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## **COMPARATIVE STUDY ON SOURCES OF GROWTH IN AGRICULTURE OF BANGLADESH UNDER VARIOUS SOCIO-POLITICAL REGIMES FROM 1961-2016 USING GROWTH ACCOUNTING FRAMEWORK**

**Zannatul Fardoush**

*Joint Director, Department of Financial Institutions & Markets, Bangladesh Bank (the Central Bank of Bangladesh), Dhaka, Bangladesh*  
[zannatul.fardoush@yahoo.com](mailto:zannatul.fardoush@yahoo.com)

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### **Abstract**

*Investigating the determinants of economic transformation has become an important fundamental goal of the development economics. Among the economic sectors, agriculture is considered as the highly challenging area to increase the productivity and efficiency. Yet, it remains the most wide-spread economic activities with immense implications for the economic growths in many developing and least-developed countries. This study has examined the sources of growth in the agriculture sector in Bangladesh over the last five and half decade (1961-2016) under the various socio-political regimes. TFP-based Growth accounting model is used to determine the sources. Results reveal that agricultural growth in Bangladesh has a reasonable relationship with the socio-political factors. The rate of growth was lowest during the 15 years of the military regime (1975-1990). Under all non-democratic regimes and within some closed economy the growth was mainly led by the input factors. The sustainability in growth led by TFP has come only under the proper democratic environment with liberalized trade policies.*

## Keywords

Growth Accounting Model, Sources of Growth, Bangladesh Agriculture, Total Factor Productivity

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## 1. Introduction

Empirical evidence reveals that the economic development of a country comes along with its structural transformation from the agricultural economy towards the manufacturing and service sectors-based economy (Herrendorf et al., 2014). Investigating the determinants of this transformation has become an important fundamental goal of the development economics' research (Smirnov & Stukova, 2015). In this regard, economists have come with a diversity of models. The famous *Marxian* and *neoclassical* growth theories acknowledge the significances of technological advancements and organization of production to instigate the productivity improvements that, in turn, would drive the growth (Laibman, 2016). Alternatively, the new-fangled growth theories along with another branch of the neoclassical economics, known as the *theory of capital and investment*, emphasize on the increased investments in human capital, fixed capital, and knowledge base in propelling the economic growth (Iamsiraroj, 2016). Growth accounting has been a key element and a fundamental policy tool vastly used by the policymakers to decompose the economic growth into the changes of the input factors (i.e., the direct components of growth) and the technological progress (i.e., the indication about how effectively and efficiently the inputs are processed). The technological progress, also known as the *Solow residual*, or Total Factor Productivity (TFP) growth (Solow, 1957).

In general, the empirical works on the growth accounting need to undergo two key stages. Firstly, to constructing a reliable dataset with historical data on relevant inputs and outputs; and, secondly, to calculating the degree to which the output growth results from the usage of inputs and how much is due to the technological factors, i.e., productivity (Barro, 1998). Such a scholarly approach is sometimes termed as the *sources of growth analysis*. In literature, this type of analysis is widely used not only in macroeconomic level (Sarel, 1996, Senhadji, 2000, Bosworth & Collins, 2008, Zhu, 2012), but also at sectoral levels (VanArk, 1996), and even at the firm-level (Petrin & Levinsohn, 2012).

Among the economic sectors, agriculture is considered as the highly challenging area to increase the productivity and efficiency (Alston et al., 2009). Yet, it remains the most widespread economic activities with immense implications for the economic growths in many

developing and least-developed countries. That is why a considerable number of studies has focused on the agricultural growth accounting. Fuglie (2015) used it to compare the sources of growth in global agriculture during the 1961-2012 period. Dhehibi et al. (2016) applied it to explore the sources of growth in Egypt's agriculture. Das (2016) used the approach for determining the driving factors for India's agriculture. Such studies have become more significant in cases of the small countries with a big population to feed. Bangladesh, with a small land area of 130,170 square km and a population density of 1278 people per square km, this type of study should be of utmost significance (Worldometers, 2018). This paper, therefore, attempts to use the growth accounting framework to determine the sources of growth in agriculture of Bangladesh over the 1961-2016 period. To linking with the policy implication, the study period has been categorized under various socio-political regimes.

## **2. Background of this Study**

In the field of development economics, Total Factor Productivity (TFP) has been considered as an important measure of economic growth. Several empirical studies have been conducted by the researchers in the various part of the world to determine the sources of growth in agriculture using TFP (Suresh & Chandrakanth, 2015). However, in Bangladesh, while a good number of researches have been accomplished to measure the TFP growth at the aggregate economy level, very few of them have dealt with the agriculture sector (Rahman, 2016). This paper thus seeks to contribute to the growing literature by examining the pattern of sources of growth in the agriculture sector of Bangladesh under different socio-political regimes.

Bangladesh economy has a large agricultural base. Along with its contribution to the primary sector, agriculture also supports the large-scale agro-based industrial sector of the country. As a primary sector, agriculture comprises about 14.8% of the country's GDP (ADB, 2017). The agriculture sector is broadly comprised of the crops, forests, fisheries, and livestock. The share of crop sub-sector dominates with its contribution amounting to 71 percent of agriculture output. Forest contributes with 10 percent, fisheries 10 percent and livestock 9 percent in total agriculture GDP (BBS, 2014). The primary sector alone generates 42% percent of total national employment too (ADB, 2017). Throughout the past decade, the agriculture sector, on average, contributed to about 4.5% percent per annum to the annual economic growth rate which slightly came down to 2.8% in 2016. The performance of this sector has a significant impact on

key macroeconomic policy implications such as creating employment, alleviation of poverty, human resource development and food security.

Bangladesh's success in transforming its distressed agricultural sector of the 1960s and 70s into one of the most productive farm-economies is an exemplary development model in South Asia (Gathala et al., 2015). Historically, the country was portrayed by the famine and its heavy reliance on food imports over the decades. The country now, in essence, attained the long-awaited self-sufficiency in food. It also emerged as a momentous exporter of high-value agricultural products. Rice production has been doubled from 11.7 million metric tons in 1974 to 23.1 million tons in 2000, i.e., with an average annual increase of 3.6 percent. Wheat production, on the other hand, climbed a 16-fold increase from 0.11 million metric tons in 1974 to 1.8 million metric tons in 2000. The agricultural composition of the economy also is showing quick diversification, predominantly in the livestock and poultry sectors (Swain & Teufel, 2017). Alongside, over the last five years, exports of agricultural products, regarding crops, commodities and the processed products, grew by nearly 5 percent, on average. Unlike the garment industry where the value addition is relatively lower since the bulk of the export earnings of these garments go out of the country to make payment for imported raw materials and machinery, the value addition in agriculture sector is fairly higher.

Bangladesh's prosperous agricultural sector is advancing towards new global cooperation and ties between the people of Bangladesh and respective foreign aid agencies, international research organizations, and NGOs. It has been well-recognized as a South Asian success story. Alongside, agricultural development of the country is comprehended over the decades through better crop diversification, free-market oriented policies, investments in seed research and development, state-of-art irrigation, infrastructure developments, and innovative approaches to food security measures have facilitated the country to move into this successful attainment (Gordon, 2002).

### **3. Historical Background of Agro-Policies in Bangladesh**

In developing countries like Bangladesh, an economic development largely depends on the policymaking bodies, especially the political will and commitments. Therefore, a close relationship has been observed between growth in agriculture and socio-political characteristics. History reveals that Bangladesh has experienced several political ups and downs with different regimes. Broadly, we can divide the whole scenery into five eras:

- Pre-independence military regime (1961-1971)
- Post-independence restructuring democratic era (1971-1975)
- Post-independence prolonged military regime (1975-1990)
- Revived democratic era phase-I (1990-2000)
- Consolidating democratic era phase-II (2000-2016)

For a deeper analysis of the democratic era's policy impacts on development, the study has divided this era into two phases; phase-I (1990-2000) refers to the first terms of the two main political parties to be in power (one after another) after the country's restoration into the democratic practice since the prolonged military regime of one and half decade. Phase-II encompasses the consolidation of democracy with the duration from 2000-2016.

### **3.1 Pre-independence military regime (1961-1971)**

Bangladesh, the then East Pakistan, was suppressed under the Pakistani administration and was deprived in all aspects of development. There was no such policy undertaken by the Pakistani military ruler for the welfare of agricultural development except some small attempt under the 'Green Revolution' adopted by the Dictator Field Martial Ayub Government. Lack of infrastructure and usage of traditional technology in agriculture was the detrimental feature of this era. The country often experienced severe food shortage during the 60s, which was common for all countries in this region.

### **3.2 Post-independence restructuring democratic era (1971-1975)**

The post-independence government started with huge expectation but with limited resources. Dislocation of resources (including the crops, livestock, and tractors) and destruction of the whole economic infrastructure during the independence war resulted in the real hardship for the country's agricultural development during this time. The government put the focus on increasing production using the available resources. However, the then world political polarization and food supply made the scenario further worsen during that period. Proper management of land and ensuring food security was the greatest challenges for the policymakers at that time. Introducing a National Land Policy as well as National Agricultural Policy was attempted by the government. However, they could not prepare these in their short tenure of three and a half years.

### **3.3 Post-independence prolonged military regime (1975-1990)**

With the intervention and taking over the power by the military government seemed to be hindered the fundamental focus of the social welfare of the economy. However, to make the

government popular, in the early 80s government started thinking about the improvement of irrigation and crop diversification. Some significant improvement in irrigation was observed. However, the production method was still relying on the traditional process and machinery. During the second half of this regime, some policy measures had been taken. Liberalization of trade started getting momentum during this era in minor irrigation sector and encourage the private sector for supplying the minor irrigation tools and system in the country. It happened steadily in different phases with the gradual elimination of restriction of import of small diesel engine in 1986-87. It had been followed by the withdrawal of duty on such imports in 1988-89. Despite some internal efforts, the production, as well as TFP, did not get the desired momentum since the non-cooperation of the other countries and development partners due to the political legitimacy of the government.

### **3.4 Revived democratic era phase-I (1990-2000)**

The first decade after the reintroduction of democracy was the preliminary stage of real development. Joining in WTO in 1995 was a turning point as the government started removing subsidies in agricultural products and tools. Efforts were taken to make agricultural inputs readily accessible to the farmers while guaranteeing fair commodity prices through the gradual elimination of policy restrictions, reduction of the tariff, and adoption of an open-market economy. According to the World Bank, Bangladesh has the most open and least subsidized agriculture sector among the countries in South Asia (World Bank, 2007).

Liberalization in the trade of food has been considered as one of the key policy decision taken by the governments in this era. During this phase, the private sector is allowed to step in to import food grains at times of domestic production shortfall resulted from sudden flood or droughts. This liberalization has some notable implications in supply and price stabilization of food grains in Bangladesh. It also helped in to ease the financial burden in the public sector. For instances, after the devastating flood in 1998, 2.26 million metric tons of food was imported by the private sector that helped the government to save its \$185 million. The private sector's share in food imports ascended from zero in 1991 to 50 percent in 1996, which climbed to 100 percent in 2000.

One of the major policy outlooks during this era was the issuance of the revised *Fertilizer Control Ordinance* in 1995 in consultation with the private sector and IFDC. It was adopted for a better quality control mechanism and regulation in fertilizer pricing. It was also aimed to increase the supply of fertilizer, especially the chemical fertilizers at the farm level. Due to the

gradual amputation of government power and bureaucratic complexities in fertilizer distribution, the economic activities in rural areas got substantial momentum during this era. Import of agro-machineries, including power tiller, was also liberalized. The growing usage of power tiller accelerated the cultivation as it encompassed 3.5% more land area under cultivation per annum, on average (ReportBD.com, 2006).

### **3.5 Consolidating democratic era phase-II (2000-2016)**

In the second phase, Bangladesh's flourishing agricultural sector has been furthering from new global experiences and cooperation from the foreign aid and supports by the international agencies in developing capacity and infrastructures. One of the remarkable milestones in Bangladesh's agricultural sector was the development and achievement of dry-season irrigated rice. During the 70s and 80s, cereal production of the country predominantly relied on the monsoon which dramatically changed during this era. Following the continuous research and development, especially by the public universities and research institutions, the emergence of high-yielding rice varieties was able to be tailored to shorter days and cooler temperatures. The fertilizer system has been undergone a comprehensive reform. Privatization policies have resulted in a remarkable improvement in fertilizer management within just ten years. The growing agricultural R&D and private sector's investment also helped to the modernization of the conventional irrigation system that largely aided the higher agricultural production in Bangladesh. Alongside, collaborations from the global organizations like the International Rice Research Institute (IRRI) and the International Maize and Wheat Improvement Center (CIMMYT) has shaped Bangladesh's agricultural research system to innovate more sustainable and productive crop varieties with the more efficient agriculture production system in the country.

The government also implemented significant reforms in its large public food supply and management system under the "safety net" program for the poor. Structural changes have also made in the food procurement policies from the farmers, the reasonable pricing based on market prices, and allowing import of food grains by the private sector.

The policy reforms during this period primarily targeted to offer greater scope and opportunities for the private sector to engage in a conducive environment towards promoting agribusiness and attracting adequate investment. National Agriculture Policy (NAP) of 1999 was adopted during this time that includes:

- Appropriate distribution of the agricultural inputs at reasonable prices and in a timely manner,
- Suitable action plan for ensuring better access towards the agricultural credit and marketing of agricultural products,
- Government support for agricultural development, infrastructure, and capacity building,
- Emphasizing the development of agro-based small and medium industries,
- Encouraging the private sector's participation in both primary and processed industrial areas of agriculture
- Adopting mechanization and updated tools for agriculture production
- Implementing effective pest management strategies at farm level
- Ensuring enhanced coordination between the government, NGOs and private sector in agriculture
- Adopting the food-based nutrition strategies
- Protecting the land and environment to ensure more sustainable agriculture and
- Encouraging the involvement of women in agriculture.

## **4. Methodology and Data**

### **4.1 Growth Accounting Framework**

Considering the neoclassical aggregate production function:

$$Y = F(A, K, L) \quad (1)$$

where Y is total output, K is the stock of capital in the economy, L is the labor force, and A is a composition of untouchable factors like technology, the contribution of institutions, markets and government which refers how effectively the capital and labor are used in production.

Let's assume that the function F(.) is homogeneous of degree one. The underlying assumption of a perfect competition should imply that the input factors must get their marginal products:

$$\frac{dY}{dK} = MPK = r \quad (2)$$

$$\frac{dY}{dL} = MPL = w \quad (3)$$



For simplicity, this study assumes unit price (i.e.,  $P = 1$ ), and therefore, the factor and output quantities would represent the values in all respective equations.

By using the total differentiation on the above production function (1), we get

$$dY = F_A \cdot dA + F_K \cdot dK + F_L \cdot dL \quad (4)$$

where  $F_i$  denotes the partial derivative with respect to factor  $i$ . Hence, in case of the capital and labor,  $F_i$  would refer the marginal products of capital and labor respectively.

Under the perfect competition assumption, equation (4) becomes:

$$\begin{aligned} dY &= F_A \cdot dA + MPK \cdot dK + MPL \cdot dL \\ &= F_A \cdot dA + r \cdot dK + w \cdot dL \end{aligned} \quad (5)$$

If we divide both sides of equation (5) by  $Y$ , we get:

$$\frac{dY}{Y} = \left(\frac{F_A A}{Y}\right) \left(\frac{dA}{A}\right) + \left(\frac{rK}{Y}\right) \left(\frac{dK}{K}\right) + \left(\frac{wL}{Y}\right) \left(\frac{dL}{L}\right)$$

By denoting a growth rate (percentage change over time) of a factor, we can rewrite it as

$$g_Y = \left(\frac{F_A A}{Y}\right) g_A + \left(\frac{rK}{Y}\right) g_K + \left(\frac{wL}{Y}\right) g_L \quad (6)$$

Then  $\frac{rK}{Y}$  represents the share of total income that goes to capital (lets denote it as  $\alpha$ ) and  $\frac{wL}{Y}$  refers to the share of total income that goes to labor (lets denote it by  $1 - \alpha$ ). Hence, equation (6) can be rewritten as:

$$g_Y = \left(\frac{F_A A}{Y}\right) g_A + \alpha * g_K + (1 - \alpha) * g_L \quad (7)$$

In principle, the terms  $\alpha$ ,  $g_Y$ ,  $g_K$ , and  $g_L$  are all observable and can be estimated by using the standard national income accounting methods. The term  $\left(\frac{F_A A}{Y}\right) g_A$ , however, is not directly observable since it apprehends the technological advancement and improvement in productivity which is rather an exogenous factor into this model and considered to be unrelated to the changes in use of input factors. This term is generally referred to as Solow residual or **Total factor productivity (TFP)** growth.

Thus,

$$\text{TFP growth} = g_Y - \alpha * g_K - (1 - \alpha) * g_L \quad (8)$$

Now, for this paper let us consider an aggregate agriculture production function of the following form

$$Y = A(t) f(L, N, F, M, S)$$

where Y= total output from the agriculture sector

A = Technological progress factor

L = Total number of active labor deployed in economic activity in the agriculture sector

N = Amount of land for agriculture

F = Amount of fertilizer consumed for agriculture production

M = Number of machinery used in agriculture

S = Number of Livestock

The production function assumes that output growth is derived from two growth factors-

(a) Factor accumulation or input growth

(b) Total Factor Productivity growth

Following the approach of traditional growth accounting method as discussed earlier, the growth of output can be decomposed into the following form:

$$\frac{Y_2 - Y_1}{Y_1} * 100 = \frac{A_2 - A_1}{A_1} + w_L \frac{L_2 - L_1}{L_1} + w_N \frac{N_2 - N_1}{N_1} + w_F \frac{F_2 - F_1}{F_1} + w_M \frac{M_2 - M_1}{M_1} + w_S \frac{S_2 - S_1}{S_1} \quad (9)$$

where subscripts indicate the consecutive time periods while  $w_L, w_N, w_F, w_M$  and  $w_S$  represent the share or weights of corresponding inputs (labor, land, fertilizer, machinery and livestock) for the production.

The weights on the input variables can be production elasticity or cost shares of individual inputs under the assumptions of a Cobb-Douglas type production function and the existence of competitive equilibrium. However, there are few challenges in the estimation of a production function. Since the extensive studies on the time-series data and the information on cost shares for Bangladesh are limited, a set of weights from previous studies of socialist agriculture by Wong and Ruttan (1986) and Wong and Ruttan (1990) can be utilized for the examination of data from transition economies. The weights are 0.155 for labor, 0.042 for land, 0.239 for fertilizer, 0.173 for machinery and .391 for livestock. Another set of weights (0.45 for labor, 0.1 for land, 0.15 for fertilizer, 0.1 for machinery and 0.2 for livestock) used by Hayami and Ruttan (1985) might be good for the use if the study deals with non-transition countries.

## 4.2 Description of Data

Data used for the study has been extracted from the agriculture section of the Statistics Division of the Food and Agricultural Organization (FAO). The analysis covers the case of

Bangladesh agriculture for the period 1961-2016. The following are the key features of the data set:

**Output:** The output is based on the agricultural PIN (production indices). These indices are net of the amount used for feed and seed.

**Input:** This paper considers five input variables: labor, land, machinery, fertilizer, and livestock. Each of them is discussed below:

- a) Labor (L): The variable *Labor* refers to all *economically active population* engaged in the agricultural activities comprising agriculture (crops), poultry & livestock, forestry, hunting, and fishing.
- b) Land (N): *Land* covers the arable land which comprises the land under temporary crops, temporary meadows for mowing or pasture, land temporarily fallow with less than five years. As a convention, land with double-cropped areas is counted only once. Arable land also includes the land for permanent crops-land that need not be replanted after each harvest.
- c) Fertilizer (F): Total fertilizer consumption data were available for the period till 2002 which was used. However, after 2002, data for fertilizer has been used as the sum of nitrogenous fertilizer, phosphate fertilizer and potash fertilizer, which were consumed. This variable is expressed in metric tons.
- d) Machinery (M): This variable reflects the total number of tractors used in agriculture. It is to note that only the number of tractors is used as the input variable with no allowance (or scaling) is made based on the horsepower or capacity of those tractors.
- e) Livestock (S): The livestock input variable used in this study is calculated based on the aggregation of 11 animals. The weights used for calculation are Buffalo and cattle (0.8); sheep and goat (0.1); chicken and duck (0.01).

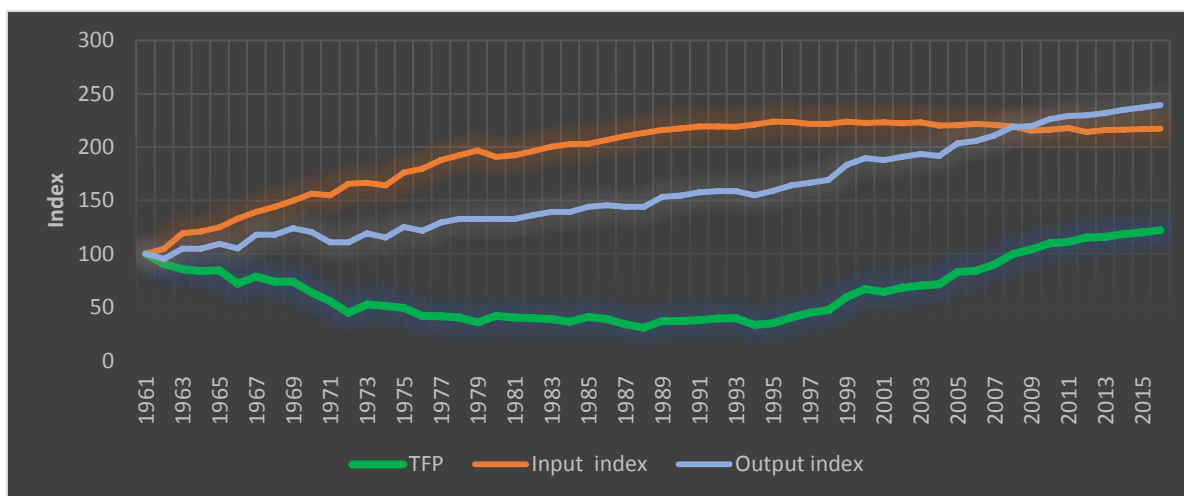
To aggregating the above inputs, the following weights were adopted from Hayami and Ruttan (1985): 0.45 for labor, 0.10 for land, 0.15 for fertilizer, 0.10 for machinery and 0.20 for livestock.

## 5. Results and Analysis

### 5.1 Overall analysis

Figure 1 shows the trend of TFP, total input and total output in the agriculture sector of Bangladesh for a period of 1961-2016. The trend reflects the fact that, agriculture in Bangladesh

has been performing consistently better with time. The output shows the convex nature of growth while the input curve shows a diminishing increment till 2000. Since then, it experienced a slightly downward trend. The resultant TFP has been declining until the end of the 1980s, since then it is found with persistent positive growth trend.



**Figure 1:** Trend of TFP, total input, and output for agriculture of Bangladesh (1961-2016)

Source: Author’s calculation based on FAOSTAT dataset

Table 1 shows the decomposed Growth Accounting for the agricultural sector of Bangladesh in different socio-political regimes. Result reveals that output growth rate was the lowest in the military-backed pre-independence era, which rose at a great pace after the independence. During the post-independence restructuring era (1971-1975) the output growth rate was the highest in the country’s record. However, after the obstacles in the ongoing democratic phase, the military regime began, and the output growth rate started slowing down. Interestingly, this military regime (1975-1990) also resulted in the second lowest output growth rate among the all socio-political phases. However, the output growth rate increases after that with a consistent momentum during the following two democratic phases. Output growth rate, however, slightly slowed down during the Democratic phase II, largely due to the major political instabilities throughout that period.

**Table 1:** Decomposition of Output growth for the agriculture of Bangladesh (1961-2016)

Phases/Era	Period	TFP Growth	Total Input Growth	Total Output Growth
Pre-independence military regime	1961-1971	-4.90%	6.11%	1.21%

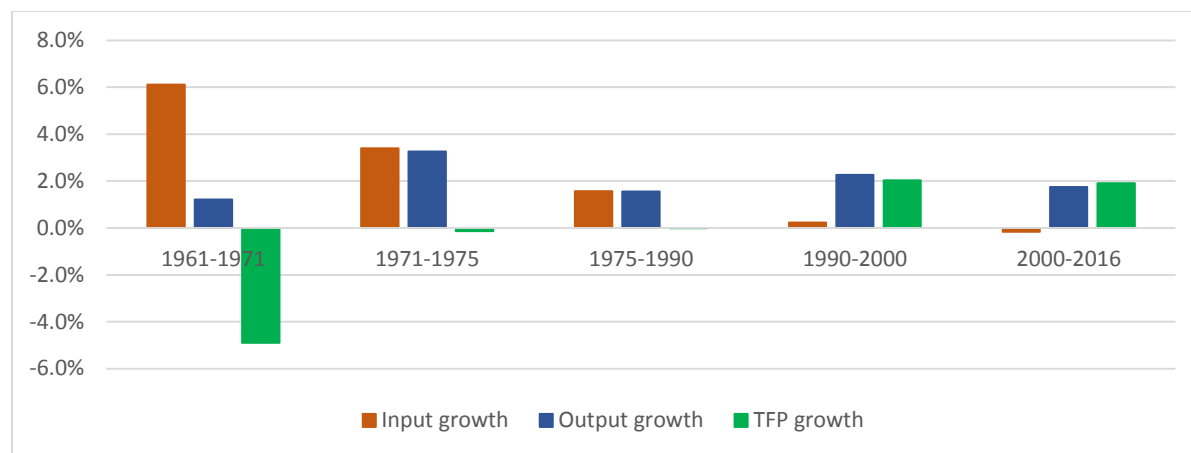
<b>Post-independence restructuring democratic era</b>	1971-1975	-0.13%	3.40%	3.27%
<b>Post-independence prolonged military regime</b>	1975-1990	-0.01%	1.57%	1.56%
<b>Revived democratic era phase-I</b>	1990-2000	2.03%	0.23%	2.26%
<b>Consolidating democratic era phase-II</b>	2000-2016	1.91%	-0.16%	1.75%

Source: Author's calculation based on FAOSTAT dataset

The contributing factor behind this growth trend was initially driven by the input growth, but with time the input growth rate has been substantially declining throughout the phases. Especially, it had a remarkable decline in democratic phases and came down to negative during the Democratic phase II (2000-2016).

Importantly, the resultant impact on TFP growth has been experiencing a phenomenal growth throughout the 1961-2016 period. Starting with a negative growth rate of 4.90% per annum during 1961-1971, it increases to 2.03% per annum during Democratic phase I (1990-2000). The pace slowed down a bit during the Democratic phase II, yet, showing much potential. Again, the military regime (1975-1990) has shown very little pace in TFP growth from its previous restructuring era.

Figure 2 clearly shows the transformation in the performance of the agricultural sector over the last five and half decades. Noticeably the total input growth rate has been declining in contrast with the increasing trend in TFP growth rate. One interesting observation is that the TFP growth rate exceeded the total input growth rate as soon as the country started enjoying democracy in 1990. In the early 90s, lots of reform, restructuring, and liberalization had helped to get the momentum going.



**Figure 2:** Trend of growth rates in TFP, total input, and output (1961-2016)

Source: Author's calculation based on FAOSTAT dataset

The primary objective of this study is to determine the major contributing factors behind the growth in agriculture sector in a different era, i.e., whether it is due to the deployment of more of input factors or there is some technological advancement occur that helped boosting up the growth. Table 2 shows the disaggregated input growth (growth of labor, land, machinery, fertilizer, and livestock) over the periods. It would reveal the contribution of specific factors in total input growth for the agricultural sector in various periods.

**Table 2:** Segregation of Total Input Growth for the agriculture of Bangladesh (1961-2016)

Era	Period	Labor	Land	Machinery	Fertilizer	Livestock
Pre-independence military regime	1961-1971	1.69%	0.26%	20.42%	35.88%	2.67%
Post-independence restructuring democratic era	1971-1975	1.75%	0.80%	8.59%	22.16%	0.00%
Post-independence prolonged military regime	1975-1990	1.70%	0.25%	4.70%	22.23%	-0.17%
Revived democratic era phase-I	1990-2000	-0.23%	-0.95%	0.63%	4.14%	0.32%
Consolidating democratic era phase-II	2000-2016	-2.00%	-0.22%	0.27%	2.87%	1.16%

Source: Author's calculation based on FAOSTAT dataset

However, the trend reveals that the growth rate of all the inputs except the livestock has been declining throughout. It also affirms the fact that there is a transformational shift in the characteristics of the economy of Bangladesh from agro-based to manufacture or service-oriented economy. Employment in agriculture had a positive growth trend even until the military regime, which, however, had experienced a declining trend since the democratic phase in 1990. Land usage also experienced the similar trends like the labor. The growth rate in the applications of machinery (especially, the conventional tractors, and ploughs) and fertilizers have been drastically declined over the period. The implication of livestock shows a declining trend till the end of the military regimes. However, the emergence of poultry and livestock sectors since the early 90s have resulted in an increasing application of livestock in the agriculture of Bangladesh.

In the following section, a more specific diagnosis has been performed to determine the actual determinants of agricultural production growth for each period.

## 5.2 Pre-independence military regime (1961-1971)

During the ruling of Pakistani dictators, the desired growth in the primary sector of the economy was not experienced in this period. It has been shown from Table 1 that during the pre-independence era the average annual growth of agricultural output was about 1.21%. In this period, the average annual growth of total input was higher (6.11%) than that of output, and average annual TFP growth was negative (-4.90%). Hence this period can be termed as “*Highly Input-driven growth*”.

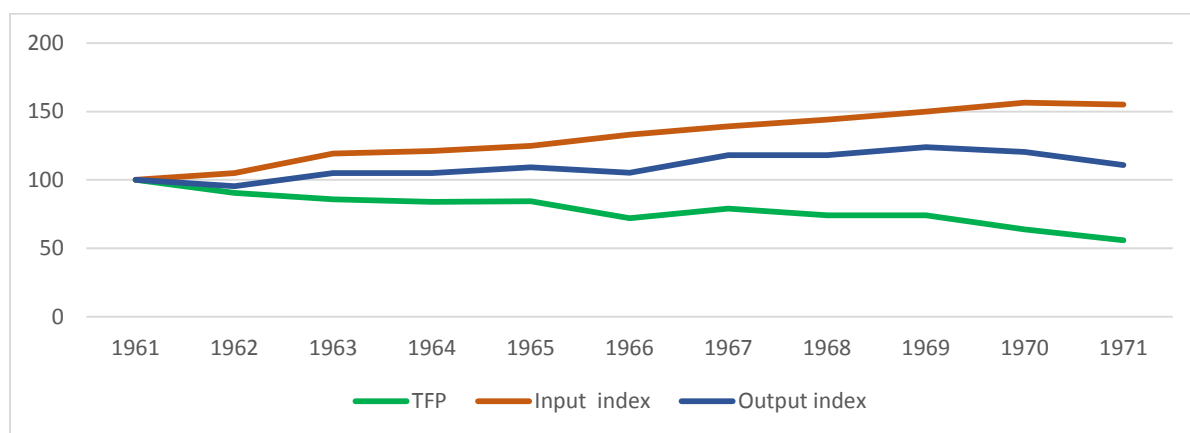
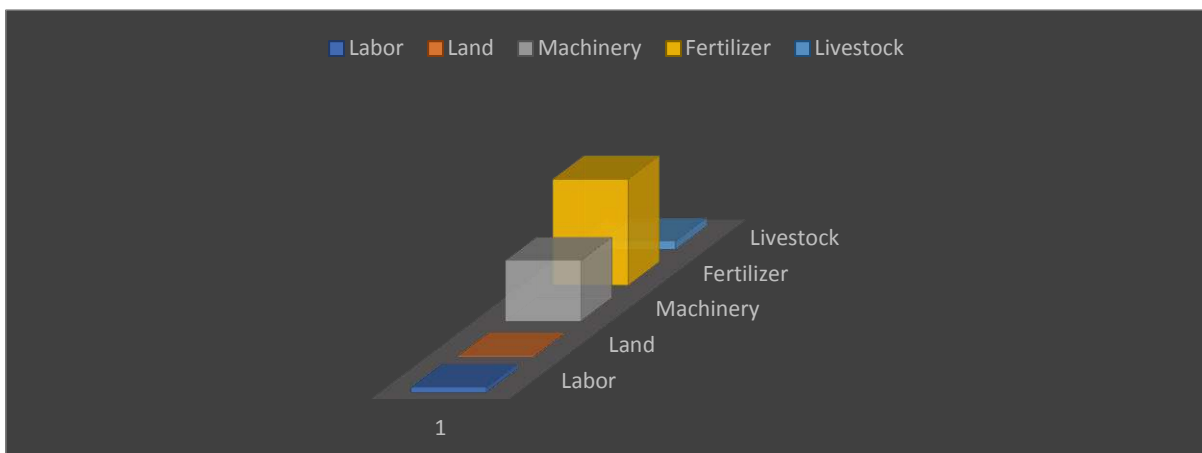


Figure 3: Trend of TFP, total input, and output during the pre-independence era (1961-1971)

Source: Author’s calculation based on FAOSTAT dataset

Despite having around 11% output growth in agricultural production throughout this pre-independence era, there was not any qualitative productivity improvement. Figure 3 reveals that,

for receiving this amount of output growth, total input has to increase to around 55% which implies that TFP growth over the period had declined by about 46%.



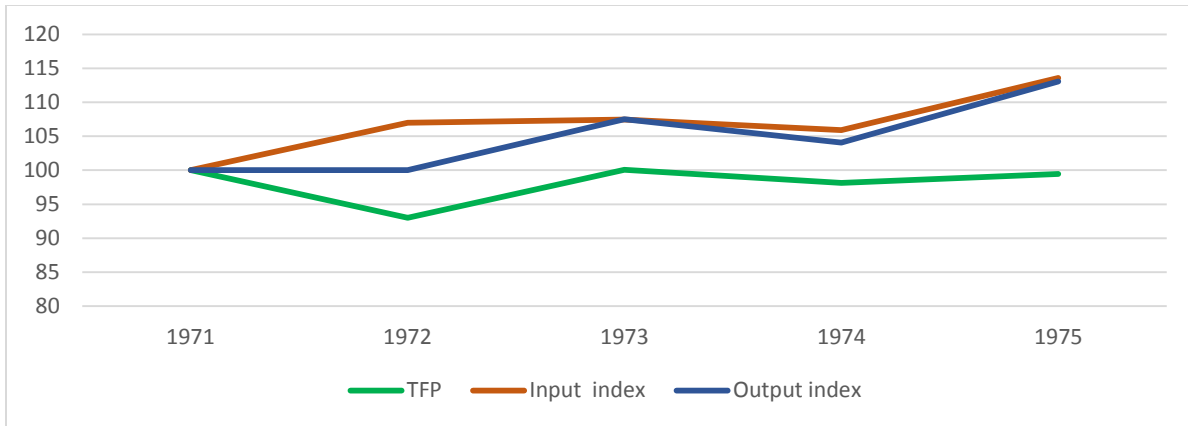
**Figure 4:** Contribution of factors in input growth during the pre-independence era (1961-1971)  
Source: Author's calculation based on FAOSTAT dataset

Among the input factors, fertilizer growth had contributed more than half of overall growth. During this period, small farmers began to use fertilizers intensively, especially in the late 1960s. Usage of ploughs, tractors also contributed significantly to this growth in input as depicted in Figure 4.

### 5.3 Post-independence reconstructing democratic era (1971-1975)

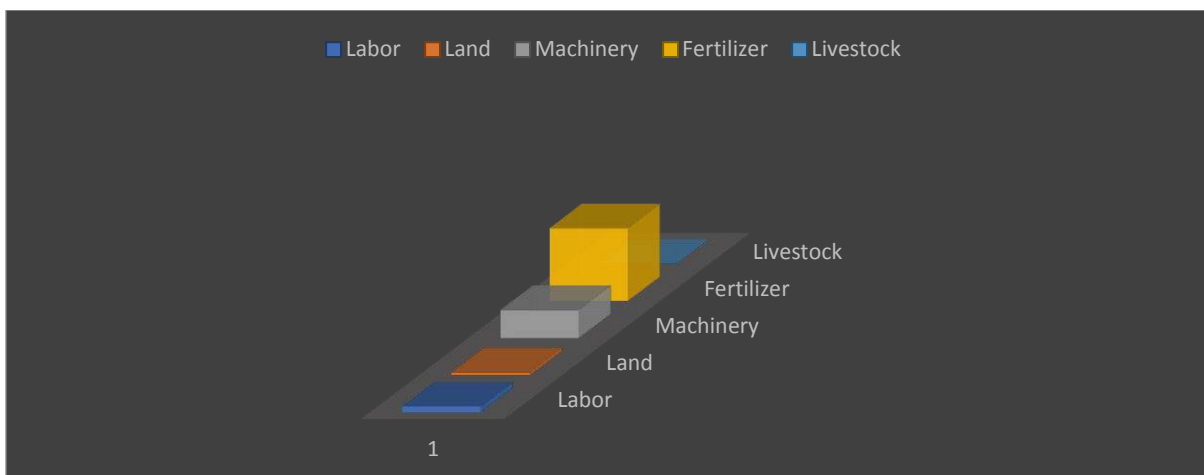
Following a nine-month-long war of independence against the then West Pakistan, Bangladesh emerged as an independent state at the end of 1971. The independence war in 1971 had resulted in terrible devastation for overall economy since all the resources were heavily damaged and there needed some urgent recovery, especially in this primary agriculture sector. The post-war government had to handle the enormous pressure of expectation from the newly independent nation. Certainly, due to lack of resources, it was quite hard to stand up on this challenge. The main challenges for the new Bangladesh government were to ensure post-war relief, rehabilitation, and reconstruction of the economy and the society. The government lasted for only about four years. The result of this study shows that during this short-term the average annual growth of agricultural output was about 3.27% against the average annual growth of total input which comes down to 3.40%. It implies that average annual TFP growth was still negative (-0.13%) but higher than the previous era. Hence this period can be termed as “*Reviving Input-driven growth*”.





**Figure 5:** Trend of TFP, total input, and output during the restructuring era (1971-1975)  
Source: Author's calculation based on FAOSTAT dataset

Even in this very short period, there was a reasonable improvement in the qualitative aspect of agriculture production. Overall output growth in agricultural production was about 13.1% during this era. Accumulated input growth was 13.6%, implying total TFP growth over the period was slightly negative with 0.5% as depicted in Figure 5.



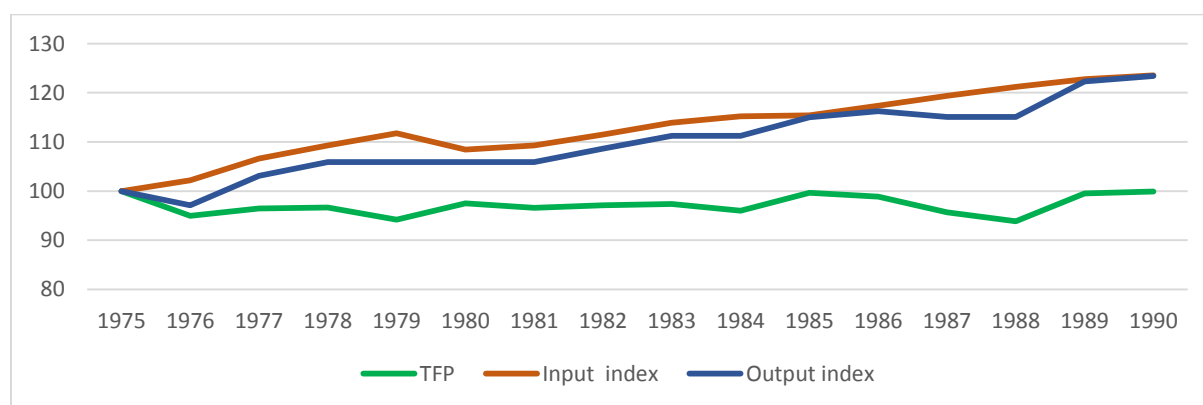
**Figure 6:** Contribution of factors in input growth during the restructuring era (1971-1975)  
Source: Author's calculation based on FAOSTAT dataset

From the bar chart shown in Figure 6, it is evident that among the input factors, the growth rate of fertilizer consumption was still higher, but noticeably there was a huge growth of agricultural machinery usage. The growth rate of livestock used in agriculture production was negative at this time.

#### 5.4 Post-independence prolonged military regime (1975-1990)

Through some socio-political instability, the military government took power in 1976. The result of this study shows that (referring to Table 1), during this long period the average annual growth of agricultural output was the second lowest (after the pre-independence military regime) of all time which was about 1.56% against the average annual growth of total input which comes down to 1.57%. It implies that average annual TFP growth was negative and close to zero. Hence this period can be termed as “Fully Input-followed growth”.

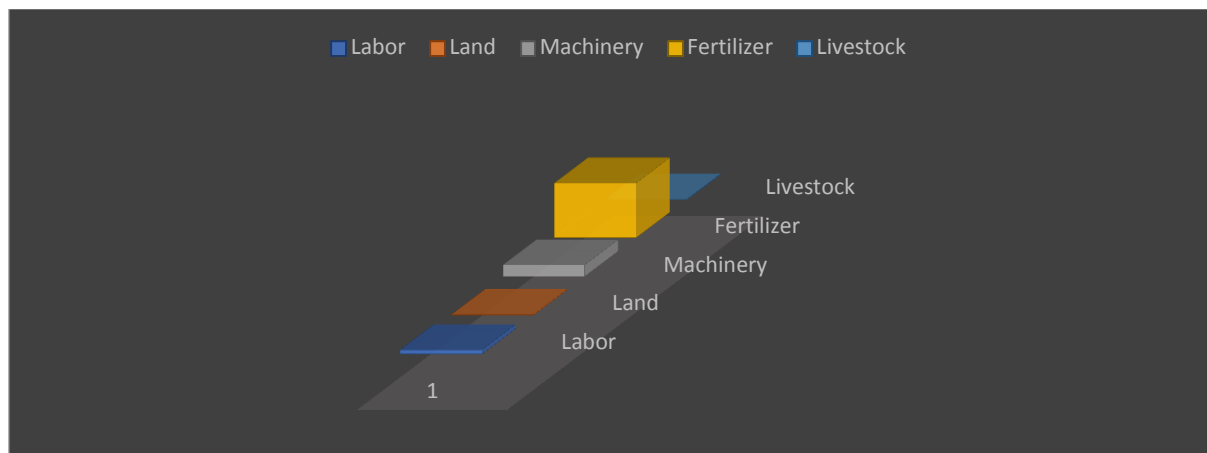
There was a slight improvement in the qualitative aspect of agriculture production during the first half of the 80s due to some initiatives were taken by the military rulers to boost up the agriculture production. These include the popular “Canal digging program” for better irrigation management, reversing of collectiveness of farms and reduction of quotas and restriction of agricultural activities. Accumulative output growth in agricultural production during this period was about 23.4%. Figure 7 reveals that, for receiving this amount of output growth, total input has to increase around 23.5% point which implies that accumulative TFP growth over the period had declined by about 0.11% point. (i.e., there was, in fact, no noticeable change in TFP growth for the whole military regime).



**Figure 7:** Trend of TFP, total input, and output during the prolonged military regime (1975-1990)

Source: Author’s calculation based on FAOSTAT dataset

From Figure 8 it is evident that among the input factors, the growth of total input was mainly attributed to the extensively increasing use of chemical fertilizer. Usage of tractors was also extended rapidly. The growth rate of livestock used for agriculture production was negative again like the previous era.

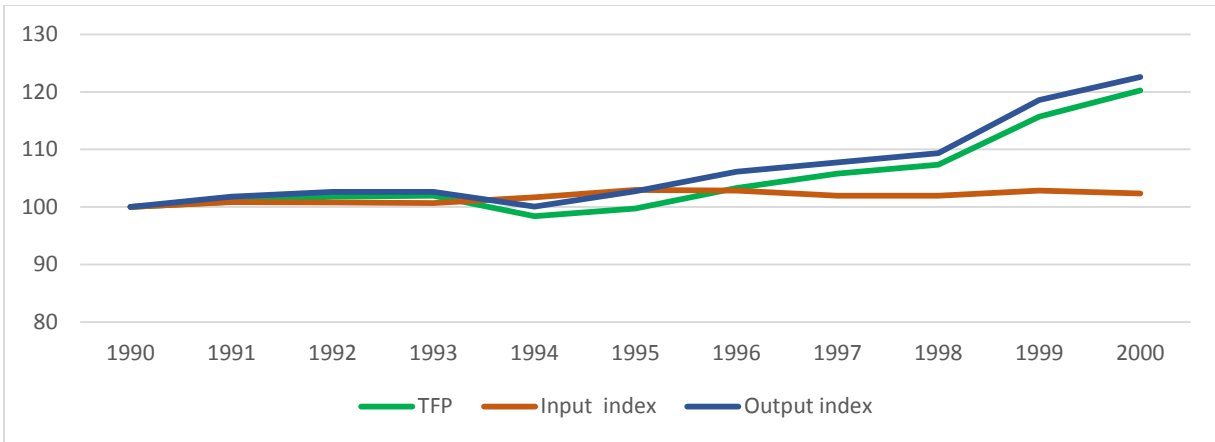


**Figure 8:** Contribution of factors in input growth during prolonged military regime (1975-1990)  
Source: Author's calculation based on FAOSTAT dataset

### 5.5 Revived democratic era phase-I (1990-2000)

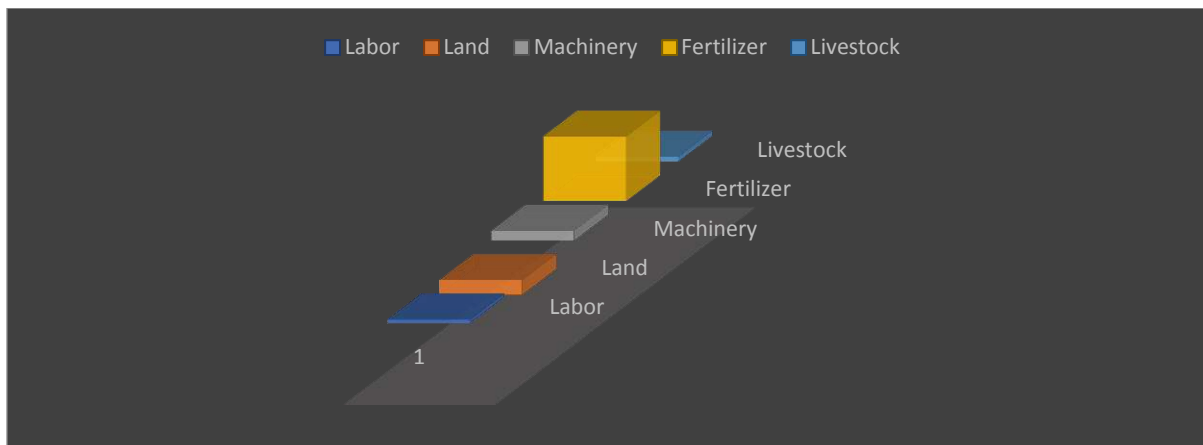
It was the period of transition and transformation in the agricultural sector. With the new democratic political environment, things were started to happen in a positive mood. The focus of the elected government was to restore their commitment to ensuring welfare to the society. Private sector came up with ideas and investments; researchers concentrated on developing high-yield varieties of crops; trade relation with other countries started to develop; many institutional reforms were taken; developing partner organizations aided in various development and capacity building projects; Bangladesh entered in WTO agreement for trade liberalization. In all, the positive outlook in a hopeful atmosphere helped both the government and the people to work together and increase substantial agriculture production.

The result shows that (referring to Table 1), during this phase of development, the average annual growth of agricultural output was 2.26% against the average annual growth of total input which comes down to 0.23%. It implies that average annual TFP growth was increased significantly to 2.03%. Hence this period can be termed as “TFP-driven growth”. Accumulative output growth in agricultural production during this period was about 30%. Figure 9 reveals that, for receiving this amount of output growth, total input has to increase around 22% point which implies that accumulative TFP growth over the period was about 8% point.



**Figure 9:** Trend of TFP, total input, and output during the Democratic era phase-I (1990-2000)  
Source: Author’s calculation based on FAOSTAT dataset

Figure 10 reveals that the growth of total input was mainly accredited by the increasing use of chemical fertilizer. Usage of tractors was also comprehensive. However, due to manufacturing establishment and medium-scale industrialization, the arable land was declined.

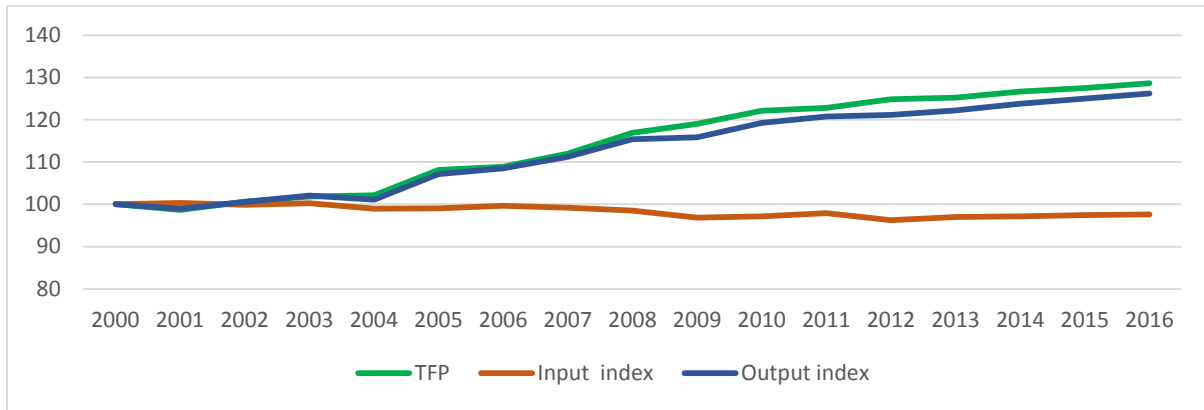


**Figure 10:** Contribution of factors in input growth during the democratic era phase-I (1990-2000)  
Source: Author’s calculation based on FAOSTAT dataset

### 5.6 Consolidating democratic era phase-II (2000-2016)

This phase refers to the consolidation of agriculture sector development in Bangladesh. The steady growth rate continued in this decade. Table 1 has shown that, during this stage of development, the average annual growth of agricultural output was 1.75% against the average annual growth of total input which comes down to -0.16%. It results in an average annual TFP growth of 1.91%. Hence this period can also be termed as “Steady TFP-driven growth”.

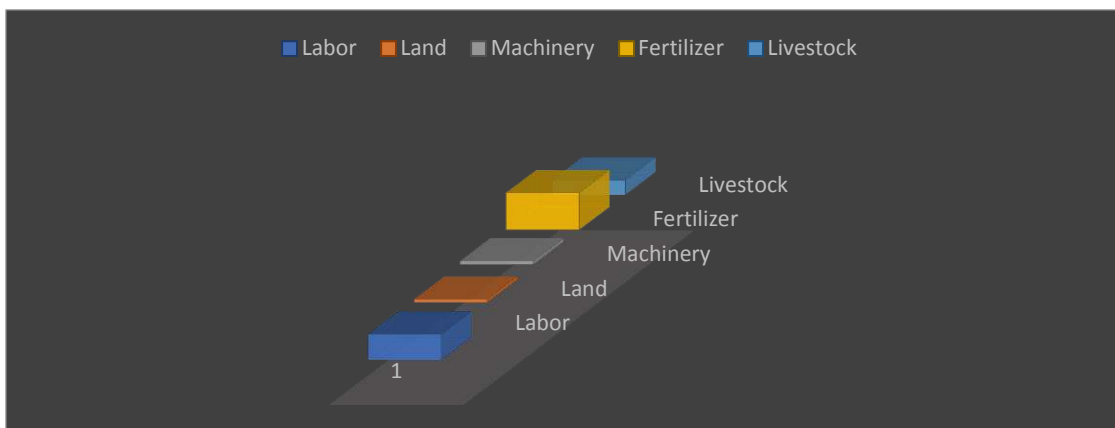
Accumulative output growth in agricultural production during this period was about 26.2% as depicted in Figure 11. while the total input growth has declined to 2.4% which implies that accumulative TFP growth over the period was about 28.6% point.



**Figure 11:** Trend of TFP, total input, and output during the democratic era phase-II (2000-2016)

Source: Author’s calculation based on FAOSTAT dataset

Figure 12 reveals the interesting fact that the growth of total input was mainly attributed to the increasing use of livestock. The growth of fertilizer consumption was also another major contributor. However, the growth rate of agricultural machinery was declined.



**Figure 12:** Contribution of factors in input growth during the democratic era phase-II (2000-2016)

Source: Author’s calculation based on FAOSTAT dataset

## 6. Conclusion and policy recommendations

Agriculture production in Bangladesh was kept on almost stagnant at around 11 to 12 million Metric Tons a year in the 1950s. The population growth rate, however, accelerated from less than one percent per year to nearly three percent during the decade, which inserted immense pressure and concerns for the country to feed its growing population. The 1960s, however, experienced a rapid growth in agriculture production promoted by the government's "*grow more food production program*" through increase in cropping intensity of rice, transition from the direct seeding method to transplanting method of cultivation, and adoption of modern agricultural inputs such as chemical fertilizers and irrigation by power pumps (Hossain, 1988). This study also reveals the fact that agricultural production growth in this "*Pre-independence era*" was highly driven by the input factors, especially the fertilizer and machinery. Although modern high-yielding varieties (HYV) of rice were adopted in the late 1960s, the impact was evident in the "*Post-independence or Reconstructing Era*" as the agriculture production experienced the highest rate of growth during this period. From the study, it is found that the major sources of growth of food grain production in this period were the participation of labor along with continuing use of chemical fertilizer and tractors.

The average annual growth of agricultural output was amongst the lowest of in the "*Military Regime*". However, the second half of this period was better due to the rapid diffusion of rice HYVs along with the policy liberalization on the procurement, supply, and distribution of agricultural inputs, and reduction of tariff and other import duties on agricultural tools, machinery, and equipment (Hossain and Akash, 1994). TFP growth was close to zero, and therefore, it was the era of "*Fully Input-followed growth*".

The first phase of the democratic era was most encouraging. TFP growth got some good momentum due to some real research work and capacity development programs. The innovation of high yield hybrid crops also helped the cause of a great deal to increase land productivity. The second phase of the democratic era (2000-2016) was mainly the period to maintain the consistency in agriculture production. TFP growth has shown some encouraging signs with an average annual growth of 1.91%. Land productivity has continuously increased over the last five decades due to extensive use of chemical fertilizer and faster growth of implementation of high-yield variety crops in recent time. The recent-time involvement of private sector in agricultural development has shown some positive signs in increasing the labor productivity as well.

It has been observed from the study that, research and capacity building has a huge impact on TFP growth in agriculture of Bangladesh. The overall scenario looks bright, and the process of development should continue.

More public and private investment should be provided in the research of agriculture sector development. Financial support to Bangladesh Rice Research Institute (BRRI) and Bangladesh Agricultural University should be increased to encourage more research works. Media should be used as a communicative tool to build the capacity of the farmers. Better disaster management policy should be adopted to challenge the loss in production caused by the natural calamities. Besides, the ongoing structural adjustments such as privatization and liberalization of investment in irrigation, trade in fertilizer and equipment should also strengthen in future.

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