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Analysis of Price Forecasting and Spatial Co-Integration of Banana in Bangladesh

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ABSTRACT

The study was conducted for understanding the present situation of marketing system of banana in different hilly regions of Bangladesh.The objectives of the study were to estimate costs and margins, to test market integration, and price forecasting of Banana. Secondary data was used for this study. So the farmers of Bangladesh who are still suffering from indecision about the future prices of banana, should come forward to fruits farming as the analysis provides a positive insights for fruits cultivation. Engle Granger co-integration test was used to examine the market integration. Analysis of market integration shows that banana market in Bangladesh was well integrated except hilly region of Bangladesh it's due to lack of well transportation and communication system in hilly region. The study identified some problems related to transportation facilities, lack of agro-processing industries, low prices and natural calamities aspects and suggested some measures for solving these problems.

Key words: ARIMA model, Engle Granger co-integration, Price forecasting, Market integration, Banana.

INTRODUCTION

Bangladesh is an agricultural country. More than 80% people directly or indirectly depends on agriculture. About 19.29% of GDP is derived from agriculture in fiscal year 2011-12 (BBS-2012). Bananas are one of our best sources of potassium, an essential mineral for maintaining normal blood pressure and heart function. Since the average banana contains a whopping 467 mg of potassium and only 1 mg of sodium, a banana a day may help to prevent high blood pressure and protect against atherosclerosis. About 35,000 children become blind each year due to Vitamin-A deficiency. The common deficient nutrients of Bangladesh are Vitamin-An and Vitamin-C, riboflavin, folic acid etc. banana, tomato and cauliflower are the most in expensive and rich sources of those nutrients. In Bangladesh banana is the only fruit crop, which is available throughout the year and consumption rate is also higher than any other fruits. It has been associated with man for centuries and many people consider the banana as on off man's finest fruit. Banana is delicious fruit crop gross widely all over Bangladesh and most important fruit in the country from the stand point of food value and availability, throughout the year (USAID, 1969). Districts of wild grown Banana are Sylhet, Moulvibazar, Netrokona, Rangamati, Khagrachhari, Bandarban. In Bangladesh, total estimated production of banana was 801000 metritons and cultivated area is 131 acres in 2010-11. The characteristics of agricultural commodities like fruits are bulky in production and perishable in nature. The surplus production of different fruits grown in hill regions are not marketed in proper time due to lack of transport and infrastructural facilities. Farmers usually deprived from getting the fair price of their product due to presence of large number of seller, low market demand etc.Rapid distribution of the products to different distant places ensured the consumers from preventing high fluctuation of prices. So, the marketing system should be developed for the welfare of the farmers in obtaining incentive price for their product. The study provides valuable information for the banana producers, traders and policy makers in Bangladesh to take appropriate decisions regarding further expansion of commercial layer farming and trading. The demand for different fruits for consumption as well as for industrial processing has increased significantly in recent years. Through development of hill agriculture, by commercially growing of different fruits and processed by establishing industries, there will be a greater scope for increasing income and employment both in domestic and international markets. Before designing any technological development, understanding of existing situations are essential. Thus the study was conducted for understanding the present situation of production, processing and marketing system of magor fruits in different hill regions of Bangladesh with following objectives.

Objectives

i. To analyse the market integration of banana and
ii. To examine price forecasting of banana

METHODOLOGY

Data sources

The present study is based on scondary data. Secondary data were accumulated from BBS, FAO publication, official records, books, journals and from the various statistical year books. The weekly average wholesale prices of Banana of various markets like Dhaka,Chittagong, Sylhet, Bandarban, Rangamati, Lasha and Cox'sbazar during 1983 to 2012 were collected from Department of Agricultural Marketing (DAM). Latter it was converted into monthly figures.

Analytical Techniques

The following techniques were used for the analysis.

i. Determination of market integration through Engle and Granger co-integration method
ii. Price forecasting analysis by using ARIMA model

In addition, for analysis of important socio economic criteria, descriptive statistical tools like, mean, percentage was used whenever necessary.

Market Integration:

The main objective of price policy is to safeguard the interests of producers and consumers. The producer's interest can best be safeguarded if he is paid appropriate price for his product. He gets fair prices if markets are well integrated. The basic idea behind the measurement of market integration is to understand the interaction among prices in spatially separated markets (Goletti and Babu, 1994, pp. 311-325). Thus integrated markets are defined as markets in which prices of differentiated products do not behave independently (Monke and Petzel, 1984, pp. 401-487). If price movement of a commodity in one market is completely irrelevant to forecast price movements of the same commodity in other markets, the markets are characterized as segmented (Kumar and Sharma 2003, p. 203). In well integrated markets, middlemen's share should be reasonable and consumers get produce at fair price. So it is very important to understand whether commodity markets function efficiently. Markets function efficiently when these are integrated in price relationships and it is also imperative to see whether infrastructural and technological development in communication system has improved the functioning of commodity markets.

Measurement of Market Integration by Co-integration Method:

The bulk of econometric theories have been based on the assumption that the underlying data process is stationary a) stochastic process is said to be stationary if its mean and variance are constant over time and the value of covariance between two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed (Gujarati, 2003, p.797). In practice, most economic time series are non-stationary. Applying regression models to non-stationary data may arise the problem of "spurious or nonsense" correlation (Gujarati, 2003, p. 792). If the time series data like prices, which are non-stationary, are used, it usually would yield a high R^2 and 't' ratios which are biased towards rejecting the null hypothesis of no relationship between the variables concerned. To overcome such problems, the concept of co-integration was used becauseit offers a means of identifying and hence avoiding the spurious.In a high inflationary situation like Bangladesh, use of nominal price to use in estimation to correlation coefficient (pair wise) would be misleading as the force of inflation over the years for which, estimated coefficients may tend to show high degree of association between pair of prices of two markets. So, other advanced method of assessing market integration like co-integration method was also needed and that was used in this study. The underlying principle of co-integration analysis is that, although trend of many economic series show upward or downwards over time in a non-stationary fashion, group of variables may drift together.

Unit Root and Co-integrationTest: The individual price series were tested for the order of integration to determine whether they are stationary which is known as the unit root test (Gujarati, 2003, p.799). A number of tests for stationarity are available in the literature; these include the Dickey-Fuller (DF) test (Dickey and Fuller,1979),the Augmented Dickey-Fuller(ADF) test (Dickey and Fuller,1981)and the Philips-Perron(PP) test (Perron,1988). For theoretical and practical reasons, the Dickey–Fuller test is applied to regressions run in the following forms:

$Y_t$is a random walk or without constant:

$$\Delta Y_t = \delta Y_{t-1} + e_t \quad \ldots\ldots (1)$$

$Y_t$is a random walk with drift or constant:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + e_t \quad \ldots\ldots (2)$$

$Y_t$is a random walk with drift around a stochastic trend (constant plus trend):

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + e_t \ldots\ldots (3)$$

Where t is the time or trend variable.

In each case the *null hypothesis* is $\delta = 0 (\rho = 1)$; that is, there is a unit root, that meanst the time series is non-stationary. The alternative hypothesis is that δ is less than zero; that is, the time series is stationary. Under the null hypothesis, the conventionally computed t statistics is known as the τ (tau) statistic, whose critical values have been tabulated by Dickey and Fuller. If the null hypothesis is rejected, it means that Y_t is a stationary time series with zero mean in the case of (1), that Y_t is stationary with a non-zero mean [$= \beta_1/(1-\rho)$] in the case of (2), and that Y_t is a stationary around a deterministic trend in equation (3).

It is extremely important to note that the critical values of the tau test to test the hypothesis that $\delta = 0$, are different for each of the preceding three specifications of the DF test. If the computed absolute value of the tau statistics (τ) exceeds the DF or MacKinnon critical tau values, we reject the hypothesis that $\delta = 0$, in which case the time series is stationary. On the other hand, if the computed (τ) does not exceed the critical tau value, we do not reject the null hypothesis, were the time series is non-stationary.

In conducting the DF test as in (1), (2), or (3), it was assumed that the error term $e_t$was uncorrelated. But in case the e_t are correlated, Dickey and Fuller have developed a test known as the augmented Dickey-Fuller (ADF) test.

This test is conducted by "augmenting" the preceding equation by adding the lagged values of the dependent variable ΔY_t. The ADF test here consists of estimating if the error term $e_t$is auto correlated, one modifies (4) as follows:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \quad \ldots\ldots (4)$$

where ε_t is a pure white noise error term and where, $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc., that is, one uses lagged difference terms. The number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term in (4) is serially uncorrelated. The null hypothesis is still that $\delta = 0$ or $\rho = 1$, that is, a unit root exists in Y (i.e., Y is non-stationary).

Spatial Price Relationship: To test the market integration, the following co-integration regression was run for each pair of price series:

$$Y_{it} = \alpha_0 + \alpha_1 Y_{jt} + \varepsilon_t \quad \ldots\ldots (5)$$

Where, Y_i and Y_j are price series of a specific commodity in two markets i and j, and ε_t is the residual term assumed to be distributed identically and independently. The test of market integration is straightforward if Y_i

and Y_j are stationary variables but if the price series proved as non-stationary then we have to done another test (Engle-Granger test)

Testing whether the variables are co-integrated is merely another unit root test on the residual in equation (5). However, since the Y_i and Y_j are individually non-stationary, there is the possibility that the regression is spurious. The DF and ADF tests in the present context are known as Engle-Granger (EG) test whose critical values was provided by Engle-Granger (Ramakumar, 1998). The test involved regression the first-difference of the residual lagged level and lagged dependent variables (Engle-Granger test) is as follows:

For Engle-Granger (EG) test, $\Delta\varepsilon_{t} = \beta\, \varepsilon_{t-1}$ …………………. (6)

If the computed value of 't' of regression coefficient β is higher (in absolute term) than tabulated value, our conclusion is that the residuals from the regression are I (0), that is they are stationary and the regression is not spurious even though individually two variables are non-stationary.

Forecasting of Banana Prices

The autoregressive-integrated-moving average (ARIMA) model is discussed in detail in Box and Jenkins (1994) and O'Donovan (1983). Briefly, this technique is a univariate approach which is built on the premise that knowledge of past values of a time series is sufficient to make forecasts of the variable in question. ARIMA econometric modeling take into account historical data and decompose it into an *Autoregressive* (AR) process, where there is a memory of past events (e.g., the prices of mangoes of this month is related to the prices of mangoes of last month, and so forth, with a decreasing memory lag); an *Integrated* (I) process, which accounts for stabilizing or making the data stationary, making it easier to forecast; and a *Moving Average* (MA) of the forecast errors, such that the longer the historical data, the more accurate the forecasts will be, as it learns over time. ARIMA models therefore have three model parameters, one for the AR(*p*) process, one for the I(*d*) and one for the MA(*q*) process, all combined and interacting among each other and recomposed into the ARIMA (*p*,*d*,*q*).

Autoregressive Integrated Moving Average or ARIMA (*p*,*d*,*q*) models are the extension of the ARIMA model that uses three components for modeling the serial correlation in the time series data. The first component is the autoregressive (AR) term. The AR(p) model uses the p lags of the time series in the equation. An AR(p) model has the form:

$Y_t = A_1Y_{t-1} + \dots + A_pY_{t-p} + E_t$ ……………………………..…(a)

Where Y_t is directly related to one or more past series values.

The second component is the integration (d) order term. Each integration order corresponds to differencing the time series. I(1) means differencing the data once. I(d) means differencing the data d times. The third component is the moving average (MA) term. The MA(q) model uses the q lags of the forecast errors to improve the forecast. An MA(q) model has the following form:

$Y_t = -(B_1E_{t-1} + \dots + B_qE_{t-q}) + E_t$ ………………………. (b)

Where Y_t is related to one or more past random errors.

Finally, an ARMA (*p*,*q*) model has the combined form of equation a and b and that is:

$Y_t = (A_1Y_{t-1} + \dots + A_pY_{t-p})-(B_1E_{t-1} + \dots + B_qE_{t-q}) + E_t$ ………..(c)

Where Y_t is related to both past series values and past random errors.

The A_is are called autoregressive parameters and B_is are also called moving-average parameters. The subscripts on the A's and B's are called the orders of the parameters. There are several additional sets of results specific to the ARIMA analysis. The first is the addition of Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are often used in ARIMA model selection and identification. That is, AIC and SC are used to determine if a particular model with a specific set of p, d, and q parameters is a good statistical fit. SC imposes a greater penalty for additional coefficients than the AIC but generally, the model with the lowest AIC and SC values should be chosen.

Finding the right ARIMA model takes practice and experience. These AC, PAC, SC, and AIC are highly useful diagnostic tools to help identify the correct model specification. Finally, the ARIMA parameter results are obtained using sophisticated optimizations and iterative algorithms, which means that although the functional forms look like those of a multivariate regression, they are not the same. ARIMA is a much more computationally intensive and advanced econometric approach.

The estimation methodology of the ARIMA model consists of three steps, namely identification, estimation of parameters and diagnostic checking. The identification steps involve the use of the techniques for determining the value of p, d, and q. These values were determined by using autocorrelation and partial autocorrelation functions (ACF and PACF) and Augmented Dickey-Fuller (ADF) test. Having identified the appropriate p and q values, the next step is to estimate the parameters of the autoregressive and moving average terms included in the model by simple least squares and for this purpose "Risk Simulator" and SPSS software were used. Having chosen a particular ARIMA model, and having estimated its parameters, the third step is to whether the chosen model fits the data reasonably well, or another ARIMA might do the job as well. One simple test is to see if the residuals estimated from the model are white noise (zero mean, constant variance and is serially uncorrelated); if they are , we would accept the particular fit; if not, we must start over. Thus, the ARIMA model, popularly known as the Box- Jenkins methodology is an iterative process.

To evaluate and compare that which ARIMA model had the better forecasting power, the data were categorized into the whole period and the recent period and ARIMA was run on this two periods as well as the root mean square (rms)error, rme percent error and the Theil's inequality coefficient (U) were calculated. The formula of rms error, rms percent error and the Theil's inequality coefficient (U) are as follows:

$$rms\ \ error\ = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(Y_t^{\,s} - Y_t^{\,a}\right)^2}$$

$$rms\ \ percent\ error = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(\frac{Y_t^s - Y_t^a}{Y_t^a}\right)^2}$$

$$U = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^s - Y_t^a)}}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}\ (Y_t^s)^2} + \sqrt{\frac{1}{T}\sum_{t=1}^{T}\ (Y_t^a)^2}}$$

Where,
Y^s_t = forecasted price,
Y^a_t= actual price and
T= number of forecasted periods.
U will always fall between 0 and 1. If U=0, $Y^s_t = Y^a_t$ for all t and there is a perfect fit. If U=1, on the other hand, the predictive performance of the model is as bad as it could be. Forecasting power of a model will be higher for which U value is found lower.

Before use of data to create ARIMA model, the data was needed to test for stationarity. A series is stationary if it varies more or less uniformly over time, about a constant, fixed level. Otherwise, a series is non-stationary if it

appears to have no fixed level. If fruits prices of different districts are stationary then it means they are not affected by other factors, such as seasonality, trends etc.
In this research, stationarity test was done by "Augmented Dickey-Fuller Regression's Unit Root Test" by setting hypothesis as;

H_o: $\delta = 0$ (Non-Stationary)
H_1: $\delta \neq 0$ (Stationary)

To test the the stationarity or non-stationarity of data, the Dickey–Fuller (DF) test and ADF test were applied to regressions run in the following form:

$Y_t$is a random walk with drift around a stochastic trend (constant plus trend):

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + e_t \text{..} \quad (d)$$

Where,

ΔY_t is the difference of the actual price series
Y_{t-1} is the 1st order lagged price
and t is the time or trend variable.

If the computed absolute value of the tau statistics (τ) does not exceed the DF or MacKinnon critical tau values, we do not reject the hypothesis that $\delta = 0$, in which case the time series is non-stationary.
ADF test was conducted by "augmenting" the preceding equation by adding the lagged values of the dependent variable ΔY_t. The ADF test is:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \quad \text{……………………..} \quad (e)$$

where ε_t is a pure white noise error term and where, $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc., that is , one uses lagged different terms.

When the price series of each district was found non-stationary, then DF and ADF test ran to made the data stationary because to predict the future price, the data series must be stationary. In that case the DF test was ran in the following form:

$$\Delta(\Delta Y_t) = \beta_1 + \beta_2 t + \delta \Delta Y_{t-1} + e_t \quad \text{..} \quad (f)$$

Where,

$\Delta(\Delta Y_t)$is the 1st difference of the actual price series
ΔY_{t-1} is the 1st order lag of the differenced price
and t is the time or trend variable.

Again the ADF test was conducted by "augmenting" the preceding equation by adding the lagged values of the dependent variable $\Delta(\Delta Y_t)$. The ADF test is:

$$\Delta(\Delta Y_t) = \beta_1 + \beta_2 t + \delta \Delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta(\Delta Y_{t-i}) + \varepsilon_t \quad \text{……………………..} \quad (g)$$

Where ε_t is a pure white noise error term and where, $\Delta(\Delta Y_{t-1}) = (\Delta Y_{t-1} - \Delta Y_{t-2})$, $\Delta(\Delta Y_{t-2}) = (\Delta Y_{t-2} - \Delta Y_{t-3})$, etc., that is , one uses lagged different terms.
If the computed (τ) value exceeds the critical tau value, we had rejected the null hypothesis, in that case the time series is stationary.
The procedure of price forecasting of fruits discussed above by the researcher assumes that no extraordinary events occur in the production process. Furthermore, the forecasts are based on total production of fruit products, consumption, price, and exchange rate about currency in the world fruit market.

RESULT AND DISCUTION

Spatial Price Relationship

Co-integration Test for *Banana (Chapa)*

To test the stationary of the data of banana, the DF and ADF tests for wholesale price of banana were conducted. ADF test was applied in case where serial correlation exists and that could be found from the Durbin Watson statistic (d-value). The estimated tau (τ) statistic of the regression coefficient of one period lagged price, DW statistic and decisions that were undertaken the prices of Banana of all the selected districts or markets were non-stationary.

Table-1 to Table-2 showed the results of estimated co-integration regression between Rangamati and other markets, Bandarban and other markets, and other markets to Dhaka for the prices of banana and the final decisions were presented.

Table 1: Spatial Price Relationships between Rangamati and other Markets for *Banana (Chapa)*

Markets	Co-integrating Regression	Co-integration Test Engel-Granger	Decision
Rangamati-Dhaka	P_D= 179.147- 0.548P_{Rang} R^2= 0.118 (-3.212)	ΔU_t= -0.118 U_{t-1}^{**} (-2.076)	Co-integrated
Rangamati-Chittagong	P_{Chi}= 64.461- 0.007P_{Rang} R^2= 0.002 (-0.430)	ΔU_t= -0.598 U_{t-1}^{***} (-5.725)	Co-integrated
Rangamati-Sylhet	P_{Syl}= 153.317- 0.524P_{Rang} R^2= 0.166 (-3.912)	ΔU_t= -0.042 U_{t-1} (-1.160)	Not Co-integrated
Rangamati - Bandarban	P_{Band}= 90.766+ 0.118P_{Rang} R^2= 0.011 (0.938)	ΔU_t= -0.063 U_{t-1} (-1.946)	Not Co-integrated
Rangamati - Lasha	P_{Lasha}= 67.206- 0.068P_{Rang} R^2= 0.012 (-0.961)	ΔU_t= -0.304 U_{t-1}^{***} (-3.725)	Co-integrated
Rangamati – Cox'sbazar	P_{Cox}= 189.869- 0.211P_{Rang} R^2= 0.052 (2.047)	ΔU_t= -0.072 U_{t-1} (-1.557)	Not Co-integrated

Tau (τ) values (without constant) at 1% and 5% level of significance are -2.55 and -1.95 respectively in the equation.

*** indicates 1% level of significance.

** indicates 5% level of significance.

In Table 2, it was found that in most of the cases the co-integration regression results provide positive coefficient which indicated that movement of prices are in same direction. Bandarban-Dhaka, Rangamati-Lasha and Rangamati-Cox'sbazar markets are integrated. But Bandarban-Sylhet, Bandarban -Rangamati markets were not co-integrated.

Table 2: Spatial Price Relationships between Bandarban and other Markets for *Banana (Chapa)*

Markets	Co-integrating Regression	Co-integration Test Engel-Granger	Decision
Bandarban -Dhaka	P_D= 50.261+ 0.733P_{Band} R^2= 0.260 (5.203)	ΔU_t= -0.142 U_{t-1}^{**} (-2.282)	Co-integrated
Bandarban -Chittagong	P_{Chi}= 68.742- 0.048P_{Band} R^2= 0.156 (-3.777)	ΔU_t= -0.650 U_{t-1}^{***} (-6.081)	Co-integrated
Bandarban -Sylhet	P_{Syl}= 28.757+ 0.714P_{Band} R^2= 0.378 (6.847)	ΔU_t= -0.067 U_{t-1} (-1.425)	Not Co-integrated
Bandarban - Rangamati	P_{Rang}= 88.490+ 0.096P_{Band} R^2= 0.011 (0.938)	ΔU_t= -0.075 U_{t-1}^{***} (-1.799)	Not Co-integrated
Rangamati - Lasha	P_{Lasha}= 69.214- 0.085P_{Rang} R^2= 0.023 (-1.340)	ΔU_t= -0.317 U_{t-1}^{***} (-3.838)	Co-integrated
Rangamati - Cox'sbazar	P_{Cox}= 117.428+ 0.505P_{Rang} R^2= 0.363 (6.622)	ΔU_t= -0.118 U_{t-1}^{**} (-2.008)	Co-integrated

Tau (τ) values (without constant) at 1% and 5% level of significance are -2.55 and -1.95 respectively in the equation.

*** indicates 1% level of significance.

** indicates 5% level of significance.

Table 3: Spatial Price Relationships between Dhaka and other Markets for *Banana (Chapa)*

Markets	Co-integrating Regression	Co-integration Test Engel-Granger	Decision
Chittagong-Dhaka	P_D= 271.709- 2.295P_{Chi} R^2= 0.038 (1.741)	ΔU_t= -0.130 U_{t-1}^{**} (-2.252)	Co-integrated
Sylhet -Dhaka	P_D= 17.315+ 1.061P_{Syl} R^2= 0.733 (14.538)	ΔU_t= -0.509 U_{t-1}^{***} (-5.132)	Co-integrated
Bandarban-Dhaka	P_D= 50.261+ 0.733P_{Band} R^2= 0.260 (5.203)	ΔU_t= -0.142 U_{t-1}^{**} (-2.282)	Co-integrated
Rangamati-Dhaka	P_D= 179.147- 0.548P_{Rang} R^2= 0.118 (-3.212)	ΔU_t= -0.118 U_{t-1}^{**} (-2.076)	Co-integrated
Lasha-Dhaka	P_D= 184.929- 0.985P_{Lasha} R^2= 0.148 (-3.658)	ΔU_t= -0.177 U_{t-1}^{***} (-2.697)	Co-integrated
Cox'sbazar-Dhaka	P_D= -135.714+ 1.543P_{Cox} R^2= 0.810 (18.136)	ΔU_t= -0.865 U_{t-1}^{***} (-7.663)	Co-integrated

Tau (τ) values (without constant) at 1% and 5% level of significance are -2.55 and -1.95 respectively in the equation.

*** indicates 1% level of significance.

** indicates 5% level of significance.

From the analysis of spatial price integration of banana for the selected markets pairs, it was observed as a whole that those markets are not co-integrated with study areas which are the surrounding markets or districts especially the hill regions markets are not co-integrated with each other but in most cases the distant markets are co-integrated with the hill regions. The following is the possible explanation:

Real situation is that, the road and transportation system or facilities are very poor and time consuming for moving the commodity from the hill regions to the distant market including Dhaka and Chittagong and hence the transfer costs are also high. When small *beparies* or *farias* brought their product to other hill regions, then they have to sell the produce at a price that is slightly more from their buying costs as these regions are also the producing area and after deducting their transfer costs, often they have to bear losses that means their buying and selling price are not equal and hence these market becomes non-integrated.

Market integration does not mean that prices across geographical regions should be the same. Inter-market price differences may exist because of differences in transfer costs. These differences should not impair the transmission of price signals and trade among markets. Therefore it may be concluded that the results of this study strongly support the existence of co-integration in the selected banana market in Bangladesh due to good communication facilities especially of cell phone technology and good infrastructural availabilities among the market centres in Bangladesh except the hills region.

Forecasting of Banana Prices

The most growing variety in the hill regions is *Chapa* and price data of banana (per 100 pieces) was collected from 2005 to 2011 and this type of banana is available in all year round. Prediction of next four year prices (2012 - 2015) was estimated (Table 4 and Table 5). Using the whole period and recent period price data, the best selected model for Bandarban was (p,d,q) = (1,1,1) and (p,d,q) = (1,1,0) and for Rangamati it was (p,d,q) = (1,1,2) and (p,d,q) = (1,1,0) respectively. It was observed from the table that, when whole period price data were used then for example in 2014, the predicted prices per 100 piece of banana in Bandarban district will be Tk. 231 and in Rangamati it will be Tk. 189 which are 34% and 17% higher than those of the price of 2011. By using recent period data this price may be Tk. 204 and Tk. 179 respectively that are 19% and 11% higher than the price of 2012.

In all the tables of forecasting it was observed that, the forecasted prices for banana of the study areas shown upward pattern and also the interval between lower and upper price limit was very close to the forecasted price and also the forecasting error was too small. So the people living in hill regions can cultivate more fruits for intensifying the land use as the decision to utilize the land for fruits cultivation greatly depends on the future expectation of prices.

This study made the best effort to develop a short run forecasting model of banana prices in hill regions of Bangladesh. To meet up this objective the collected data were segmented in two parts and that were the whole period price data and the recent period price data. With the help of the best selected values of p, d and q, ARIMA model was fitted on both periods price data and compared with one another to evaluate which model has the better forecasting power. It was observed that the model based on the recent period price data has the better and more accurate forecasting ability than the model based on prices for longer period. So conclusions were drawn on the basis of the model based on the recent period price data. As data were available upto the year 2011 so prediction was done for the next four years that means upto 2015 but as the current year is 2013 so the predicted price for the year 2014 and 2015 will be used for policy guidline. To provide guideline to the farmers what percentage in price would increase, the price of 2012 was considered as base. In brief the major findings are as follows:

- If the existing trend of prices will continue and the factors that affects prices would not be changed abruptly then in 2014 and 2015 price will show an increasing trend.
- In 2014 and 2015, banana prices may be increased by 19% and 23% in Bandarban, 11% and 15% in Rangamati .

It is very encouraging that for all fruits in all districts the percentage increase in price from the year 2012 ranges from 5% to 25% for the next two years. So the farmers of the hilly areas of Bangladesh who are in indecision about the future prices ofbanana should come forward to fruits farming as the analysis provides a positive insight for fruits of banana cultivation.

Table 4: Forecasted price (Tk/100 pieces) of banana in Bandarban

Year	Month	Bandarban (whole period) ARIMA (1,1,1)				Bandarban (recent period) ARIMA (1,1,0)			
		Forecast	Average	Lower limit	Upper limit	Forecast	Average	Lower limit	Upper limit
2013	January	205		158	252	191		115	268
	February	207		158	255	192		112	272
	March	208		159	257	193		109	276
	April	210		159	260	193		106	281
	May	211		160	262	194		103	285
	June	213	213	161	265	195	195	101	289
	July	214	(23.8)	161	267	196	(13.4)	98	293
	August	216		162	269	196		96	297
	September	217		163	272	197		93	301
	October	219		163	274	198		91	305
	November	220		164	276	198		88	309
	December	221		165	278	199		86	313
2014	January	223		165	280	200		83	317
	February	224		166	282	201		81	320
	March	226		167	285	201		78	324
	April	227		168	287	202		76	328
	May	229		169	289	203		73	332
	June	230	231	169	291	203	204	71	336
	July	231	(34.3)	170	293	204	(18.6)	69	340
	August	233		171	295	205		66	344
	September	234		172	297	206		64	347
	October	236		173	299	206		61	351
	November	237		173	301	207		59	355
	December	238		174	303	208		57	359
2015	January	240		175	305	208		54	362
	February	241		176	307	209		52	366
	March	243		177	308	210		50	370
	April	244		177	310	211		47	374
	May	245		178	312	211		45	377
	June	247	247	179	314	212	212	43	381
	July	248	(43.6)	180	316	213	(23.3)	41	385
	August	249		181	318	213		38	389
	September	251		182	320	214		36	392
	October	252		182	322	215		34	396
	November	254		183	324	216		31	400
	December	255		184	326	216		29	403

Note: Figure within ( ) shows the percentage increases from the price of the year 2012

Table 5: Forecasted price (Tk/100 pieces) of banana in Rangamati

Year	Month	Rangamati (whole period) ARIMA (1,1,2)				Rangamati (recent period) ARIMA (1,1,0)			
		Forecast	Average	Lower limit	Upper limit	Forecast	Average	Lower limit	Upper limit
2013	January	175		159	192	171		154	188
	February	176		159	193	171		153	190
	March	177		159	195	172		153	191
	April	178		159	196	172		153	192
	May	178		159	198	173		152	193
	June	179	180	159	199	173	174	152	195
	July	180	(11.8)	160	200	174	(8.1)	152	196
	August	181		160	202	174		152	197
	September	182		160	203	175		151	198
	October	182		160	205	175		151	199
	November	183		160	206	176		151	201
	December	184		161	208	176		150	202
2014	January	185		161	209	177		150	203
	February	186		161	210	177		150	204
	March	187		161	212	178		150	205
	April	187		162	213	178		149	207
	May	188		162	215	178		149	208
	June	189	189	162	216	179	179	149	209
	July	190	(17.4)	162	217	179	(11.2)	149	210
	August	191		163	219	180		148	211
	September	191		163	220	180		148	212
	October	192		163	221	181		148	214
	November	193		164	223	181		148	215
	December	194		164	224	182		148	216
2015	January	195		164	225	182		147	217
	February	196		164	227	183		147	218
	March	196		165	228	183		147	219
	April	197		165	229	184		147	221
	May	198		165	231	184		147	222
	June	199	199	166	232	185	185	146	223
	July	200	(23.6)	166	234	185	(14.9)	146	224
	August	200		166	235	186		146	225
	September	201		166	236	186		146	226
	October	202		167	238	186		145	228
	November	203		167	239	187		145	229
	December	204		167	240	187		145	230

Note: Figure within ( ) shows the percentage increases from the price of the year 2012

CONCLUSION

The banana growers were bound to sell major part of this produce at advance selling due to immediate cash need. High price gap was found between producers and consumer's level due to inefficient marketing system. It discourages the producers to produce more banana fruits in future. On the other hand price forecasting indicates that the next two year price will increasing trend between 5% to 25% which will be encourage the farmer for more banana production. Transportation and communication and storage facilities were the barrier for market integration in the hilly areas. Nevertheless, both farmer and trader encountered various problems during marketing of banana. Most of the farmers mentioned that poor knowledge about banana production technology and lack of irrigation water was the major problems of the banana production.

RECOMMENDATION

Co-operative marketing system should be developed to ensure assured market and better price of fruits of banana for the farmers and intermediaries. Government, private entrepreneurs and NGOs should establish agro-based processing plant at different fruits growing areas with a view to domestic use as well as to export the product at international markets for increasing income and livelihood pattern of the hilly farmers. Private entrepreneur should come forward to establish storage facilities at the important fruit concentrated areas and different wholesale and retail markets which will be helpful for development of better integration among the hilly areas market. Transportation facilities should be ensured for the farmers and intermediaries to carry fruits from farmyard to local market place or in distant bigger market where they are likely to get better prices for their productsAs price uncertainty can be minimised if prices can be forecasted well ahead and necessary steps can be taken against production and post-harvest losses so the findings of this study would be more useful for policy makers, researchers as well as producers for future fruits production policies.

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