Marketing System, Seasonal Price Variation and Market Integration of Hilsha (Tenualosa Ilisha) Fish in Some Selected Areas of Bangladesh


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Abstract

A study was undertaken to examine the marketing system and price behavior of Hilsha fish in selected areas of Chandpur district of Bangladesh during the month of March-April 2012. The objectives of the study were to estimate costs and margins, seasonal price variation and to test market integration of Hilsha fish. Primary and secondary data were used for this study. The higher marketing cost was incurred by aratdars and the lowest by retailer. On the other hand, retailers earned the highest net marketing margins. Analysis of market integration shows that Hilsha fish market in Bangladesh was well integrated. The findings of the study revealed that the marketing of Hilsha was a profitable business and some recommendations were provided for the improvement of Hilsha marketing in the country.

Keywords: Engle granger co-integration; Market integration; Marketing system; Price behavior; Hilsha; Chandpur

Introduction

Hilsa shad, one of the most important tropical fish of the family clupeidae under the genus Tenualosa and species ilisha is anadromous in nature, not a common phenomenon in tropical water compared to temperate and arctic regions, lives in the sea for most of its life, but migrates at least 1,200 km up in some river system in Indian sub-continent for spawning behavior. Distances of 50-100 km are more typical in Bangladesh.Hilsa shad contributing 30% of total fish production of Bangladesh, and about 40% fishermen or 2% of total population of the country earn their livelihood depending on Hilsa fishery directly or indirectly. Therefore economic contribution from this single species of fish is very high, in an agricultural based country like Bangladesh.

Large number of different types of water bodies both inland and marine makes Bangladesh one of the most suitable countries of the world for freshwater aquaculture. The freshwater inland aquaculture production in Bangladesh is the second highest in the world after China [1]. The total annual fish production is estimated at 2.90 million tonnes in 2009-10 (Bangladesh fiscal year: 1 July-30 June), of which 1.35 million tonnes (46.62%) are obtained from inland aquaculture, 1.02 million tonnes (35.53%) from inland capture fisheries, and 0.52 million tonnes (17.85%) from marine fisheries [2]. The main production systems for freshwater aquaculture in Bangladesh are extensive and semi-intensive pond poly-culture of Indian major carps and exotic carps, which account for 80% of the total freshwater aquaculture production. The remaining 20% are mainly from catfish, tilapia, small indigenous fish and rice-fish farming [3]. Presently, 1.4 million people are engaged full time and 12 million as part time in fisheries sector in the country for livelihood and trade. Another 3.08 million fish and shrimp farmers are cultivating fish both at subsistence and commercial level. In Bangladesh, fish farming is currently one of the most important sectors of the national economy. Within the overall agro-based economy of the country, the contribution of fish production has been considered to hold good promise for creating jobs, earning foreign currency and supplying protein. About 97% of the inland fish production is marketed internally for domestic consumption while the remaining 3% is exported [4]. A large number of people, many of whom living below the poverty line, find employment in the domestic fish marketing chain in the form of farmers, processors, traders, intermediaries, day laborers and transporters [1,5,6]. Traditionally, people of Bangladesh like to eat fresh fish. However, chilled and dried fish are also marketed currently in large quantities in the towns and cities. Utilization and marketing distribution of fish is around 70% fresh fish, 25% dried, and the other forms of locally processed fish include fermented products and frozen products [7]. The export market of value added products is highly competitive, involving changes in type of products, forms and packaging as well as consumer behavior. Export of fish, shrimp and other fishery products were considered as non-conventional items before the independence of the country. It has increased many-folds during the last decades and the country is earning foreign exchange to minimize the trade gap. In this case the dried coastal and marine fish, the marine finfish and organism even other than fish, could be on the top of the list of export earning items. Bangladesh exported fish and fisheries products worth Taka 32,106 million in 2009-10 of which frozen fish and shrimp shared more than 90% of the total exports of the fishery products and attained 3.7% of total export earnings of Bangladesh [8]. Since fish production in Bangladesh is increasing over the years, its disposal pattern is very important as growers, wholesalers, retailers and consumers- all are affected due to value addition in the marketing process. For the sustainability of these stakeholders, fish marketing studies are very necessary. Thus, the present study is conducted to examine the fish marketing system, supply chain and value addition to determine the pulling factors for enhancing production, processing and marketing of different species of fishes in Bangladesh. The specific objectives of the study were to examine the existing marketing system of Hilsha fish, to examine cost and margins

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at different stages of marketing channels, to examine the price behavior in terms of seasonal price variation, to analyse the market integration of hilsha fish to identify the major problems of Hilsha fish marketing and suggest some remedial measures. Thus the study was conducted for understanding the present situation of marketing system of Hilsha fish in different regions of Bangladesh with following objectives.

Objectives

- To identify different marketing channels and intermediaries involved of hilsha fish
- To determine the extent of value addition in terms of costs in successive stages of hilsha fish movement.
- To examine the marketing cost and marketing margin of hilsha fish
- To analyse the market integration of hilsha fish and
- To examine price seasonal price variation of hilsha fish

Materials and Methods

The present study was conducted based on field survey method wherein primary data were collected from the respondents. Secondary data was collected from journals, thesis and raw data from monthly bulletin of Directorate of Agricultural Marketing (DAM) and District Fisheries Office. In Chandpur district there were a number of successful Hilsha producers, trader’s i.e. Aratdar, Bepar, LC (Letter of Credite) paiker, Paiker and retailer etc. The study area is confined to one Upazilas namely Chandpur Sadar in Chandpur district, where the cultivation of Hilsha fish was concentrated. Purposive sampling techniques were used for selecting the sample. Total sample size of the study was 120. Selected samples consisted of 40 fish farmers and 80 traders. The intermediaries dealing with Hilsha marketing were categorized into three groups, namely, Aratdar, Paiker and retailer. From different stages of fish marketing, 10 Aratdars 8 LC (Letter of Credite) paiker, 20 Paikers and 42 retailers were selected as respondents for the study. Among them five Aratdars five LC (Letter of Credite) paiker, 12 Paikers and 20 retailers were selected and five retailers from Chandpur Sadar upazila in Chandpur district and five Aratdars three LC(Letter of Credite) paiker, eight Paikers and twenty two retailers from Kawran Bazar of Dhaka City were selected. The data were collected intensively by using structured interview schedules. The weekly average wholesale prices of Hilsha fish of various markets like Dhaka, Chittagong, Sylhet, Khulna, Rajshahi and Chandpur during 1997 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.

- For analyzing seasonal and spatial price variation, ratio to moving average and
- Determination of market integration through Engle and Granger co-integration method

**Farmer’s net prices were calculated by using following formulas:**

Farmer’s net price = Farmer’s sale price - Farmer’s marketing cost

**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. Thus integrated markets are defined as markets in which prices of differentiated products do not behave independently.

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. 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 [9]. 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 [9]. If the time series data like prices, which are non-stationary, are used, it usually would yield a high R2 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 because it 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-integration Test: 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 [9]. A number of tests for stationary are available in the literature; these include the Dickey-Fuller (DF) test, the Augmented Dickey-Fuller (ADF) test 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:

\[ Y_t = \delta Y_{t-1} + \epsilon_t \]  

(1)

\[ \Delta Y_t = \epsilon_t \]  

(2)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(3)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(4)

\[ Y_t = \delta Y_{t-1} + \epsilon_t \]  

(5)

\[ \Delta Y_t = \epsilon_t \]  

(6)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(7)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(8)

\[ Y_t = \delta Y_{t-1} + \epsilon_t \]  

(9)

\[ \Delta Y_t = \epsilon_t \]  

(10)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(11)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(12)

\[ Y_t = \delta Y_{t-1} + \epsilon_t \]  

(13)

\[ \Delta Y_t = \epsilon_t \]  

(14)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(15)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(16)

\[ Y_t = \delta Y_{t-1} + \epsilon_t \]  

(17)

\[ \Delta Y_t = \epsilon_t \]  

(18)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(19)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(20)

\[ Y_t = \delta Y_{t-1} + \epsilon_t \]  

(21)

\[ \Delta Y_t = \epsilon_t \]  

(22)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(23)

\[ \Delta Y_t = \beta Y_{t-1} + \epsilon_t \]  

(24)

\[ Y_t = \delta Y_{t-1} + \epsilon_t \]  

(25)
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 means the time series is non-stationary. The alternative hypothesis is that \( \delta \) is less than zero; that is, the time series is stationary.

Under the null hypothesis, the conventionally computed t-statistics is known as the \( \tau \) (tau) statistic, whose critical values have been tabulated by Dickey and Fuller. If the null hypothesis is rejected, it means that Yi is a stationary time series with zero mean in the case of (1), that Yi is stationary with a non-zero mean \([=\beta_1/(1-\rho)]\) in the case of (2), and that Yi 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 (\( \tau \)) 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 (\( \tau \)) 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 et was uncorrelated. But in case the et 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 \( \Delta Yt \). The ADF test here consists of estimating if the error term et was auto correlated, one modifies (4) as follows:

\[
\Delta Yt = \beta 1 + \beta 2 t + \Delta Yt-1 + \alpha 1 Yt-i + t \quad (4)
\]

where \( t \) is a pure white noise error term and where, \( \Delta Yt-1=(Yt-1 weirness-1) \), \( \Delta Yt-2=(Yt-2 - Yt-3) \), 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:

\[
Yit = \alpha 0 + \alpha 1 Yjt + \epsilon t \quad \text{..........................} \quad (5)
\]

Where, Yi and Yj are price series of a specific commodity in two markets i and j, and \( \epsilon t \) is the residual term assumed to be distributed identically and independently. The test of market integration is straightforward if Yi and Yj 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 Yi and Yj 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. The test involved regression the first-difference whose critical values have been tabulated by Dickey and Fuller. If the null hypothesis is rejected, it means that Yi is a stationary time series with zero mean in the case of (1), that Yi is stationary with a non-zero mean \([=\beta_1/(1-\rho)]\) in the case of (2), and that Yi is a stationary around a deterministic trend in equation (3).

If the computed value of ‘\( t \)’ of regression coefficient \( \beta \) 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.

**Results and Discussion**

**Marketing system of Hilsha fish**

From the result of the study, a complete Hilsha marketing system in Chandpur region were found, which include fish farmers, channel of and Dhaka City.

Major Value chains of hilsha in the study areas are as follows:

- **Domestic market:**
  - Value chain - I Fishermen – Aratdar – Paiker – Aratdar – Retailer – Consumer
  - Value chain - II Fishermen – Aratdar – Paiker – Retailer – Consumer

- **Distant market:**
  - Value chain - III Fishermen – Aratdar – Paiker – Retailer – Consumer

- **Local market:**
  - Value chain - IV Fishermen – Aratdar – LC Paiker – Consumer

Hilsha fish transacted by value chain actors

Hilsha fish farmers sell 16% of fish to farias; 24% to beparis via aratdars, 16% to paikers via aratdars and 12% to LC (Letter of Credit) paikers via aratdar and 32% to retailers. Farias sell 100% to retailers via aratdar. Bepari sells 80% to retailers and 20% to paikers via aratdar. Paikers sell 100% of their fishes to retailers via aratdar. LC paikers sell 100% of their fishes to India. Retailers sell the entire fish to ultimate consumers. Hilsha fish farias purchase 100% fish from fishermen. Paiker, bepari, LC paiker and retailer purchase 100% fish from fishermen through aratdar. Consumers purchase 100% of hilsha fish from the retailers in the study area (Table 1).

**Sources of finance of hilsha fish farmers and intermediaries**

Table 2 shows that in the case of shrimp, most of the farmers, aratdar, bepari and retailers are self-financed. Depot owners use a combination of own funds, bank loans, NGO and aratdars for shrimp marketing. Only 20% of depot owners procure loans from banks while 5% and 3% received from NGOs and dadon giving aratdars respectively. However, a majority of depot owners use their own fund for the business. 34% of the paikers take dadon.

**Pricing for Hilsha**

In the study areas all intermediaries who were involved in the buying and selling of Hilsha fish followed the open bargaining method for fixing the price of their products. The fish farmers enjoyed low bargaining power because of many factors such as perishable ability of product, absence of storage facilities and immediate need for cash. The number of buyers attending the market and the volume of product offered for sale mainly determined the price at market level. In the wholesale market, price varied with the variation of quality of and size of fish. At Arat level prices were fixed through auction. In that case, prices were determined on the basis of supply and demand.
Aratdar negotiate between buyers and sellers of fish and help them at their own business premises on receipt of Aratdari commission. In the hilsha marketing system, the highest value added cost per maund of fish sold is incurred by LC paiker (Taka 977.73) followed by local paiker (Taka 520.23) and inter district Bepari (Taka 228.27) of fish.

Marketing Cost of Hilsha Fish Traders

In hilsha marketing system, the highest value added cost per maund of fish sold is incurred by LC paiker (Taka 977.73) followed by local paiker (Taka 520.23) and inter district Bepari (Taka 228.27) of fish.

Marketing margin of intermediaries

In the study area of Chadpur district, net marketing margins of all intermediaries for hilsha are shown in Table 21. Amongst all intermediaries, profit of retailers is the highest (Taka 1222.65 per maund) followed by LC paiker (Taka 902.27), Aratdar (Taka 296.65) and inter district Bepari (Taka 228.27) of fish.

Seasonal price variation of Hilsha fish in Chandpur and comilla market

The monthly wholesale price indices of Hilsha for Chandpur and Comilla market have been presented in Table 6. It is evident from Table that the price index of Hilsha was the highest (105.38) in April and the lowest (95.22) in November. The important feature of hilsha fish prices was more or less same during November to February. This implies that during this period the supply matched the demand for hilsha fish. After slight increasing in the March it continue up to the month of June. The difference between highest and lowest indices was 10.16. After slight increasing in the March it continue up to the month of June. The difference between highest and lowest indices was 10.16.

Total marketing cost of all intermediaries in dhaka city

In hilsha marketing system, the highest value added cost per maund of fish sold is incurred by LC paiker (Taka 977.73) followed by local paiker (Taka 520.23) and inter district Bepari (Taka 228.27) of fish.

Marketing Cost of Hilsha Fish Traders

In hilsha marketing system, the highest value added cost per maund of fish sold is incurred by LC paiker (Taka 977.73) followed by local paiker (Taka 520.23) and inter district Bepari (Taka 228.27) of fish. The co-efficient of variation of monthly price indices of Hilsha in the Chandpur market of that period was 3.09. In the Dhaka market the highest (Taka 1190.50 per maund) followed by LC paiker (Taka 902.27), Aratdar (Taka 296.65) and inter district Bepari (Taka 228.27) of fish.

Table 1: Percent of hilsha fish transacted by value chain actors. Source: Field survey, 2012.

<table>
<thead>
<tr>
<th>Sources of finance</th>
<th>Market participants (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fisher men</td>
</tr>
<tr>
<td>Own fund</td>
<td>3</td>
</tr>
<tr>
<td>Bank</td>
<td>0</td>
</tr>
<tr>
<td>NGO</td>
<td>0</td>
</tr>
<tr>
<td>Friend and relatives</td>
<td>0</td>
</tr>
<tr>
<td>Dadon from Aratdar</td>
<td>97</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2: Sources of finance of hilsha fish farmers and intermediaries. Source: Field survey, 2012.

<table>
<thead>
<tr>
<th>Cost items</th>
<th>Aratdar</th>
<th>Inter-district bepari</th>
<th>LC paiker</th>
<th>Local paiker</th>
<th>Retailer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Govt. tax</td>
<td>209.03</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>209.03</td>
<td>5.50</td>
</tr>
<tr>
<td>Dadon cost</td>
<td>145.02</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>145.02</td>
<td>3.67</td>
</tr>
<tr>
<td>Transportation</td>
<td>-</td>
<td>180.26</td>
<td>192.38</td>
<td>123.2</td>
<td>103.29</td>
<td>599.13 (16.16)*</td>
</tr>
<tr>
<td>Baskets</td>
<td>-</td>
<td>88.5</td>
<td>88.57</td>
<td>62.65</td>
<td>46.2</td>
<td>285.92 (7.71)*</td>
</tr>
<tr>
<td>Icing</td>
<td>-</td>
<td>64.71</td>
<td>91.43</td>
<td>42.83</td>
<td>67.07</td>
<td>266.04 (7.18)*</td>
</tr>
<tr>
<td>Wages</td>
<td>106.59</td>
<td>37.27</td>
<td>11.44</td>
<td>18.43</td>
<td>-</td>
<td>173.73 (4.69)*</td>
</tr>
<tr>
<td>Salaries</td>
<td>38.19</td>
<td>-</td>
<td>-</td>
<td>3.05</td>
<td>-</td>
<td>41.24 (1.11)*</td>
</tr>
<tr>
<td>House rent</td>
<td>18.64</td>
<td>0.52</td>
<td>0.48</td>
<td>-</td>
<td>25.64</td>
<td>46.28 (1.22)*</td>
</tr>
<tr>
<td>Electricity</td>
<td>4.41</td>
<td>-</td>
<td>-</td>
<td>0.52</td>
<td>-</td>
<td>27.24 32.17 (0.87)*</td>
</tr>
<tr>
<td>Telephone bill</td>
<td>29.06</td>
<td>5.8</td>
<td>1.44</td>
<td>2.65</td>
<td>22.83</td>
<td>61.16 (1.78)*</td>
</tr>
<tr>
<td>Personal expenses</td>
<td>38.24</td>
<td>8.54</td>
<td>1.74</td>
<td>3.75</td>
<td>30.56</td>
<td>82.83 (2.23)*</td>
</tr>
<tr>
<td>Storage</td>
<td>2.43</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.43</td>
<td>0.07*</td>
</tr>
<tr>
<td>Tips and donation</td>
<td>5.58</td>
<td>4.27</td>
<td>0.29</td>
<td>0.8</td>
<td>-</td>
<td>10.94 (0.30)*</td>
</tr>
<tr>
<td>Coop subscription</td>
<td>3.82</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.82</td>
<td>0.10*</td>
</tr>
<tr>
<td>Aratdari’s commission</td>
<td>-</td>
<td>581.86</td>
<td>586.39</td>
<td>585.47</td>
<td>-</td>
<td>1753.72 (47.31)*</td>
</tr>
<tr>
<td>Others</td>
<td>0.47</td>
<td>-</td>
<td>-</td>
<td>7.46</td>
<td>-</td>
<td>7.93 (0.21)*</td>
</tr>
<tr>
<td>Total</td>
<td>587.5</td>
<td>971.73</td>
<td>977.73</td>
<td>839.77</td>
<td>340.25</td>
<td>3707.02 (100.00)*</td>
</tr>
</tbody>
</table>

Table 3: Total marketing cost of different intermediaries involved in hilsha marketing at Chandpur (per maund). Source: Field survey, 2012.

*Figures in the parentheses indicate percentages of total cost. 1 maund=40 kg.
The degree of interrelationships between price movements in two markets is called market integration. In other words, in an integrated market, price of a homogeneous commodity at different spatially separated locations should tend to move together indicating efficient spread of price information and inter-linkages of markets. In interlinked commodity market price movement in one location should be highly correlated with price movement in other locations.

### Market integration

To avoid the problem of spurious correlation between time series variables especially price variable, co-integration method was used which was developed by Engle and Granger for making firm decisions on market integration. The valuable contribution of the concepts of unit root, co-integration, is to force to find out if the regression residual is stationary [9]. As Granger, notes, “A test for co-integration can be thought of as a pre-test to avoid spurious regression situations.” An intuitive explanation of the main concepts of co-integration analysis is that prices move from time to time, and their margins are subject to various shocks that drive them apart or not. If in the long run they exhibit a linear constant relation, it can be said that they are co-integrated.

#### Integration by co-integration method

To test the stationarity of the prices of Hilsa Fish, the DF and ADF tests for wholesale price of Hilsa fish 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 decision that was undertaken are presented in Table 7.

The tau (τ) statistic compared with absolute values (e.g., estimated t values 1.256, -1.971 and -1.828 for Dhaka district prices which are less

<table>
<thead>
<tr>
<th>Month</th>
<th>Seasonal indices in Chandpur</th>
<th>Seasonal indices in Dhaka</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>99.8</td>
<td>100.9</td>
</tr>
<tr>
<td>February</td>
<td>96.38</td>
<td>98.35</td>
</tr>
<tr>
<td>March</td>
<td>98.38</td>
<td>99.26</td>
</tr>
<tr>
<td>April</td>
<td>105.38</td>
<td>105.02</td>
</tr>
<tr>
<td>May</td>
<td>100.39</td>
<td>102.03</td>
</tr>
<tr>
<td>June</td>
<td>101.38</td>
<td>101.09</td>
</tr>
<tr>
<td>July</td>
<td>104.94</td>
<td>102.13</td>
</tr>
<tr>
<td>August</td>
<td>101.23</td>
<td>100.85</td>
</tr>
<tr>
<td>September</td>
<td>103.79</td>
<td>98.41</td>
</tr>
<tr>
<td>October</td>
<td>99.83</td>
<td>96.17</td>
</tr>
<tr>
<td>November</td>
<td>95.22</td>
<td>97.46</td>
</tr>
<tr>
<td>December</td>
<td>100.55</td>
<td>102.11</td>
</tr>
<tr>
<td>Highest</td>
<td>105.38</td>
<td>105.02</td>
</tr>
<tr>
<td>Lowest</td>
<td>95.22</td>
<td>96.17</td>
</tr>
<tr>
<td>Range</td>
<td>10.16</td>
<td>8.85</td>
</tr>
<tr>
<td>C.V.</td>
<td>3.09</td>
<td>2.41</td>
</tr>
</tbody>
</table>

Table 6: Seasonal price variation of Hilsa fish in different markets.

#### Spatial Price Relationship

### Market integration

To avoid the problem of spurious correlation between time series variables especially price variable, co-integration method was used which was developed by Engle and Granger for making firm decisions on market integration. The valuable contribution of the concepts of unit root, co-integration, is to force to find out if the regression residual is stationary [9]. As Granger, notes, “A test for co-integration can be thought of as a pre-test to avoid spurious regression situations.” An intuitive explanation of the main concepts of co-integration analysis is that prices move from time to time, and their margins are subject to various shocks that drive them apart or not. If in the long run they exhibit a linear constant relation, it can be said that they are co-integrated.

Granger representation theorem tests that if a set of variables are co-integrated or integrated of order 1, denoted by I (1), there exists a valid error correction representation of the data. For instance, price changes in one period may depend upon surplus demand of the previous period. Hence it is possible to recognize the short-run and long-run behavior through an error correction mechanism. The detail method is as follows:

#### Co-integration test for Hilsa Fish

To test the stationarity of the prices of Hilsa Fish, the DF and ADF tests for wholesale price of Hilsa fish 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 decision that was undertaken are presented in Table 7.

The tau (τ) statistic compared with absolute values (e.g., estimated t values 1.256, -1.971 and -1.828 for Dhaka district prices which are less...
than the critical $r$ values without a constant, with a constant and with a constant and trend (-2.60, -3.51 and -4.04 at 1% level). That means the null hypothesis is accepted and concluded that the Hilsha fish prices of Dhaka district contained unit root that is the price series is non-stationary. Similarly, it is found that prices of Hilsha fish of all the selected districts are non-stationary.

The next step is to examine whether bivariate co-integration exists among different districts Hilsha fish prices. The researcher’s aim was to find that which market’s price influences others. It is normally assume that Dhaka is the reference market and it influences other markets prices. As data on prices of Hilsha fish for Dhaka, Chittagong, Rajshahi, Khulna, Sylhet, Chandpur and Gazipur was available from DAM’s weekly price report from the year of 2000 to 2012, so the available data were used for the analysis. In Table 8, the results of estimated co-integration regression and the final result were presented. The Engle-Granger (EG) tests of residual or error term confirmed the stationary of the residual series for all groups of two markets.

Thus the results indicated that the residual series (which are linear combination of Hilsha fish price series) are stationary at level I (0). That means yet the original price series being non-stationary but their linear combination being I (0), the series are co-integra.

As mentioned earlier, Chandpur is surplus area in Hilsha fish production and the rest districts considered in the study are deficit area, so when price changes in this surplus area then automatically prices will changes for the other districts.

Finally, the result implies that if any divergence from long-run equilibrium occurs in period t-1, it will be adjusted towards equilibrium level in period t. Thus, the selected Hilsha fish markets in Bangladesh are shown to be integrated. This is mainly attributed to close proxy, good communication facilities especially development of cell phone technology and good infrastructure availabilities among the market centers in Bangladesh.

**Conclusion**

Though hilsha fish marketing in Bangladesh is beset with a number of problems, there have been a number of positive changes that are expected to improve fish marketing environment in the country. These
positive drivers includes, (i) the shift from subsistence to commercial fish farming, (ii) emergence of super-markets, and (iii) a changing social attitude towards fish marketing, as it is less considered as a dishonorable job as it was in the past. But the government in Bangladesh needs to ensure that the proper infrastructure and necessary social capital are available for effective participation of all the market intermediaries of the seafood value chain. For better fish marketing, side by side with the private sector, government should also play active role in providing physical facilities like refrigerated storage, refrigerated vans, good market places with related facilities like water, ice, electricity, drainage facilities and sitting arrangements etc. The development of good road and transport networks can reduce superfluous involvement of intermediaries, which could be beneficial for both the fishers/farmers and consumers. Assembling centers with refrigerated storage facilities may be developed so that the perishability of fish is checked, which would enable the assembling centers to make bulk sell/transfer to the next destination. This could reduce post-harvest loss and provide better price for the fishers/farmers.

**References**


### Table 8: Unit Root Test (Test of Stationarity/Non-stationarity) for the Prices of Hilsha fish.

<table>
<thead>
<tr>
<th>Market</th>
<th>Method</th>
<th>Condition</th>
<th>Intercept</th>
<th>Coefficient of</th>
<th>Coefficient of</th>
<th>Coefficient of</th>
<th>Coefficient of trend</th>
<th>d-value</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka</td>
<td>DF</td>
<td>Without</td>
<td>0.01</td>
<td>-1.3</td>
<td>27.2</td>
<td>-0.1</td>
<td>(1.971)</td>
<td>3.3</td>
<td>Non-stationary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant and trend</td>
<td>55.4</td>
<td>-0.2</td>
<td>(1.828)</td>
<td>3.3</td>
<td>1.96</td>
<td>Non-stationary</td>
<td></td>
</tr>
<tr>
<td>Chittagong</td>
<td>DF</td>
<td>Without</td>
<td>0</td>
<td>-1.251</td>
<td>17.7</td>
<td>-0.1</td>
<td>(-1.628)</td>
<td>2.3</td>
<td>Non-stationary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant and trend</td>
<td>39.4</td>
<td>-0.3</td>
<td>(2.397)</td>
<td>2.26</td>
<td>Non-stationary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Khulna</td>
<td>DF</td>
<td>Without</td>
<td>0</td>
<td>-0.868</td>
<td>13.6</td>
<td>-0.2</td>
<td>(-1.958)</td>
<td>4.98</td>
<td>Non-stationary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant and trend</td>
<td>28</td>
<td>-0.4</td>
<td>(2.214)</td>
<td>1.81</td>
<td>Non-stationary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADF</td>
<td>1 lagged difference with trend</td>
<td>67.1</td>
<td>-0.6</td>
<td>(2.417)</td>
<td>0.24</td>
<td>6.6</td>
<td>1.94</td>
<td>Non-stationary</td>
<td></td>
</tr>
<tr>
<td>Sylhet</td>
<td>DF</td>
<td>Without</td>
<td>0.01</td>
<td>-1.267</td>
<td>38.2</td>
<td>-0.1</td>
<td>(-1.89)</td>
<td>3.24</td>
<td>Non-stationary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant and trend</td>
<td>74.4</td>
<td>-0.2</td>
<td>(1.825)</td>
<td>1.98</td>
<td>Non-stationary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gazipur</td>
<td>DF</td>
<td>Without</td>
<td>0</td>
<td>-0.75</td>
<td>25.6</td>
<td>-0.1</td>
<td>(-1.524)</td>
<td>4.21</td>
<td>Non-stationary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant and trend</td>
<td>93.5</td>
<td>-0.3</td>
<td>(1.789)</td>
<td>1.98</td>
<td>Non-stationary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chandpur</td>
<td>DF</td>
<td>Without constant</td>
<td>0</td>
<td>-1.3</td>
<td>(1.537)</td>
<td>1.39</td>
<td>Non-stationary</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>With constant</td>
<td>-0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Dickey-Fuller Critical values for 1% and 5% are: Without a constant: -2.60 and -1.95 respectively, with a constant: -3.51 and -2.89 respectively, with a constant and trend: -4.04 and -3.45, respectively, for sample size 100 (Gujarati 2004, p.975). Source: Department of Agricultural Marketing (DAM 1997-2012)


