production and yield of various pulse crops in Bangladesh.

(2) To examine the acreage response of various factors determining decision regarding allocation of land among different pulse crops in Bangladesh.

(3) To suggest policy measures to increase the production of pulse crops in the country.

2. Materials and Methods

Time series data on area, production and yields of different pulse crops for 35 years from 1971/72 to 2005/06 were obtained from the website of the Ministry of Agriculture and different issues of the Statistical Yearbook of Bangladesh. The data on rainfall, gross irrigated area, and prices of different pulses were collected from unpublished records maintained by Directorate of Agricultural Marketing. The whole period (1972-2006) was divided into two major periods viz Period I (1972-1991) and period II (1992-2006) to compare the rate of changes occurred in the area, production and yield of different pulses and explore the causes of changes.

2.1. Measuring the trend of change

Five year moving average was used to estimate fluctuation and an index was prepared to compare the change in area, production and yield of different pulse crops considering 1972-1976 as base period. Index number was calculated as:

$$\text{Index} = \{\frac{(Currentyearvalue - Baseyearvalue)}{Baseyearvalue} \times 100\} + 100$$

2.2. Growth rate estimation

The growth rates of area, production and yield of pulse crops were worked out by fitting a semi-log function of the following type:

$$y = e^{a+bt} \; or \; l_n y = a + bt$$

Where, y = Area (ha) or production (ton) or yield (t/ha), t = Time period (year)

2.3. Test of structural stability

It was assumed that the effect of policy reform might influence pulses production during post-adoption period (1992-2006) since a number of improved pulse production technologies were developed and disseminated during these periods. Structural stability test was performed to verify the structural changes occurred in the area, production and productivity of different pulses between two periods of 1972-1991 and 1992-2006. In this study, from 1972 to 1991 was treated as period-I (non-adoption period of improved pulse variety) and from 1992 to 2006 was treated as period-II (adoption period of improved pulse variety). The following regression model was used for structural stability test.

$$LnYi = \beta_1 + \beta_2 D_i + \beta_3 X_i + \beta_4 D_i X_i + U_i$$

Where, Yi = Area (ha) or production (t/ha) or yield (t/ha) of different pulses in i^{th} year; Di = Period dummy (1 for 2^{nd} period, otherwise 0); Xi = Time (i = 1, 2, 3 .... 35); β_1 is general intercept; β_2 is differential intercept; and β_4 is differential slope coefficient. β_2 indicates the significant change occurred in the 2^{nd} period. On the other hand, β_4 indicates how much the slope coefficient of 2^{nd} period differs from the slope coefficient of

1st period. It means that the rate of change occurred in period II over time. When Di = 1, then $\ln Yi = (\beta_1+\beta_2) + (\beta_3+\beta_4)\ Xi = \gamma_1+\gamma_2 Xi$; When Di=0, then $\ln Yi = \beta_1 + \beta_3 Xi$. The null hypothesis of the structural stability test is Ho: $\gamma_1 = \beta_1$ and $\gamma_2 = \beta_3$. If the 1st null hypothesis is accepted then it indicates that there is no change occurred in the 2nd period, which is originated from the intercept (due to autonomous production). If the 2nd null hypothesis is accepted then it indicates that there is no structural change occurred in the 2nd period, which is originated from the slope coefficient (due to adoption effect).

2.4. Estimation of supply response

Nerlovian partial adjustment lag model (Nerlove, 1956) was used for estimating supply response for various pulse crops in Bangladesh. The model implies that the change in current area is in proportion to the difference between the long-run equilibrium area and an actual area in the previous year. The double-log (natural) form of the Nerlovian partial model was employed in view of its suitability to the data. Hence, we get the following basic equation:

$$LnA_t = b_0 + b_1\ LnRP_{t-1} + b_2\ LnRY_{t-1} + b_3\ LnCV_{RP} + b_4\ LnCV_{RY} + b_5\ LnA_{t-1} + U_t$$

Where, 't' always refers to the t-th production period.

A_t = The actual area (ha) planted under the crop concerned, which is used as a depended variable.

A_{t-1}= One year lagged area (ha) under the crop concerned.

RP_{t-1} = Relative price, i.e., ratio of the price of the crop concerned to the price the competitive crop.

RY_{t-1} = Relative yield, i.e., ratio of the yield of the crop concerned to yield of the competitive crop.

CV_{RP} and CV_{RY} = The coefficients of variation of the preceding one years' relative price and relative yield respectively.

I_t = Gross irrigated area (ha) under all selected crops.

U_t =Error term

3. Results and Discussion

3.1. Trend of area and production of pulses

An index approach considering five years moving average was applied to show the trend of area and production of different pulses in Bangladesh. The area indices constructed for different pulses showed an overall increasing trend over the period from 1982-1986 to 1992-1996 (Table 1). The area under chickpea, lentil, blackgram and other minor pulses (i.e. orhor, motor, etc) drastically decreased over the period from 1997-2001 to 2002-2006 compared to base year of 1972-1976. The reasons for decreasing pulse area were: i) most lentil and blackgram areas were replaced by *boro* rice, wheat, tobacco, mustard and cotton due to their high yield potential and better economic returns (Miah *et al.*, 1991); ii) pulse crops are highly susceptible to environmental stresses; iii) the economic returns of these crops were not satisfactory to the farmers compared with other competing crops; and iv) low response to irrigation and fertilizer use. The area indices for mungbean and khesari represented an impressive increasing trend over the period from 1982-1986 to 2002-2006 which might be due to introduction of its improved varieties that started from 1992 (Table 1). However, the area under all types of pulses decreased during 2002-2006 compared to its base period as well as its previous periods.

The indices prepared for the production of different pulses showed an increasing trend over the period from 1987-1991 to 2002-2006 with slight exception in the production of chickpea and blackgram during 2002-2006. In this period, the production of chickpea and blackgram decreased to a greater extent due to decrease in area. On the other hand, the index of lentil production showed an increasing trend compared to its area which might be due to higher productivity. The trend of other minor pulses production was found to be satisfactory (Table 1). However, the production of all types of pulses decreased during 2002-2006 compared to its base period as well as its previous periods.

Table 1. Index of area and production of pulses in Bangladesh.

Year	Chickpea	Mungbean	Lentil	Khesari	Blackgram	Other pulses	All Pulses
				Area Index			
1972-1976	100	100	100	100	100	100	100
1977-1981	96	113	44	115	98	84	77
1982-1986	146	296	91	207	122	101	132
1987-1991	171	412	114	280	135	143	169
1992-1996	140	383	111	292	132	129	163
1997-2001	97	385	102	252	97	84	137
2002-2006	24	254	81	192	48	56	94
				Production Index			
1972-1976	100	100	100	100	100	100	100
1977-1981	94	97	108	104	88	138	102
1982-1986	150	257	253	203	108	115	182
1987-1991	169	348	340	264	124	254	238
1992-1996	140	342	359	285	128	223	241
1997-2001	96	375	329	264	91	213	214
2002-2006	24	272	258	212	45	78	147

Source: Ministry of Agriculture (www.moa.gov.bd)

3.2. *Rate of change in srea, production and productivity of pulses*

The area and production of mungbean, lentil and khesari registered higher growth rates, while negative growth rates were found in the cases of blackgram, chickpea and other minor pulses over the 35 years (1972-2006). The overall growth rate of pulse production was higher than the growth rate of pulse area (Table 2). The table further shows that the area and production of all types of pulses registered positive growth rates during pre-adoption period (1972-1991), but showed negative growth rates during post-adoption period (1992-2006). The average growth rates of pulse area and production were 4.6 and 6.2% during pre-adoption period and -5.6 and -5.0% during post-adoption period respectively. In spite of adoption of improved technology of pulses, the area and production registered negative growth rates during post-adoption period. The reasons behind this negative growth were that the pulse farmers were compelled to reduce their pulse area and switch on to other crops, as its cultivation was less profitable and susceptible to environment compared to other competing crops e.g. vegetables, Boro rice.

The overall productivity growth of all types of pulses increased during 1972-2006 due to adoption of improved technologies. This fact can also be seen in the post-adoption period as the productivity growth of major pulses except blackgram and other minor pulses increased although the growth of pulses area decreased during this period (Table 2).

3. 3. *Structural stability test*

Table 3 depicts that all the differential intercepts (β_2) of different pulses area and production are highly significant and all the 1st null hypotheses are rejected, which indicates that there are significant differences in the area and production of different pulses between 'pre adoption' period (1972-1991) and 'post adoption' period (1992-2006). On the other hand, the differential slope coefficient (β_4) indicates the nature of changes occurred in the area and production of different pulses over time. All the β_4 are negatively significant at 1% level and all the 2nd null hypotheses are rejected which indicate that there are structural changes in the area and production of different pulses during post adoption period due to policy effect and autonomous production as well.

Table 2. Rate of change in area, production and yield of pulses during major improved pulses adoption period (1992-2006) in Bangladesh.

Year	Mungbean	Lentil	Blackgram	Chickpea	Khesari	Other pulses	All pulses
				Area			
1972-1991	10.0	5.2	2.2	3.9	7.1	2.4	4.6
1992-2006	-4.8	-3.2	-10.0	-17.8	-4.4	-8.5	-5.6
1972-2006	4.0	2.2	-1.6	-3.5	2.8	-1.1	1.1
% Change*	+32.3	+11.2	-18.6	-32.3	+28.4	-16.2	+9.2
				Production			
1972-1991	9.0	8.7	1.7	3.9	6.9	5.2	6.2
1992-2006	-2.9	-3.2	-10.3	-17.6	-3.1	-15.0	-5.0
1972-2006	4.4	4.0	-1.6	-3.4	3.2	-0.4	2.1
% Change*	+39.2	+36.5	-16.0	-32.4	+33.9	11.3	22.5
				Yield			
1972-1991	-1.0	3.5	-0.6	-0.1	-0.2	2.8	1.5
1992-2006	1.9	0.1	-0.3	0.2	1.3	-6.5	0.6
1972-2006	0.4	1.8	0.0	0.1	0.4	0.7	1.0
% Change*	+9.8	+18.3	+2.4	+0.96	+8.5	+25.9	+13.3

* % change in the mean area/production/yield of period 1992-2006 over 1972-1991.

Table 3 further reveals that the differential intercepts (β_2) of mungbean, khesari and other pulses yield are highly and all the 1st null hypotheses of these pulses yield are rejected implying that there are significant differences between two periods, which is originated from the intercept (due to autonomous production). Again, the differential slope coefficients (β_4) of mungbean and khesari yield are positively significant at 1% level which indicate that there are positive structural changes in the yield of these two pulses during post-adoption period due to adoption of improved varieties. On the other hand, negative structural changes have been occurred in the yields of other minor pulses. The differential intercepts of the yields of lentil, blackgram, and chickpea are not significant and the corresponding null hypotheses are accepted implying that there are no differences in the yields of these pulses between two periods. Again, the differential slope coefficients (β_4) of these pulse yields are also insignificant and the corresponding null hypotheses are rejected indicating that structural changes occurred in the yields of those pulses to some extent, but those changes are not significant at desired level confidence.

3. 4. Supply Response Behaviour of Pulses

An attempt was made to study the supply response of various pulse crops namely lentil, chickpea, mungbean and blackgram in Bangladesh during the period 1979/80 to 2004/05.The competing crops selected in respect of each of the crops studied were *Boro* rice, wheat and mustard. Different supply response functions fitted for various pulse crops showed that *Boro* rice competed with lentil and chickpea, while mustard competed with mungbean and blackgram.

It was assumed that the area under various pulses is likely to be influenced by different variables such as lagged area, lagged relative price, lagged relative yield, relative price risk, relative yield risk and gross irrigated area. Price is one of the important variables that influence farmers to allocate area for crop production. It is evident that farmers produce different crops mostly depending on previous year's harvest price.

Table 3. Test of structural stability in area, production and yield between 'pre-adoption (1972-1991)' and 'post-adoption (1992-2006)' of major improved pulses in Bangladesh.

Pulses	β_1 (t-value)	β_2 (t-value)	β_3 (t-value)	β_4 (t-value)	R^2 (F-value)	γ_1 ($\beta_1+\beta_2$)	γ_2 ($\beta_3+\beta_4$)	H_0: γ_1=β_1	H_0: γ_2=β_3
					Area				
Mungbean	9.1066* (62.15)	3.004* (5.42)	0.1007* (8.23)	-0.1490* (-6.63)	0.771 (34.71*)	12.1106	-0.0483	Rejected	Rejected
Lentil	11.211* (52.21)	1.7884** (2.20)	0.0523* (2.91)	-0.084** (-2.56)	0.319 (4.85*)	12.9997	-0.0320	Rejected	Rejected
Blackgram	10.710* (123.06)	2.7434* (8.34)	0.0224* (3.08)	-0.1224* (-9.17)	0.779 (36.62*)	13.4537	-0.1000	Rejected	Rejected
Chickpea	10.783* (70.52)	4.7229* (8.17)	0.0393* (3.06)	-0.2174* (-9.27)	0.804 (42.49*)	15.5063	-0.1781	Rejected	Rejected
Khesari	11.037* (126.41)	2.4034* (7.28)	0.0713* (9.78)	-0.1150* (-8.59)	0.833 (51.82*)	13.4407	-0.0437	Rejected	Rejected
Other pulses	10.333* (102.87)	2.4217* (6.38)	0.0241* (2.88)	-0.1091* (-7.08)	0.658 (19.87*)	12.7550	-0.0850	Rejected	Rejected
All pulses	12.574* (96.43)	2.2173* (4.50)	0.0464* (4.27)	-0.1025* (-5.13)	0.509 (10.71*)	14.7913	-0.0561	Rejected	Rejected
	Production								
Mungbean	8.6560* (53.05)	2.4560* (3.98)	0.0900* (6.61)	-0.1191* (-4.76)	0.719 (26.44*)	11.1120	-0.0291	Rejected	Rejected
Lentil	10.3310 (86.72)	2.4220* (5.38)	0.0873* (8.78)	-0.1189* (-6.51)	0.809 (43.72*)	12.7530	-0.0316	Rejected	Rejected
Blackgram	10.4483 (111.28)	2.8100* (7.92)	0.0169* (2.17)	-0.1205* (-8.37)	0.750 (31.05)	13.2583	-0.1036	Rejected	Rejected
Chickpea	10.4619 (66.83)	4.6717* (7.90)	0.0388* (2.97)	-0.2178* (-8.95)	0.792 (39.44*)	15.1336	-0.1790	Rejected	Rejected
Khesari	10.7529 (108.96)	2.1114* (5.66)	0.0656* (8.33)	-0.0968* (-6.59)	0.803 (42.11*)	12.8643	-0.0312	Rejected	Rejected
Other pulses	9.3516* (47.62)	4.7068* (6.34)	0.0518* (3.16)	-0.2019* (-6.71)	0.594 (15.13*)	14.0584	-0.1501	Rejected	Rejected
All pulses	11.9856 (125.09)	2.3674* (6.54)	0.0617* (7.71)	-0.1116* (-7.59)	0.758 (32.28*)	14.3530	-0.0499	Rejected	Rejected
	Yield								
Mungbean	-0.4497* (-13.39)	-0.5316* (-4.19)	-0.0105* (-3.73)	0.0293* (5.70)	0.625 (17.23*)	-0.9813	0.0188	Rejected	Accepted
Lentil	-0.8806* (-4.95)	0.6287 (0.94)	0.0351** (2.36)	-0.0346 (-1.27)	-0.0346 (-1.27**)	-0.2519	0.0005	Accepted	Rejected
Blackgram	-0.2623* (-11.65)	0.0616 (0.72)	-0.0055* (-2.93)	0.0022 (0.62)	0.284 (4.10**)	-0.2007	-0.0033	Accepted	Rejected
Chickpea	-0.3202* (-12.63)	-0.0465 (-0.49)	-0.0006 (-0.27)	0.0024 (0.62)	0.025 (0.26)	-0.3667	0.0018	Accepted	Rejected
Khesari	-0.2885* (-12.82)	-0.3006* (-3.53)	-0.0022 (-1.20)	0.0153* (4.44)	0.620 (16.87*)	-0.5891	0.0131	Rejected	Accepted
Other pulses	-0.9806* (-4.42)	2.2869* (2.73)	0.0276 (1.46)	-0.0928* (-2.73)	0.216 (2.85**)	1.3063	-0.0652	Rejected	Rejected
All pulses	-0.5901* (-6.87)	0.1487 (0.46)	0.0152** (2.13)	-0.0089 (-0.68)	0.273 (3.89**)	-0.4414	0.0063	Accepted	Rejected

'*' and '**' indicate significant at 1% and 5% levels respectively.

Table 4. Estimates of area response functions of pulses in Bangladesh, 1979-1980 to 2004-2005.

Variables	Lentil	Chickpea	Mungbean	Blackgram
Constant	1.6012	7.2734	10.5621	5.2495
Lagged area (A_{t-1})	0.4289**	0.6736***	0.8239***	0.7552***
	(2.05)	(5.29)	(4.87)	(5.58)
Lagged relative price (RP_{t-1})	-0.4250	-0.0653	0.3585	-0.0599
	(-1.35)	(-0.15)	(1.04)	(-0.16)
Lagged relative yield (RY_{t-1})	-3.9140	1.3307	1.5022	1.3917*
	(-2.41)	(0.91)	(1.67)	(1.85)
Relative price risk (CV_{RP})	-0.0391	-0.1241*	0.0266	-0.0526
	(-0.96)	(-1.97)	(0.55)	(-0.71)
Relative yield risk (CV_{YR})	5.1143**	0.1789**	-0.0773	-0.0029
	(3.09)	(2.26)	(-1.06)	(-0.07)
Irrigated area (I_t)	0.4900	-0.1267	-0.5656*	-0.1721
	(1.54)	(-0.27)	(-0.1.99)	(-0.75)
R^2	0.742	0.899	0.701	0.804
F-value (6, 18)	8.605***	26.621***	7.042***	12.273***
N	25	25	25	25
D-W test statistic	1.843	2.415	1.296	1.870

Note: (i) '***' '**' and '*' represent 1%, 5% and 10% level of significant.
(ii) Figures in the parentheses are t-value.

Therefore, the harvest prices of crops were taken into consideration in this study, because wholesale and retail prices may not sometime reflect the actual price received by the farmers. On the other hand, the risks due to variations in yield and price are expected to act as deterrent factors on acreage under various pulse crops during a particular year. Therefore, only the price and yield risk or the coefficient of variations of prices and yield of different pulses for the preceding two years (CV) were used in this study as risk variables. This might be a sufficient way to incorporate risk particularly in the annual time series aggregate model (Sidhu and Sidhu, 1988). The study also hypothesized that an increase in gross irrigated area in Bangladesh would cause a reduction in the area under various pulse crops. This is due to the fact that old varieties of most of these crops give lower yield on irrigated land, whereas new varieties of *Boro* rice and wheat give very high yield on irrigated land. The estimated elasticity coefficients of different supply response variables are shown in Table 4 and discussed below.

3. 4. 1. Lagged area

The elasticity estimates of lagged area were found to be positive and significant at 1% level for all selected pulse crops. It implies that allocation of area under pulse crops in the preceding year had significant influence on current year's allocation. The lagged area influence was found higher on the allocation of land for mungbean production followed by blackgram, chickpea and lentil. The magnitude of coefficient for mungbean is close to 1, indicating that the farmers had considerably high adjustment response (Table 4).

3. 4. 2. Lagged relative price

The results of the regression analysis presented in Table 4 show that the relative prices of lentil and chickpea vis-à-vis *Boro* rice, and blackgram in comparison with mustard showed insignificant negative impact on area under lentil, chickpea and blackgram in Bangladesh. The insignificant impact of relative price variable would show that the farmers did not consider the changes in relative prices of lentil, chickpea and blackgram, while allocating area under these crops. On the other hand, insignificant positive impact was found in the case of mungbean but this impact was not significant.

3. 4. 3. Lagged relative yield

The lagged relative yield of blackgram with respect to competing crop mustard has registered positive and significant impact on acreage allocation under blackgram cultivation. The short-run elasticity of blackgram with respect to relative yield variable was 1.39 for the country. The lagged relative yield of lentil turned out to be insignificant and negative which implied that the lentil farmer in the country did not consider the lagged relative yield of lentil vis-à-vis Boro rice during allocation of land for lentil cultivation. It was fact that the area and production of lentil drastically decreased over the period from 1997-2001 to 2002-2006 compared to base period (1972-1976) with slightly increased yield in that period.

3. 4. 4. Risk factors

Of the various pulse crops considered in the analysis, risk arising due to variations in relative price and relative yield. The elasticity coefficients of lentil, chickpea and blackgram were negative and it was positive for mungbean. Price risk variable with negative sign implied farmers' risk aversion response to price fluctuation which means that pulse farmers appeared to be risk lovers by putting less area under the crop. On the other hand, farmers did not consider relative price risk during allocation of mungbean cultivation which might be due to its all season production nature.

The elasticities of yield risk variable were found to be positive and significant at 5% level for lentil and chickpea which indicate that the farmers did not consider relative yield risk in cultivating the aforesaid pulses. They cultivate these two pulse crops mostly for their household need. Thus, the lentil and chickpea farmers in the country exhibited yield risk aversion attitude as the yield risk variable came out with negative sign. On the other hand, the yield risk variable was found insignificant and with negative sign for mungbean and blackgram production indicating that the cultivation of these two crops negatively influenced with yield risk.

3. 4. 5. Irrigated Area

Increase in gross irrigated area in the country has registered in a fall in the area under chickpea, blackgram and lentil. The coefficients of irrigated area variable in chickpea, mungbean and blackgram have emerged negative sign implying that irrigation had the most adverse impact on the cultivation of the above pulse crops in the country with short-run elasticity of –0.126, -0.565 and –0.172, respectively. Besides, the elasticity coefficient of irrigated variable for mungbean was negatively significant at 10% level. This means that one percent increase in irrigated area would decrease the mungbean area by 0.265% keeping other variables constant. In the case of lentil, the coefficient (0.490) was positive and insignificant indicating that farmers considered irrigation factor during allocation of land for lentil cultivation.

4. Conclusions and Recommendations

The study has analyzed the growth of area, production and yield of various pulse crops and estimated the supply response functions for various pulse crops in Bangladesh. Area indices show that the area under chickpea, lentil, blackgram and other minor pulses drastically decreased over the period from 1997-2001 to 2002-2006 compared to base period (1972-1976). Again, the area indices for mungbean and khesari represented an impressive increasing trend over the period from 1982-1986 to 2002-2006 which might be due to introduction of its improved varieties. The production indices of different pulses showed an increasing trend over the period from 1987-1991 to 2002-2006 with slight exception in the production of chickpea and blackgram during 2002-2006. The index of lentil production showed an increasing trend compared to its area which might be due to higher productivity.

The area and production of all types of pulses registered positive growth rates during pre-adoption period (1972-1991) but showed negative growth rates during post-adoption period (1992-2006). The overall productivity growth of all types of pulses increased during 1972-2006 due to adoption of improved technologies. Significant structural changes have occurred in the area and production of different pulses during post adoption period due to policy effect and autonomous production as well. Again, positive structural changes have also been registered in the yield of mungbean and khesari and negative structural changes were found in the yield of minor pulses during post-adoption period due to adoption of improved variety.

Supply response functions fitted for various pulses revealed that lagged area and relative yield risk significantly influenced farmers to allocate land for lentil and chickpea cultivation. They do not consider relative yield risk in cultivating these two crops. The lagged relative yield of blackgram with respect to mustard has registered positive and significant impact on acreage allocation under blackgram cultivation. Farmer shows risk aversion attitude toward relative price risk variable by putting less area under lentil, chickpea and blackgram. Irrigated area variable shows the most adverse impact on the cultivation of chickpea, mungbean and blackgram.

It is recommended that for the dissemination of BARI released HYV pulse varieties to the farmers, existing on-farm research trial, pilot production programme, and block farming of improved pulse crops should be strengthened and extended these programme to other new areas. Regular training programme on the production technology of various pulse crops should be organized for farmers, extension workers and private seed companies for quick dissemination of improved pulse varieties.

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