TREND OF CHANGING GROWTH RATE OF MAJOR SPICES – ASSESSING THE IMPACT OF AGRICULTURAL POLICIES IN BANGLADESH

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Abstract

The study examined the trend of changing in area, production and yield of major spices and the decomposition of output growth systematically documented in pre and post policy implementation period in Bangladesh. Compound growth rates of area, production and yield were estimated by fitting semi-log trend equation using data for 1975/786 to 2007/08. Decomposition analysis of growth was used to measure the relative contribution of area, yield, cropping pattern and interaction to the total output changed for the individual spices. The performance of spices sector was immensely better during the post policy implementation period, than that of pre policy period. During the post policy implementation period, growth rate of area, production, and yield grew at the higher rate than that of pre policy implementation period. The main sources of increasing spices production in post policy implementation period noticed mainly due to area expansion and yield increased through variety substitution.

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1. INTRODUCTION

Agriculture plays an important role in economic development, such as provision of food to the nation, enlarging exports, contribution to capital formation and securing markets for industrialization. Moreover, agriculture has strong direct forward linkages to agricultural processing and backward linkages to input-supply industries. Because of these strong linkage effects, agricultural growth can lead wider economic growth in many countries; even open economies, during their early stages of industrialization (Fan *et al*., 2005; Barrett *et al*., 2003; Irz *et al.*, 2001). It is known empirically that a large share of manufacturing in the early stage of development is agriculturally related (Pryor and Holt, 1999; Gemmell *et al*., 2000). Research by Gollin *et al*., (2002) shows the importance of agriculture in the early stage of development. The researchers find that growth in agricultural productivity is quantitatively important in explaining growth in GDP (Gross Domestic Product) per worker.

Agriculture makes other contributions to nutrition, food security and macroeconomic stability beyond the pro-poor growth (Timmer, 2002). Macroeconomic stability is especially sensitive to volatility in the agricultural sector (Timmer, 2005; Perry et al., 2005). In turns, volatility in the agricultural sector tends to be relatively high because of climate shocks that reduce domestic production and unstable world prices of agricultural commodities. The implication is that these shocks in the agricultural sector, especially food crices, are often the major source of macroeconomic instability in the early stages of development (Barro and Sala-I-Martin, 1995; Dawe, 1996; Timmer 2002). Agricultural growth combined with appropriate policies can mitigate the effect of these shocks, with benefits to the poorest and most vulnerable farming community.

Spices are minor but important agricultural crops of Bangladesh. In the world scenario the "Mother Nature" has blessed the mankind with so many plants out of which man has exploited some for his benefit to make his life enjoyable. Among them, spices have made man's life happier with the required of small quantities, manifold properties and their beneficial uses. Webster and International Standard Organization (ISO) defined spices as "Any of aromatic vegetable products", used in cooking, seasoning and preserving the food, sauces, pickles, etc. The spices and spice products after adding in food, resulted in change of colour appearance, aroma, taste and food materials, can also be stored in fresh state of longer periods.

The use and cultivation of spices go back to the beginnings of history. Most of them are Asiatic in origin. India is said to be the oldest place where spices were available since time immemorial. Among various trade items, spices were the first item of trade between the East and West (Singh 2003). Presently 109 kinds of spices are cultivated in the world (ISO list of spices) but in Bangladesh about 27 spices are used but produce only 17. On the basis of area, yield, demand and availability, spices are divided into three categories viz. major, minor and exotic. Major spices are regularly used in daily diet at large amount such as chilli, onion, garlic, turmeric and ginger. Due to increasing population, demand for cereal food increased significantly. To mitigate this demand, the land of spices crop is being diverted to cereal food crop cultivation. On the other hand, now-a-days many spices processing industries such as Square, BD Foods, Pran, Archu, Advanced Chemical Industries (ACI), Amrita, Dekho etc. have been established in Bangladesh. Due to that, demands for spices as raw material of these industries are increasing day by day with the extension of their production. That is why, the total demands for various spices are increasing in incremental rate. Due to decreasing production and increasing demand for spices, a big gap was observed between production and demand now. To meet up this gap the country has to spend a huge amount of foreign currency (about 6000-8000 million Taka) in every year for importing spices from abroad. To lessen the gap and pressure on the foreign currency, Bangladesh Government had taken some policies to increase spices production largely to meet up the country's demand. However, Bangladesh Government had implemented some development activities during the period 1994/96 to 2008/09 with the help of different institutions and organization to increase the production of major spices. Moreover, during this period, 18 (major-12, minor-6) disease resistance improved variety of spices have been released. On the other hand, 81 technologies on production, soil and water management; disease and insect

management and post harvest management have been developed. Bangladesh Agricultural Research Institute (BARI), Bangladesh Agricultural Research Council (BARC) and Directorate of Agricultural Extension (DAE) have strengthened their works to extend these technologies. However, using these technologies, farmers are now benefited in large scale. As a result, total production of spices has increased from 3.08 lac tonnes in 1996 to 13.59 lac tonnes in 2008 (BBS).

Most of the spices are high valued crops. Net returns of major spices are almost 2 to 3 times higher than any other crops. It can contribute a vital role to increase the farmers' income, generate employment, alleviate poverty, develop food security, and empower women and to increase social development of Bangladesh.

Keeping in view the importance of agriculture, quantitative analysis was done to assess the contribution of the various factors to increase the agricultural output and to achieve higher economic growth. However, there are so many factors, which affects the growth of agricultural output but among this them, area and yield are the major one (Singh, 1981; Cauvey, 1991). The sources of output growth have relevance in deciding programmes of agricultural development and priorities of investment in it (Ranade, 1980; Deosthali and Chandrahekhar, 2004).

Decomposition of growth in agricultural output has remained of active interest to researchers and policy makers. A breakdown of growth into various components such as area, yield and cropping pattern facilities output projection with alternative targets and policies (Jamal and Zaman, 1992). Thus decomposition of among its constituent forces is of great importance. An analysis of the behaviours of agricultural production in the past and estimation of its growth rates can provide a basis for future projections of agricultural output (Lakshmi and Pal, 1988). Therefore, an attempt is made in the present study to analyse the impact of agricultural policies on spices growth and the contribution of various components to the overall changes in output growth of Bangladesh.

2. METHODOLOGY

The present study is based on secondary data for the last 23 years that is from 1975/76 to 2007/08. The data were collected through several issues of BBS (Bangladesh Bureau of Statistics). The entire study period was split into three sub periods to evaluate the impact of agricultural policies on spices performance and to assess the changes in relative contribution of

different factors on output growth over the period of time. The sub periods are Period I: 1975/76 to 1985/86, Period II: 1985/86 to 1994/95 and Period III: 1995/96 to 2007/08.

In the present study compound growth rates of area, production and yield for the selected spices wwere estimated by fitting semi-log or exponential trend equation using data. The compound growth rate (CGR) is usually estimated by fitting a semi log trend equation of the form.

$Y = a.e^{bt}$ .....(i)

or ln Y= Ina+ bt

or ln Y= a+bt (here a = lna)

Where,

A = intercept

Y = Quantity of major spices production, area and yield

b = growth rate in ratio scale and when multiplied by 100, it express percentage growth i.e. annual growth rate

t = time

In = natural log of the variable

The slope coefficient b measures the instantaneous rate of growth. Compound growth rate 'r' was calculated by the following formula; CGR (r) = (antilog of b-1) x100 (Gujrati, 2004)

The above mentioned equation has estimated by applying OLS method. The standard error test was applied to test the significance of b. This equation is generally used on the consideration that changes in agricultural area or output or yield in a given year would depend upon the area or output or yield in the preceding year (Minhas, 1966; Dandekar, 1980; Singh and Rai,. 1997; Deosthali and Chandrahekhar, 2004).

Testing the stability of growth parameter

The stability of growth parameter between two periods (pre and post policy intervention) was tasted by using the following F statistics (Chow Test)

$$F= \frac{\left\{\sum e_p^{\,2} - \left(\sum e_1^{\,2} + \sum e_2^{\,2}\right)\right\}/K}{\left(\sum e_1^{\,2} + \sum e_2^{\,2}\right)/(n_1 + n_2 - 2K)}$$ with k, (n_1+n_2-2k) df

Where

$\Sigma e_p^{\,2}$= Residual sum of squares for pooled sample

Σe_1^2= Residuals sum of squares for period 1

Σe_2^2= Residuals sum of squares for period 2

n_1= Sample size of period 1

n_2= Sample size of period 2

K= Number of parameter

A significant F rejects the stability of growth parameters between the two periods. Area, production and yield of 23 years were used to estimate the growth rate of spices in Bangladesh. The following null hypothesis was tested:

i. There is no significant change in area, production and yield between the two periods. Such change is referred as structural change.

The null hypothesis is H_0:$ß_1$= $ß_2$, Where $ß_1$ is the growth parameter of Period II i.e. 1985/86 to 1994/95 and $ß_2$ is the growth parameter of Period III i.e. 1995/96 to 2007/08.

Decomposition Analysis

Decomposition analysis of growth was done to measure the relative contribution of area and yield to the total output changed for individual spices crop. Analytical model as given below was used. However, for decomposition the component of change in output increases and their contributions were estimated by using Minhas and Vidyanathan (1965) algebraic formulae-

Change in total output	: $P_t - P_0$=
Contribution of area change (Absolute change in area)	: $Y_0 [A_t (1+C_0-C_t)-A_0]$ +
Contribution of yield change	: $[A_t \{1+ (C_0-C_t) (Y_t-Y_0)\}]$ +
Contribution of cropping pattern	: $[A_t Y_0 (C_t-C_0)]$ +
Change in interaction of cropping pattern and yield	: $[A_t (Y_t-Y_0) (C_t-C_0)]$

Where

P_0 = Production of selected spices from 1984/85-1994/95

P_t =Production of selected spices from 1995/96-2007/08

A_0 = Area under selected spices from 1984/85-1994/95

A_t = Area under selected spices from 1995/96-2007/08

C_0 = The proportion of area under the crop to gross cropped area under all crops in1984/85-1994/95

C_t= The proportion of area under the crop to gross cropped area under all crops in 1995/96-2007/08

Y_0=The yield of selected spices from 1984/85-1994/95

Y_t= The yield of selected spices from 1995/96-2007/08

3. IMPACT OF CHANGING GROWTH RATE OF MAJOR SPICES

The compound growth rates (CGR) of area, production and yield were estimated by fitting a semi log trend equation of the form. However, the compound growth rates of area, production and yield of spices were calculated by fitting semilog function. Apart from overall period, compound growth rates were estimated for the periods 1975/76-1984/85, 1985/86-1994/95 and 1995/96-2007/08 separately. The rationale behind the division of whole period into three sub periods was to asses the impact of agricultural policies on spices growth of Bangladesh.

3.1 Area Growth

Table 1 revealed that the area under onion, garlic, ginger and turmeric increased by 0.48, 0.61, 2.43 and 1.47 percent respectively during the Period I (1975/76-1984/85). On the other hand, other spices chilli (summer and winter) recorded decline in area as evident from negative rate of growth (1.104 percent). The insignificant growth rate of onion indicates that its area remained more or less same during this period . The area growth rate considering all spices is negative due to shifting spices land to food grain production to mitigating the demand for cereal food.

Table 1. Growth rate of area of major spices during the period I (1975/76-1984/85)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	3.46	0.0048	0.480	0.14
		(0.004)		
Garlic	2.50	0.0061*	0.611	0.44
		(0.003)		
Chilli	4.41	-0.0111*	-1.104	0.47
		(0.004)		

Ginger	1.63	0.0240** (0.005)	2.429	0.75
Turmeric	2.25	0.0146** (0.002)	1.471	0.85
All Spices	12.79	-0.002 (-0.003)	-0.20	0.09

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level, *= Significant at 5% level

Growth rates during the Period I (1975/76-1985/86) and Period II (1985/86-1994/95) as shown in Tables 1 and 2, showed that rate of growth of onion, garlic, ginger and turmeric acreage in the Period II (1984/85-1994/95) was lower compared to those in Period I (1975/76-1985/86). That means that the areas of these crops declined gradually. Chilli areas in both the periods declined by 1.104 and 0.261 percent respectively. The growth rate curve of area in different sub period is shown in Fig. 1.

However, to protect the decreasing trend of land and deficit of spices, government of Bangladesh had taken some development policies such as developed improved technology, quality seed production and strengthening extension activities. Again, with the consideration mentioned above, Bangladesh government had implemented some development activities with the help of different institutions and organization.

Table 2. Growth rate of area of major spices during the period II (1985/86-1994/95)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	3.52	0.0019 (0.002)	0.190	0.14
Garlic	2.52	0.0036** (0.001)	0.361	0.55
Chilli	4.23	-0.0026 (0.002)	-0.261	0.19
Ginger	1.83	0.0124**	1.248	0.62

		(0.003)		
Turmeric	2.75	0.0025	0.250	0.16
		(0.002)		
All Spices	12.73	0.001	0.10	0.04
		(0.002)		

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level, *= Significant at 5% level

Results from the implementation of these projects, the growth rate of area increased tremendously of all major spices during the Period III (1995/96-2007/08) compared to the previous two periods (Table 3 & Fig. 1). A high rate of increase in area for onion, garlic, chilli and turmeric was observed due to implementing government policy of increasing production through expansion of area under cultivation.

Table 3. Growth rate of area of major spices during the period III (1995/96-2007/08)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	3.05	0.1425**	15.310	0.81
		(0.022)		
Garlic	2.24	0.1037**	10.927	0.83
		(0.015)		
Chilli	4.71	0.0290	2.942	0.08
		(0.031)		
Ginger	1.89	0.0189**	1.908	0.94
		(0.001)		
Turmeric	2.66	0.0317**	3.221	0.78
		(0.005)		
All Spices	12.75	0.071**	7.36	0.77
		(0.012)		

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level, *= Significant at 5% level

All over the period, areas of onion, garlic, chilli, ginger and turmeric started to increase since 1975/76 and continued increasing trend up to 2007/08. The growth rate of area of onion, garlic, chilli, ginger and turmeric from 1975/76 to 2007/08 were 2.79; 2.15; 2.47; 1.22 and 1.14 percent respectively (Table 4 & Fig.1). Growth rate of area in all over period recorded significantly increased for all spices crops.

Table 4. Growth rate of area of major Spices over the period of 1975/76-2007/08

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	3.21	0.0275** (0.006)	2.788	0.43
Garlic	2.31	0.0213** (0.004)	2.153	0.46
Chilli	4.09	0.0244** (0.005)	2.470	0.39
Ginger	1.69	0.0121** (0.001)	1.217	0.89
Turmeric	2.57	0.0113** (0.001)	1.136	0.76
All Spices	12.52	0.025** (0.004)	2.53	0.61

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level

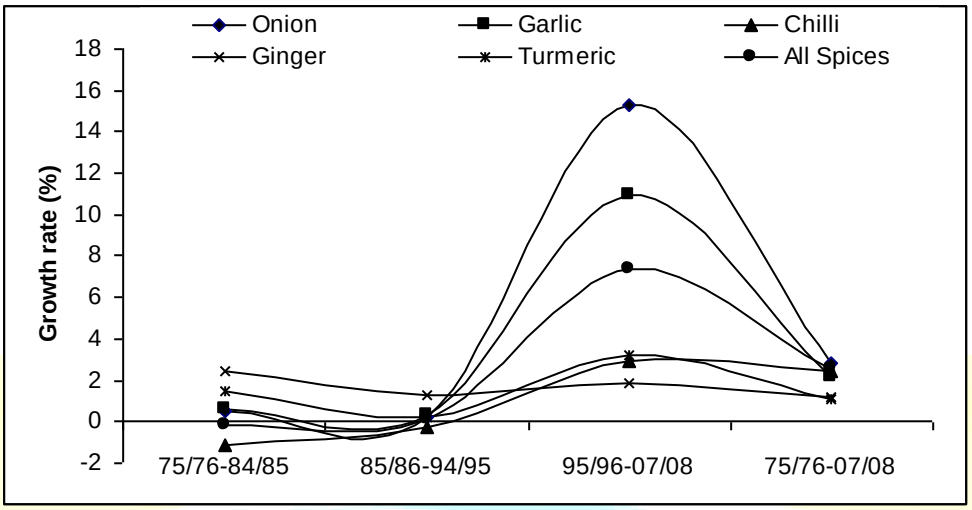

Fig.1. Growth rate of area of major spices in Bangladesh

3.2 Production Growth

The pattern of growth of spices production during period of the 1975/76 to 1984/85 is shown in Table 5. Production of onion and chilli shows negative growth in the period I (1975/76-1984/85). The negative growth was performed due to absence of high yielding varieties and reducing land of spices. Production of turmeric significantly increased by 2.62 percent and ginger 1.44 percent respectively. The negative and insignificant growth rate of all other spices indicates their production remained by and large same during the period with year to year fluctuation. Growth rate of production of all spices over the period was recorded negative (Table 5).

Table 5. Growth rate of production of major spices during the period I (1975/76-1984/85)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	4.94	-0.0087	-0.866	0.04
		(0.015)		
Garlic	3.67	0.0028	0.280	0.04
		(0.005)		
Chilli	3.91	-0.0149	-1.479	0.29

		(0.008)		
Ginger	3.52	0.0143*	1.440	0.52
		(0.005)		
Turmeric	3.04	0.0259**	2.624	0.85
		(0.004)		
All Spices	12.56	-0.002	-0.20	0.01
		(0.009)		

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level,*= Significant at 5% level

Table 6. Growth rate of production of major spices during the period II (1985/86-1994/95)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	11.82	0.0050	0.501	0.22
		(0.003)		
Garlic	3.61	0.0069*	0.692	0.47
		(0.002)		
Chilli	3.76	0.0231	2.336	0.79
		(0.004)		
Ginger	3.71	-0.0013	-0.120	0.02
		(0.003)		
Turmeric	3.47	0.0263**	2.665	0.78
		(0.005)		
All Spices	12.56	0.013**	1.31	0.72
		(0.003)		

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level, *= Significant at 5% level

Table 6 and Fig. 2 reveal that production of all spices except ginger had improved in the period II (1984/85-1995/96) compared with the Period I (1975/76-1984/85). The production of onion, garlic and chilli increased at a faster rate in the period II (1984/85-1995/96) and the negative

growth rate of onion and chilli in the period I (1975/76-1984/85) turned into positive growth rates in the period II (1984/85-1995/96). In all spices production of growth was positive and it was 1.31 percent per annum in Period II.

Table 7. Growth rate of production of major spices during the period III (1995/96-2007/08)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	11.13	0.0.2065**	3.345	0.79
		(0.033)		
Garlic	3.19	0.1424**	15.338	0.80
		(0.022)		
Chilli	4.34	0.0716*	7.423	0.40
		(0.028)		
Ginger	3.50	0.0502**	5.148	0.89
		(0.006)		
Turmeric	3.37	0.1068**	11.271	0.82
		(0.016)		
All Spices	12.25	0.139**	14.91	0.86
		(0.017)		

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level, *= Significant at 5% level

Table 8. Growth rate of production of major spices for over all period (1975/76-2007/08)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	11.41	0.0381**	3.884	0.39
		(0.008)		
Garlic	3.40	0.0252**	2.552	0.37
		(0.006)		
Chilli	3.46	0.0443**	4.531	0.68

		(0.005)		
Ginger	3.51	0.0120**	1.207	0.59
		(0.002)		
Turmeric	2.94	0.0422**	4.310	0.84
		(0.003)		
All Spices	12.20	0.038**	3.87	0.58
		(0.006)		

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level

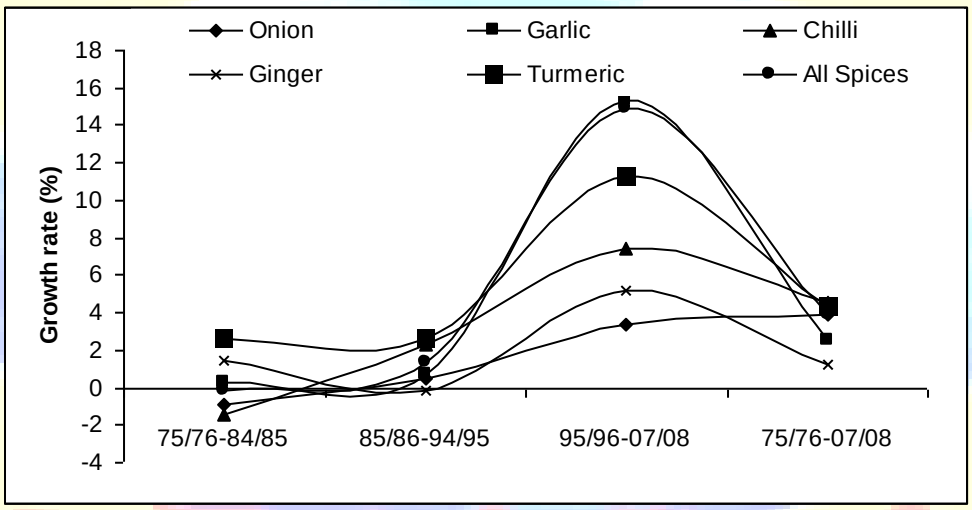

Fig.2. Growth rate of production of major spices in Bangladesh

After the implementation of Government Agricultural Policy to increase spices production, production of all spices crops increased significantly during the Period III (1995/96-2007/08) (Table 7 and Fig.2) due to increasing area, adoption of improvement management practices by farmer, development of high yielding variety and dissemination of HYV seed. The growth trend of overall period (1975/76-2007/08) of all spices crops also increased significantly (Table 8 and Fig.3).

3.3 Yield Growth

Except turmeric all spices registered negative growth rate in yield in Period I (1975/76-1984/85), yield of turmeric increased by 1.14 percent (Table 9) due to better management practices and use of more inputs. Absent of high yielding varieties, improve cultural management and cultivation in the less fertile land resulted decrease in yield of spices. Expansion of area of competing crops of spices compelled the spices to grow in the less fertile land. All spices under consideration, growth in yield was also negative in this period.

Table 9. Growth rate of yield of major spices during the period I (1975/76-1984/85)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	1.48	-0.0136 (0.011)	-1.351	0.16
Garlic	1.17	-0.0034 (0.003)	-0.339	0.11
Chilli	-0.49	-0.0038 (0.005)	-0.379	0.05
Ginger	1.89	-0.0096** (0.002)	-0.955	0.68
Turmeric	0.49	0.0113** (0.003)	1.136	0.70
All Spices	1.03	-0.006 (0.003)	-0.60	0.33

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level, *= Significant at 5% level

Table 10. Growth rate of yield of major spices during the period II (1985/86-1994/95)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	1.39	0.0032 (0.002)	0.32	0.25
Garlic	1.09	0.0033	0.331	0.19

		(0.002)		
Chilli	-0.47	0.0257**	2.603	0.90
		(0.003)		
Ginger	1.88	-0.0137**	-1.361	0.88
		(0.002)		
Turmeric	0.47	0.0239	2.419	0.85
		(0.003)		
All Spices	1.01	0.001	0.10	0.06
		(0.001)		

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level

Comparing the Period I (1975/76-1984/85) and Period II (1985/86-1995/96) from Tables 9 & 10, it was found that growth rate of yield of all spices but ginger in period II (1985/86-1995/96) was higher than the period I (1975/76-1984/85). Growth rate of ginger in period II (1985/86-1995/96) significantly declined by 1.36 percent. The insignificant growth rate of onion, garlic and turmeric in Period II (1985/86-1995/96) implies that yield fluctuated around stagnant level. Chilli growth rate was found higher (2.603 percent) in Period II.

Table 11. Growth rate of yield of major spices during the period III (1995/96-2007/08)

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	1.17	0.0641**	6.62	0.76
		(0.011)		
Garlic	0.94	0.0390**	3.977	0.71
		(0.008)		
Chilli	-0.37	0.0426**	4.352	0.72
		(0.008)		
Ginger	1.61	0.0313**	3.179	0.78
		(0.005)		
Turmeric	0.71	0.0751**	7.799	0.84
		(0.010)		

All Spices	0.84	0.041**	4.19	0.76
		(0.007)		

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level

Table 12. Growth rate of yield of major spices for over all period 1975/76-2007/08

Spices selected	Intercept	Trend Variable	Compound Growth Rate %	R^2
Onion	1.29	0.0106**	1.066	0.3
		(0.003)		0
Garlic	1.90	0.0039*	0.391	0.1
		(0.002)		3
Chilli	-0.63	0.020**	2.020	0.8
		(0.002)		2
Ginger	1.82	-0.0002	-0.110	0.0
		(0.002)		0
Turmeric	0.36	0.0309**	3.138	0.8
		(0.002)		5
All Spices	0.92	0.008**	0.80	0.3
		(0.002)		4

Note: Figure in the parentheses indicates standard error. **= Significant at 1% level, *= Significant at 5% level

It may be noted that after implementation of Government Agricultural Policy, yield of all types of spices improved in Period III (1995/96-2007/08). Yield trend of onion, garlic and chilli changed from negative in the period I (1975/76-1984/85) to positive in Period II (1985/86-1995/96) (Tables 9 & 10). As a result, the yield of all spices showed an upward trend in Period II (1985/86-1995/96) and Period III (1995/96-2007/08). Whereas it was in downward trend in Period I (1975/76-1984/85) (Fig.3.). Through the dissemination of improved technology by extension worker, application of HYV and improve cultural management might augment the yield of spices in the recent past. The growth trend of yield of overall Period (1975/76-2007/08) of all spices except ginger was positive.

In sum, despite of government policies effect during Period III in order to increase the area, production and yield per hectare for all the major spices, increased but they are not significant to meet countries requirement.

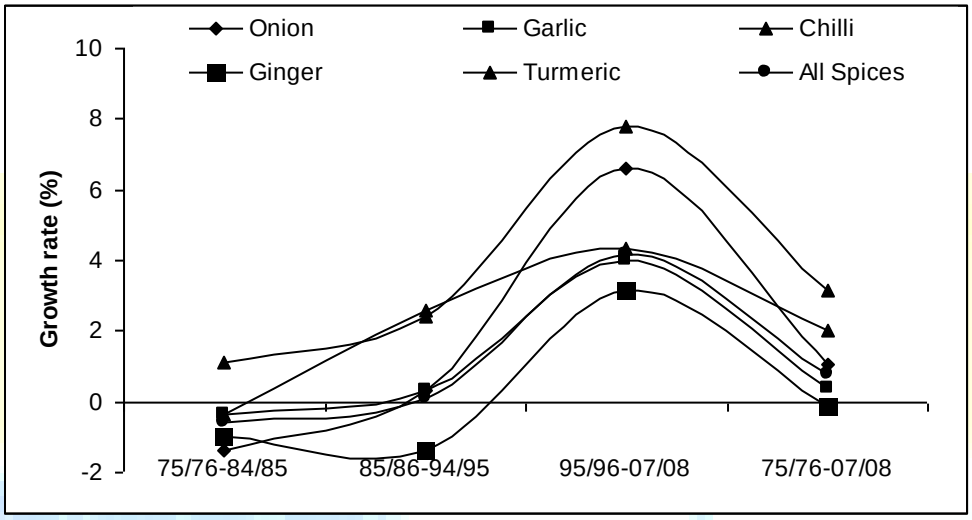

Fig.3. Growth rate of yield of major spices in Bangladesh

4. FACTORS CONTRIBUTING TO SPICES OUTPUT GROWTH

The increase of yield of crop is taken as an indicator of progress and achievement. Increase in output may be attained through increased area allocation from alternative uses and/or through yield increases. Bangladesh agriculture has attained its extensive margin of cultivation of land and there is practically no additional land to be brought under new cultivation. Therefore, achievement of total spices output growth has to be attempted mainly through yield augmenting efforts and crop intensification.

The sources of output change between two periods may be due to changes in area, yield and change in cropping pattern and the multiplicative effect of both cropping pattern and changes in yield. The relative contribution of area, yield, cropping pattern and interaction to change the production of individual spices is presented Table 13.

The study period is 1775/76-2007/08. For the sake of comparison, the average growth changes during the period of 1985/86-1994/95 (Period II) is compared with the average of 1775/76-

1984/85 (period I) and 1995/96-2007/08 (period III) with 1985/86-1994/95 (period II). The period II indicated pre-policy and the period III post –policy implementation period. The Bangladesh Bureau of Statistics (BBS) is the major data source. Between period I and II output had positively changed for all major spices except garlic. Of the four major spices, increase of turmeric output was the highest followed by ginger, chilli and onion. The decomposition analysis of growth of major spices between two periods (I and II) under the study revealed that production of onion and ginger was increased mainly on account of change in area. About 91 and 146 percent of increased output of these two spices were due to increasing and extension of area respectively, while yield increase contributed 9 percent in onion but decreased in ginger about 46 percent. The yield effect was the main source of increasing production of chilli and turmeric, and its contribution about 278 and 73 percent respectively in the production process. Negative change of output of garlic was mainly occurred due to decrease the area.

In terms of period II and III that is pre and post policy implementation period, output changes of five major spices performed positively. Between the pre and post policy implementation period, increase in output in noticed in the case of onion, garlic, chilli, ginger and turmeric which was mainly due to increase in area and the yield. The area effect was the major force of output growth of onion, garlic, chilli, and ginger mainly due to widespread dissemination of modern variety of major spices by the Department of Agricultural Extension (DAE) through several projects. Production increased was occurred about 66, 78, 66 and 79 percent in onion, garlic, chilli and ginger respectively were due to area effect. On the other hand, a remarkable positive change in production of onion, garlic, chilli and ginger by 34, 22, 33 and 21 percent respectively was mainly due to increase in yield . Yield effect was the major force of output changes in the case of turmeric and it was 83 percent while area increases contributed about 17 percent. Cropping pattern and interaction of yield and cropping pattern contributed a minor effect to the total change of production of five major spices. The yield effect was performed mainly due to adoption of modern varieties of spices by the grower. This great achievement was due to sharp increase in area and yield of major spices which was due to implementation of Government spices self-sufficiency programme.

Table 13. Sources of change in spices output growth between period I & II (1975-85 and 1985-95) and Period II & III (1985-95 and 1995-08)

Name of selected spices	Between period I and II (1975/76-1984/85 and 1985/86- 1994/95)					Total (%)	Between period II and III (1985/86-1995/96 and 1995/96-2007/08)					Total (%)
	Changes in output (%)	Source of change (%)					Changes in output (%)	Source of change (%)				
		Area (1)	Yield (2)	Cropping pattern (3)	Interaction (2 and 3)			Area (1)	Yield (2)	Cropping pattern (3)	Interaction (2 and 3)	
Onion	5.04	91.10	8.96	-0.06	0.00	100.00	160.74	65.97	33.89	0.12	0.03	100.00
Garlic	-3.30	-21.53	121.44	0.09	0.00	100.00	86.77	78.07	21.88	0.04	0.00	100.00
Chilli	6.99	-177.15	277.85	-0.57	-0.13	100.00	160.87	66.30	33.37	0.27	0.07	100.00
Ginger	10.92	145.97	-45.99	0.02	0.00	100.00	15.17	78.72	21.26	0.02	0.00	100.00
Turmeric	56.12	27.18	72.81	0.01	0.00	100.00	68.00	16.62	83.37	0.01	0.00	100.00
All Spices	9.30	144.27	-46.13	1.84	0.02	100.00	111.60	73.77	25.65	0.51	0.07	100.00

Note: Sources of the data are referred to in Appendix table 1.

4.1 Stability of growth parameter between pre and policy implementation periods

Stability of growth parameter between pre and policy implementation periods was tested by using the Chow test. The growth rates of yield during pre and post policy implementation period were 0.320 and 6.620 for onion ; 0.331 and 3.977 for garlic; 2.603 and 4.352 for chilli; -1.361 and 3.179 for ginger and 2.419 and 7.80 percent for turmeric respectively, the difference of which was found to be statistically significant at 1 percent level of probability (Table 14). Similarity, growth rates of area and production of onion, garlic, ginger and turmeric during the pre and post policy implementation periods differed significantly 1 percent level.

Table 14. Significance of the difference of per annum growth rate in the pre and post policy intervention period

Name of crops	Dependent variables	Growth rates (%)			Difference in growth	
		Pre-policy implementation period (1985/86-1994/95)	Post-policy implementation period (1995/96-2007/08)	Aggregate (1985/86-2007/08)	Calculated Fc	Tabulated Ft (2, 19)
Onion	Area	0.190	15.310**	5.053**	21.25**	5.01
	Production	0.501	3.345**	7.273**	20.26**	
	Yield	0.320	6.620**	2.113**	16.29**	
Garlic	Area	0.361**	10.927**	4.024**	22.90**	
	Production	0.692*	15.338**	5.216**	19.76**	
	Yield	0.331	3.977**	1.146**	13.23**	
Chilli	Area	-0.261	2.942	4.935**	2.91	
	Production	2.336	7.423*	7.395**	2.51	
	Yield	2.603**	4.352**	2.344**	5.82**	
Ginger	Area	1.248**	1.908**	1.087**	8.33**	

	Production	-0.120	5.148**	1.516**	37.63**
	Yield	-1.361**	3.179**	0.424	32.45**
Turmeric	Area	0.250	3.221**	1.069**	16.90**
	Production	2.665***	11.271**	4.748**	16.00**
	Yield	2.419	7.799**	3.640**	14.89**
All Spices	Area	0.100	7.360**	4.708**	10.30**
	Production	1.310**	14.910**	6.548**	29.68**
	Yield	0.100	4.190**	1.455**	22.20**

Note: **= Significant at 1% level, *= Significant at 5% level

The growth rates of area and production of chilli in pre and post policy implementation periods were -0.261 and 2.942, and 2.336 and 7.423 percent respectively, but their difference was found to be insignificant as calculated F statistics is much lower than its tabulated value.

It is clear from the table that the null hypotheses that existence of no difference in growth rates exist in area , production and yield among pre and post policy implementation is rejected and concluded that the differences in growth rates between two periods in terms of area, production and yield of five major spices are significant at 1% level of significance. The fact of the matter remains that the area, production and yield growth rate in post policy implementation is much higher than that of pre policy implementation period. Therefore, growers had rightly taken advantages of the technologies during the post policy implementation period.

V. CONCLUSIONS AND POLICY IMPLICATION

From the foregoing discussion it emerges the main sources of growth in production of major spices in period I and II, growth rate in area and production being increased in little or negative due to shifted land for food grain production to mitigate the demand for food. By increasing spices production to lessen the deficit and import of spices, Bangladesh Government has taken some active step such as; development of improved variety, production technology and storage technique, quality seed production and their dissemination during the Period III (1995/96-2007/08). Results the implementation of these government policies per annum growth rate of area and production increased remarkably in Period III. However, the main sources of growth in

this period were area and yield effect due to expansion of arable land and, dissemination and replacement of modern variety over traditional variety. The effect of changes in cropping pattern and interaction were very little in this period.

The decomposition findings have important policy implication for the simple reason that each of the growth components has a limited potential of expansion. For example, the land potential has already been exhausted due to the scarcity of land for spices instead of food grain cultivation. When this potential is exhausted, assuming that the current yield trends continue, the growth in spices production will decline after some years. Coupled with a growing population where by some arable land would be reduce accommodation this population, this will imply a decline in per capita production. There is an urgent need to increase spices production more which will become inevitable in view of population growth. As such efforts have to be directed to ward further increasing the productivities of various spices crop. The further policy of Government will have to be entered on the developing new high yielding varieties in Bangladesh. Research efforts therefore need to be more intensified further to develop high yielding varieties of the crops suitable to agro-ecological conditions of the region.

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Appendix table 1. Average area, production and yield of different selected spices in Bangladesh, 1775/76-1984/85, 1985/86-1994/95 and 1995/96-2007-08.

Name of selected spices	**Period I** : 1775/76-1984/85 (Average)				**Period II** : 1985/86-1994/95 (Average)				**Period III** : 1995/96-2007/08 (Average)			
	Area (000 ha) A_1	C_1	Production (000 tons) P_1	Yield (ton/ha) Y_1	Area (000 ha) A_2	C_2	Production (000 tons) P_2	Yield (ton/ha) Y_2	Area (000 ha) A_3	C_3	Production (000 tons) P_3	Yield (ton/ha) Y_3
Onion	32.678	0.00103	133.550	4.081	34.212	0.00100	140.276	4.099	62.711	0.00181	365.761	5.055
Garlic	12.602	0.00040	39.982	3.172	12.691	0.00037	38.662	3.046	20.039	0.00058	72.209	3.359
Chilli	77.600	0.00246	46.459	0.598	67.678	0.00199	49.706	0.735	141.008	0.00408	129.669	0.927
Ginger	5.830	0.00018	36.679	6.305	6.755	0.00020	40.684	6.033	7.506	0.00022	46.854	6.196
Turmeric	13.909	0.00044	24.270	1.742	16.037	0.00047	37.891	2.361	17.688	0.00051	63.655	3.466
All Spices	142.619	0.00451	280.941	2.722	137.497	0.00404	307.055	2.754	240.274	0.00695	649.740	3.162
Gross Cropped Area (All Crops)	-	31598.400	-	-	-	34051.200	-	-	-	34592.846	-	-

Note: C_1, C_2 and C_3 stand for area as proportion of the gross cropped area.

Source: Several issues of BBS.