Growth and Instability in World Jute Production: A Disaggregated Analysis

[1]Dr. Bidyut Kumar Ghosh, [2]Asish Jethi
[1,2]Supreme Knowledge Foundation Group of Instituttions, Khan road, Mankundu, Hooghly, India

Abstract
The study attempts at studying the growth of production of jute as well as variability in the jute production across the leading jute producing nations of the world. Using kinked exponential methodology for growth estimation, the study reveals that growth of production of jute has declined significantly during the period 1992-2010 as compared to the previous sub-period 1970-1991. The decomposition of growth and variability shows that the fluctuation in area under cultivation is the mainly responsible for output fluctuations. Finally the analysis shows the potential opportunities for the top two leaders, India and Bangladesh, in the global jute production and export.

Keywords
Growth Trend, Kinded Exponential, Variability

I. Introduction

Jute is a natural fiber popularly known as the golden fiber. It is one of the cheapest and the strongest of all natural fibers and considered as fiber of the future. Jute is second only to cotton in world's production of textile fibers. India, Bangladesh, China and Thailand are the leading producers of Jute. It is also produced in southwest Asia and Brazil. The two main types of jute, white jute (Corchorus Capsularies)and dark jute or tossa (Corchorus Olitorius) are grown in India, Bangladesh, Thailand, China and south Asian countries.

India is the largest producer of jute goods in the world, while Bangladesh is the largest cultivator of raw jute. Jute, as a natural fibre, has many inherent advantages like lusture, high tensile strength, low extensibility, moderate heat and fire resistance and long staple lengths. It is a biodegradable and eco-friendly. It has many advantages over synthetics and protects the environment and maintains the ecological balance.

Jute is not only a major textile fiber but also a raw material for non-traditional and value added non-textile products. Jute is used extensively in the manufacture of different types of traditional packaging fabrics, manufacturing Hessian, saking, carpet backing, mats, bags, tarpaulins, ropes and twines. Recently jute fibers are used in a wide range of diversified products: decorative fabrics, chic-saris, salwar kamizes, soft luggage's, footwear, greeting cards, molded door panels and other innumerable useful consumer products. Supported by several technological developments today jute can be used to replace expensive fibers and scare forest materials. However, despite its several advantage the production of raw jute and jute industries have shown very gloomy picture during last few decades. The introduction of synthetic fiber has created the recession in jute industry. Islam and Alauddin (2012) have pointed out the fluctuations and declining growth trend of jute production in the world over has created a good opportunity for countries like Bangladesh. Rahman and Khaled (2011) have also opined that the changes in the global market and global thinking as far as the jute products and jute production are concerned, there exists potential opportunities for the major producers in the world. It is mainly due to the traditional of policies followed over a number of years, jute industries tend to be slow to adapt themselves to the fast changing scenario in the international and domestic markets (Pal and Chakraborti, (2011).

Under these circumstances the present paper has made an attempt to look into the detailed growth pattern and variation of jute production across the major jute producing countries of the world. The specific objectives of the study are as follows:

- To estimate the growth rates of production of jute in the major jute producing countries of the world over the period 1970-71 to 2010-11;
- To identify the major sources of the growth of production of jute across the major jute producing countries of world during the study period;
- To measure and examine the level of variability in total jute production in the world.

II. Materials and Methods

The study is extended for the time period extending from 1970-71 to 2010-11 and it is based exclusively on the secondary data collected from the Food and Agricultural Organization (FAO) website.

Normally for measuring the agricultural production growth rate, linear trend equation

$\ln Q_t = a + bt + u_t$ where Q_t is the production in time period t and t stands for the time, is used. In this equation b gives us an estimate of the absolute increase of agricultural output per unit of time, a the constant appearing in the regression line and u_t the error term in the regression line.

However, the entire study period is divided into sub-periods (1st sub-period ranging from 1970 to 1991 and the 2nd sub-period ranging from 1992 to 2010) to get the clear picture of the growth performance during the pre and post globalization periods. To measure the growth rates in two sub-periods the Coefficient of Variation has been used to measure the variations in production of crops. There may be variation in the production of crops over the years. Also there are chances that the crop production may vary across the different countries. In this study we have measured the variability in the production of jute over the two distinct sub-periods across the countries. The difference in CVs of the two distinct sub-periods is tested by Kruskal-Wallis test (Anderson et. Al., 2008). The hypothesis for the Kruskal-Wallis test can be written as follows:

$$H_0 : Sub - period\ CVs\ are\ identical$$

$$H_1 : Sub - period\ CVs\ are\ not\ identical$$

The Kruskal-Wallis test statistic, which is based on the sum of ranks of for the CVs of each of the countries during the two sub-periods for any particular crop (jute) can be computed as follows:

$$W = \left[\frac{12}{n_T(n_T+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} \right] - 3(n_T+1)$$

$where\ k = number\ of\ populations\ (here\ countries)$

$n_i = number\ of\ items\ in\ sample\ i$

$n_T = \sum n_i = total\ number\ of\ items\ in\ all\ samples$

$R_i = sum\ of\ ranks\ for\ sample\ i$

III. Results and Discussion

To analyze the performance of the jute production of the major jute producing countries in the world, the main emphasis has been given on the sub-period growth rates of jute. For convenience, the whole period of 40 years (1970-2010) is divided into two sub-periods; first sub-period (1970 to 1991) and second sub-period (1992-2010). These three sub-periods have special significance to the economies of the most of the jute producing countries. Clearly, the first sub-periods is the periods prior to the introduction of full-phase globalization policy in almost all major jute producing countries and the second sub-period is the period of post-globalization period. The growth rates of area, production and yield of jute of major producing countries over 1970-2010 are given below in tables 1, 2 and 3 respectively.

During the first sub-period (1970-1991) it has been observed that the countries viz. India, Myanmar, China, Thailand and Bhutan have experienced positive growth rates. The highest growth rate was achieved by Bhutan (10.11 per cent per annum). The world growth rate of jute during this period was 1.23 per cent per annum. Bangladesh, Pakistan and Nepal have experienced negative growth rates of production during the period 1970-1991 and this negative growth rate is mostly due to the falling area growth rates during this period. On the other hand, countries like China, Thailand and Bhutan have experienced positive growth rates in jute production during this period which is mostly caused by the expansion of area under jute cultivation in these countries. In all of these three countries more than 85 per cent of growth of production was caused by the expansion of area under cultivation and the remaining portion has been due the increment in yield growth rates. In no countries the yield growth has played any significant role in determining the growth of production of jute. During this period (1970-1991) the highest yield growth rate was achieved by Pakistan (2.32 per cent per annum) and the world yield growth rate during the same period of time was 1.73 per cent per annum.

Thus, it has been observed that during the time period of 1970-1991 the leading jute producing countries of the world are clearly classified into two categories. The first category comprising of India, Myanmar, China, Thailand and Bhutan has experienced a positive production growth rate. On the other hand, the second category of countries (Bangladesh, Pakistan and Nepal) has experienced negative growth rate. Also countries like China, Thailand and Bhutan were penetrating into the world market with very high growth rate of production.

However, in the second sub-period a clear opposite picture has been observed in the world jute production scenario. In all the countries the growth rates of jute production have been reduced significantly. China has experienced the highest setback in relation to the growth rate of production with a negative growth of -14.0 per cent per annum followed by Pakistan (-12.62 per cent per annum), Thailand (-12.4 per cent per annum) and Myanmar (-11.15 per cent per annum). The world jute production was also negative amounting to -0.16 per cent per annum. Only Bangladesh, India, Bhutan and marginally Nepal have been able to maintain a positive growth rate of jute production in this period though the growth rates have been reduced in absolute terms. Especially, Bangladesh has been able to recover from a negative production growth rate to positive growth rate over the study period. Most interestingly, the high rate of decline in the jute production was caused by the heavy decline in the area under cultivation of jute in these countries. The area growth rates in almost all countries were negative and very high. What happened in this post globalization periods is that the demand of jute in the world market has been severely reduced due the heavy penetration of alternative goods (synthetic and plastic). These new alternatives due to its comparative price advantage have encroached the jute market.

Table 1

Growth Rates of Area Under Jute cultivation During 1970-2010

Country	Period I (1970-1991)	Period II (1992-2010)	Trend break	R^2	D.W.
Bangladesh	-1.70 (-2.281)	-1.86 (-2.234)	-0.16 (-0.115)	0.69	1.56
India	0.31 (0.689)	0.04 (0.069)	-0.27 (-0.323)	0.15	1.81
Myanmar	0.55 (0.189)	-9.81 (-3.054)	-10.36 (-1.914)	0.76	1.72
China	5.56 (4.572)	-15.40 (-11.30)	-20.95 (-9.10)	0.91	1.78
Thailand	4.26 (1.672)	-12.64 (-4.448)	-16.91 (-3.524)	0.79	1.33
Pakistan	-11.05 (-1.966)	-11.91 (-2.006)	-0.85 (-0.084)	0.86	1.81
Nepal	-7.23 (-5.328)	-1.06 (-0.704)	6.12 (2.413)	0.88	1.79
Bhutan	9.78 (10.06)	0.36 (0.335)	-9.42 (-5.195)	0.97	1.82
World	-0.49 (-0.929)	-1.61 (-2.695)	-1.11 (-1.103)	0.61	1.52

Source: Authors' calculations based on FAO data

Also the statistical difference between the growth rates of the two sub-periods has been tested using the kinked exponential model. Except in few cases (Bangladesh, India, Pakistan) the difference in the growth rate of production were statistically significant.
Thus, it is seen that a decline in the world jute production have been noticed during the second sub-period. A simple crop specific decomposition shows that decline in area under cultivation is the main factor behind the fall in growth rate. The yield growth rate of jute has never been an important factor behind the production of jute across the leading jute producing countries.

Table 2: Growth Rates of Production of Jute During 1970-2010

Country	Period I (1970-1991)	Period II (1992-2010)	Trend break	R2	D.W.
Bangladesh	-0.58 (-0.816)	0.21 (-0.258)	0.37 (0.248)	0.16	1.74
India	2.38 (7.038)	1.55 (4.075)	-0.83 (-1.292)	0.75	1.77
Myanmar	1.92 (0.627)	-11.15 (-3.375)	-13.40 (-2.339)	0.76	1.70
China	6.38 (4.576)	-14.00 (-8.942)	-20.34 (-7.709)	0.86	1.88
Thailand	4.97 (1.891)	-12.40 (-4.56)	-17.37 (-3.703)	0.76	1.41
Pakistan	-8.73 (-1.839)	-12.62 (-2.364)	-3.89 (-0.361)	0.82	1.80
Nepal	-6.63 (-4.41)	0.07 (0.046)	6.71 (2.369)	0.83	1.83
Bhutan	10.11 (12.01)	1.34 (1.431)	-8.78 (-5.549)	0.97	1.96
World	1.23 (2.598)	-0.16 (-0.298)	-1.38 (-1.547)	0.28	1.35

Source: Authors' calculations based on FAO data

Table 3: Growth Rates of Yield of Jute During 1970-2010

Country	Period I (1970-1991)	Period II (1992-2010)	Trend break	R2	D.W.
Bangladesh	1.12 (7.678)	1.59 (9.556)	0.45 (1.617)	0.87	1.83
India	2.08 (12.99)	1.48 (8.206)	-0.61 (-1.982)	0.93	1.67
Myanmar	1.37 (2.725)	-1.67 (-3.003)	-3.05 (-3.234)	0.71	1.92
China	0.77 (1.19)	1.48 (2.043)	0.71 (0.578)	0.58	2.09
Thailand	0.71 (2.882)	0.21 (0.776)	-0.49 (-1.057)	0.30	2.01
Pakistan	2.32 (2.899)	-0.71 (-0.835)	-3.03 (-2.06)	0.48	1.91
Nepal	0.49 (1.359)	1.11 (2.715)	0.61 (0.888)	0.54	1.95
Bhutan	0.15 (1.574)	1.07 (9.748)	0.92 (4.822)	0.81	1.92
World	1.73 (15.99)	1.46 (12.01)	-0.27 (-1.308)	0.96	2.22

Source: Authors' calculations based on FAO data

A. Variability of Production of Jute

To examine the variability of production of jute of major producing countries over the study period 1970-2010,the Coefficient of Variation (C.V) is used. Also an attempt has been made to examine the contribution of area and yield in the variability of total jute production separately for the two sub-periods 1970-1991 and 1992-2010. Further the difference in Coefficient of Variation values of two sub-periods based on the jute producing countries of the world wad tested by Kruskal-Wallis test.
The variability of production of jute is reported in Table 4. By looking at the production variability of jute the following important outcomes emerge:

Table 4: Coefficient of Variation of Jute Production of Major Jute Producing Countries in World

Countries	1970-1991	1992-2010
Bangladesh	21.47	13.56
India	23.04	11.26
Myanmar	45.62	53.42
China	68.08	82.36
Thailand	46.19	68.89
Pakistan	73.15	37.97
Nepal	40.48	17.00
Bhutan	77.52	8.42
World	20.80	6.76

Source: Authors' calculation based on FAO data

- The high growth experiencing countries such as Myanmar, China, Thailand, Pakistan and Nepal (both high positive and negative growth) have experienced high variability in the jute production. That is, the high growth path is associated with high degree of variability. In both sub-periods the variability in jute production was extremely high in these countries.
- The two leading jute producing countries of the world, Bangladesh and India, have been associated with moderate degree of variability in the jute production in the first sub-period and this variability has been reduced significantly during the second sub-period.
- The degree of variability of jute production in Bbutan has also greatly reduced in the second sub-period.
- The jute production variability of the world, in general, has reduced greatly during the second sub-period as also the production growth rate.

B. Decomposition of Production Variability

Now to examine the contribution of area, yield and their interaction effects on the variability of total production we use the following decomposition scheme

$$Y = \frac{P}{A}$$

$$\log Y = \log P - \log A$$

$$or,\ \log P = \log A + \log Y$$

$$\therefore \text{var.log}(P) = \text{var.log}(A) + \text{var.log}(A) + 2\,\text{cov}(\log A.\log Y)$$

$$where\ P = production$$

$$A = area$$

$$Y = yield$$

The decomposition of production variability into its different components is done for the two sub-periods for the jute production and the results are shown in Tables 5 and 6. The major outcomes of this production variability decomposition are outlined as follows:

During the first sub-period for all countries except India, variability in area under jute cultivation plays the major role behind the output variability. In India, however, both area and yield factors contribute equally to the output variability and both these two factors together contributes 96 per cent of the output variability.

During the period 1970-1991 only in case of Bangladesh the interaction effect of area and yield contributes negatively 37 per cent of the total output variability. In all other cases the interaction effect does not play any significant role.

For the total world output variability also we get the same results where area under cultivation plays more than 2/3rd of the total output variability and yield factors contributes little more than 1/3rd of the total variability.

However, during the period 1992-2010 it has been observed that yield of jute is contributing a significant portion of the total output variability. For example, in Bangladesh, India, China and Bhutan the contribution of yield in total variability were 86.66 per cent, 53.85 per cent, 123.19 per cent and 81.69 per cent respectively. The interaction effect is still not playing any major role in output variability, except in Bangladesh where it contributes 93 per cent of the output variability.

The area effect of total variability is still playing an important role in the major jute producing countries as well as in the world level.

Table 5: Decomposition of Jute Output Variability Into Its Various Components During 1970-1990

Country	Var.log(P)	Var.log(A)	Var.log(Y)	2Cov(logA.logY)
Bangladesh	0.0081(100)	0.0092(113.58)	0.0019(23.45)	-0.003(-37.04)
India	0.0077(100)	0.0037(48.05)	0.0037(48.05)	0.0003(3.90)
Myanmar	0.1956(100)	0.1664(85.07)	0.0211(10.78)	0.0076(3.89)
China	0.3572(100)	0.2804(78.50)	0.0322(9.01)	0.0446(12.49)
Thailand	0.4829(100)	0.4640(96.09)	0.0087(1.80)	0.0102(2.11)
Pakistan	0.8031(100)	0.7625(94.94)	0.0235(2.93)	0.0163(2.12)
Nepal	0.2127(100)	0.2288(107.57)	0.0132(6.21)	-0.0278(-13.07)
Bhutan	0.4513(100)	0.4467(98.98)	0.0006(0.13)	0.0036(0.79)
World	0.0352(100)	0.0247(70.17)	0.0142(40.34)	-0.0032(-9.09)

Source: Authors' calculation based on FAO data

Table 6: Decomposition of Jute Output Variability Into Its Various Components During 1991-2010

Country	Var.log(P)	Var.log(A)	Var.log(Y)	2Cov(logA.logY)
Bangladesh	0.003(100)	0.0032(106.67)	0.0026(86.66)	-0.0028(-93.33)
India	0.0026(100)	0.0011(42.31)	0.0014(53.85)	-0.0001(-3.84)
Myanmar	0.7207(100)	0.6425(89.15)	0.0056(0.78)	0.0726(10.07)
China	0.6107(100)	0.0222(3.64)	0.7523(123.19)	-0.1638(-26.82)
Thailand	0.4089(100)	0.4166(101.88)	0.0085(2.08)	-0.0162(-3.96)
Pakistan	0.2603(100)	0.2715(104.30)	0.0392(15.06)	-0.0504(-19.36)
Nepal	0.0323(100)	0.0195(60.37)	0.0122(37.77)	0.0006(1.86)
Bhutan	0.0071(100)	0.0037(52.11)	0.0058(81.69)	-0.0024(-33.80)
World	0.0052(100)	0.0094(180.77)	0.0088(169.23)	-0.0130(-250.00)

Source: Authors' calculation based on FAO data

C. Test of Difference in Variability of Crop Output: Kruskal-Wallis Test

The significance of the difference in C.V values of two sub-periods based on the eight major jute producing countries of the world was tested by Kruskal-Wallis test. The Kruskal-Wallis test statistic is presented in table 7given below.

The result indicates that there is no significant difference in the variability of production of jute production among the two sub-periods. However, it is observed that the sum of ranks for period I is higher than that for the period II, implying that the variability in jute production is less in second sub-period as compared to the first sub-period.

Table 7: Kruskal-Wallis Test for Variability in World Jute Production

Crop	Chi-squared Statistic	R_1	R_2
Jute	1.195	79	57

Where R_1 = Sum of ranks in period I (1970-1991)
R_2= Sum of ranks in period II (1992-2010)
Source: Authors' calculation based on FAO data

IV. Conclusion and Policy Prescription

The analysis shows that the production growth rate of jute has declined during the period 1992-2010 as compared to the period of 1970-1991 mainly because of fluctuations of area under jute cultivation. The two top leaders in jute production viz. Bangladesh and India, though maintaining their position well, the growth performances of these two countries is not satisfactory. The fluctuations in production for both India and Bangladesh have been found to be stabilized in the second sub-period, but for the other producers viz. China, Thailand, Pakistan it shows high fluctuations due to heavy fluctuation of area under cultivation. However, overall variability in jute production in the world has been reduced during the second sub-period. Thus the study clearly indicates that both India and Bangladesh have a very good opportunity to take the advantage of this international market. The main competitors of India and Bangladesh viz. China, Thailand, Myanmar and Pakistan were not being able to maintain the growth performances especially during the second sub-period. What require are the diversifications of the products made from this nature fiber and improvement of the quality of jute products.

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