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MARKETING SYSTEM, SEASONAL PRICE VARIATION AND MARKET INTEGRATION OF HILSHA (TENUALOSA ILISHA) FISH IN SOME SELECTED AREAS OF BANGLADESH

Md. Imran Omar[1*], Syed Ariful Haque[2], Md. Rajib Sharker[3], and Md. Fakhrul Islam[4] & Mohammad Azharul Alam[4]

[1]Scientific officer, Agricultural Economics Division, Bangladesh Agricultural Research Institute, Joydevpur, Gazipur-1701. Bangladesh. Email:imran238bau@gmail.com
. [2]Lecturer, Department of Fisheries Technology Sheikh Fajilatunnesa Mujib Fisheries College, Melandah, Jamalpur. Bangladesh.
[3]Lecturer Dept. of Fisheries Biology and Genetics Faculty of Fisheries Patuakhali Science & Technology University Dumki, Patuakhali-8602 Bangladesh.
[4]Lecturer, Department of Fisheries Management & [4]Lecturer, Department of Fisheries Biology and Genetics, Sheikh Fajilatunnesa Mujib Fisheries College, Melandah, Jamalpur. Bangladesh.

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 (FAO, 2009). 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 (DoF, 2010). 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 (ADB, 2005). 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 (Shah and Ahmed, 2006). 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 (Hasan, 2001). 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 (Ahmed *et al*. 1993, Islam, 1996; DFID, 1997; Kleih, 2001a¸ 2001b).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 (Islam *et al.* 2006). 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 (Kamal, 1994). 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 (Bangladesh Bank, 2011). 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 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, Bepari*, 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 *Aratdar*s 8 LC(Letter of Credite) paiker, 20 *Paiker*s 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.

i. For analyzing seasonal and spatial price variation, ratio to moving average and
ii. 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 (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:

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

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:

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

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:

$$\text{For Engle-Granger (EG) test, } \Delta\varepsilon_t = \beta \varepsilon_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

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.

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 (Distant market)

Value chain - II Fishermen – *Aratdar* – *Paiker* – Retailer – Consumer (Local market)

Value chain - III Fishermen – *Aratdar* – Retailer – Consumer (Local market)

Overseas 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).

Table 1. Percent of hilsha fish transacted by value chain actors

	Purchase from (%)				Sold to (%)					
Value chain actor	**Fishermen**	**Fishermen via *aratdar***	***Paiker***	**Retailer**	***Faria***	***Bepari* via *aratdar***	***Paiker* via *Aratdar***	**LC Paiker via *Aratdar***	**Retailer via *aratdar***	**Consumer**
Fishermen	-	-	-	-	16	24	16	12	32	-
Aratdar	*Aratdar*s negotiate between buyers and sellers of fish and help them at their own business premises on receipt of *Aratdar*i commission.									
Faria	100	-	-	-	-	-	-	-	100	-
Bepari	-	100	-	-	-	-	20	-	80	-
Paiker	-	100	-	-	-	-	-	-	100	-
LC *paiker*	-	100	-	-	Sold all fishes to India					
Retailer	-	100	-	-	-	-	-	-	-	100
Consumer	-	-	-	100	-	-	-	-	-	-

Source: Field survey, 2012.

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*

Table 2. Sources of finance of hilsha fish farmers and intermediaries

Sources of finance	Market participants (%)					
	Fishermen	***Aratdar***	***Bepari***	***Paiker***	**LC Paiker**	**Retailer**
Own fund	3	90	95	80	74	99
Bank	0	9	5	10	24	0
NGO	0	0		0	2	1
Friend and relatives	0	1		0		
Dadon from *Aratdar*	97			10		
Total	100	100			100	100

Source: Field survey, 2012.

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 perishes 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.

Marketing Cost of Hilsha Fish Traders

Total Cost of Intermediaries at Chandpur

Transportation is the highest cost per maund for inter district *paikers*, local *paikers* and retailers in the study areas.

In hilsha marketing system, the highest value added cost per maund of fish sold is incurred by LC *paiker* (Taka 977.73) followed by inter district *bepari* (Taka 971.73), local *paiker* (Taka 850.75), *aratdar* (Taka 587.50) and retailer (Taka 330.29). *Aratdar*'s major cost component is government tax for using landing station (Taka 204.03) because, in hilsha marketing system, fish landing station is maintained by the Bangladesh Fisheries Development Corporation (BFDC) and fishes transacted in the landing station. *Aratdari* commission is the highest cost item for inter district *Beparis*, LC *paikers* and local *paikers*. Transportation cost constituted the highest component for retailers (Taka 103.29). *Aratdar's*
commission is the highest cost of hilsha fish marketing (47.31%) in Bangladesh. (Table 3).

Table 3. Total marketing cost of different intermediaries involved in hilsha marketing at Chandpur (per maund)

Cost items	Aratdar	Inter-district bepari	LC paiker	Local paiker	Retailer	Total
Govt. tax	209.03	-	-	-	-	209.03 (5.50)
Dadon cost	145.02	-	-	-	-	145.02 (3.67)
Transportation	-	180.26	192.38	123.2	103.29	599.13 (16.16)
Baskets	-	88.5	88.57	62.65	46.2	285.92 (7.71)
Icing	-	64.71	91.43	42.83	67.07	266.04 (7.18)
Wages	106.59	37.27	11.44	18.43	-	173.73 (4.69)
Salaries	38.19	-	3.05	-	-	41.24 (1.11)
House rent	18.64	0.52	0.48	-	25.64	45.28 (1.22)
Electricity	4.41	-	0.52	-	27.24	32.17 (0.87)
Telephone bill	29.06	5.8	1.44	2.65	22.83	61.78 (1.67)
Personal expenses	38.24	8.54	1.74	3.75	30.56	82.83 (2.23)
Storage	2.43	-	-	-	-	2.43 (0.07)
Tips and donation	5.58	4.27	0.29	0.8	-	10.94 (0.30)
Coop subscription	3.82	-	-	-	-	3.82 (0.10)
Aratdar's commission	-	581.86	586.39	585.47	-	1753.72 (47.31)
Others	0.47	-	-	-	7.46	7.93 (0.21)
Total	587.5	971.73	977.73	839.77	340.25	3707.02 (100.00)

Source: Field survey, 2012
*Figures in the parentheses indicate percentages of total cost. 1 maund = 40kg

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 839.77), *aratdar* (Taka 587.50) and retailer (Taka 340.25). *Aratdar*'s major cost component is government tax for using landing station (Taka 204.03) because, in hilsha marketing system, fish landing station is maintained by the Bangladesh Fisheries Development Corporation (BFDC) and fishes transacted in the landing station. *Aratdari* commission is the highest cost item for inter district *Beparis*, LC *paikers* and local *paikers*. Transportation cost constituted the highest component for retailers (Taka 107.29). *Aratdar's* commission is the highest cost of hilsha fish marketing (49.31%) in Bangladesh. (Table 4).

Table 4. Total marketing cost of different intermediaries involved in hilsha marketing at Dhaka City (per maund)

Cost items	Aratdar	LC paiker	Local paiker	Retailer	Total
Govt. tax	204.03	-	-	-	204.03 (5.50)
Dadon cost	136.02	-	-	-	136.02 (3.67)
Transportation	240.50	200.38	125.2	107.29	599.13 (16.16)
Baskets	40	88.57	63.65	48.2	285.92 (7.71)
Icing	35.50	91.43	42.83	70.07	266.04 (7.18)
Wages	106.59	16.44	19.43	-	173.73 (4.69)
Salaries	38.19	5.05	-	-	41.24 (1.11)
House rent	18.64	0.48	-	25.64	45.28 (1.22)
Electricity	4.41	0.52	-	27.24	32.17 (0.87)
Telephone bill	29.06	2.44	2.65	25.83	61.78 (1.67)
Personal expenses	38.24	1.74	5.75	30.56	82.83 (2.23)
Storage	2.43	-	-	-	2.43 (0.07)
Tips and donation	5.58	2.29	0.8	-	10.94 (0.30)
Coop subscription	3.82	-	-	-	3.82 (0.10)
Aratdar's commission	-	586.39	585.47	-	1190.72 (49.31)
Others	0.47	-	-	7.46	7.93 (0.21)
Total	587.5	998.5	850.75	340.25	3207.02 (100.00)

Source: Field survey, 2012
*Figures in the parentheses indicate percentages of total cost. 1 maund = 40kg

Marketing Margin of Intermediaris

In the study area of Chadpur district, net marketing margins of all intermediaries for hilsha are shown in Table 5 Amongst all intermediaries, profit of retailers is the highest (Taka 1222.65 per maund) followed by LC *Paiker* (Taka 902.27), *Paiker* (Taka 520.23), *Aratdar* (Taka 296.65) and inter district *Bepari* (Taka 228.27) of fish.. In the Dhaka city market Amongst all intermediaries, profit of retailers is the highest (Taka 1190.50 per maund) followed by LC *Paiker* (Taka 971.50), *Paiker* (Taka 549.25) and *Aratdar* (Taka 296.65) of fish. Profit of intermediaries varies due to variation in their costs, purchase price and sales price

Table 5. Marketing Margin of Various intermediaries in Chandpur and Dhaka City (Tk./maund)

Area	Intermediaries	Purchase price	Sale price	Gross marketing margin	Marketing cost	Net marketing margin
Chandpur	Aratdar	-	-	884.15	587.50	296.65
	Inter district *Bepari*	13360.00	14560.00	1200.00	971.73	228.27
	LC *Paikar*	14080.00	15960.00	1880.00	977.73	902.27
	Paiker	13520.00	14880.00	1360.00	839.77	520.23
	Retailer	14600	16152.94	1552.94	330.29	1222.65
Dhaka City	Aratdar	-	-	884.15	587.5	296.65
	LC Paikar	14280	16250	1970	998.5	971.5
	Paiker	13720	15120	1400	850.75	549.25
	Retailer	14690	16220.75	1530.75	340.25	1190.5

Source: Field survey, 2012.
*1 maund = 40kg
Note: Aratdar Gross margin = Average received Aratdar's commission. Gross margin = Sale price – purchase price. Net margin = gross margin – marketing costs

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 the June. The difference between highest and lowest indices was 10.16. The co-efficient of variation of monthly price indices of Hilsha in Chandpur market of that period was 3.09. In the Dhaka market the highest price index was 105.01 in the month of April and the lowest price index of 96.17 in the month of October. Price of Hilsha fluctuated in different months. The cause of this fluctuation might be due to the change in demand or other political instability in different months. The co-efficient of variation of monthly price indices of Hilsha in Dhaka market of that period was 2.11.

Table 6. Seasonal price variation of Hilsha fish in different markets

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

In some of the months of the year the price declined due to the more supply of fish. In the winter season most of the fishes were harvested due to the lack of water and market become saturated with fishes. Due to higher supply and lower demand fishes, the prices of fish become lower. On the other hand because of lower production, the price of fish was the highest in April. Another reason of higher price prevailed in the months of April to July was that the demand remained higher in those months. Sometimes, availability of substitute products of fish like Hilsha fish, meat etc. was responsible for fluctuation of price of fish. Many religious festivals such as Ramadan, Eid-ul-Azha decreases the demand for fish and price fluctuation was found.

SPATIAL PRICE RELATIONSHIP

Market Integration

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.

Integration by Co-integration Method

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 (1987) 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 are stationary

(Gujarati, 2004, p. 822). As Granger (1987), 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 (Engle and Granger, 1987) 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 Hilsha Fish

To test the stationary of the prices of Hilsha Fish, the DF and ADF tests for wholesale price of Hilsha 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 -1.828for Dhaka district prices which are less than the critical τ 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 of2000 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 seriesareco-integra

Table 7: Unit Root Test (Test of Stationarity/Non-stationarity) for the Prices of Hilsha fish

Market	Method	Condition	Intercept	Coefficient of Pt-1	Coefficient of Δ Pt-1	Coefficient of Δ Pt-2	Coefficient of trend	d-value	Decision
Dhaka	used	used		Pt-1	Δ Pt-1	Δ Pt-2	(t)		
	DF	Without		0.007				2.12	Non-stationary
		constant		-1.256					
		With constant	27.24	-0.127 (-1.971)				2.2	
		With constant & trend	55.4	-0.248 (-1.828)			3.295	1.96	
Chittagong	DF	Without constant		0.003 (-1.251)				1.39	Non-stationary
		With constant	17.65	-0.125 (-1.628)				1.34	
		With constant & trend	39.4	-0.321 (-2.397)			2.298	2.26	
Khulna	DF	Without constant		0.004 (-0.868)				2.1	Non-stationary
		With constant	13.78	-0.176 (-1.958)				1.95	
		With constant & trend	28.008	-0.374 (-2.214)			4.981	1.81	
	ADF	1 lagged difference with trend	67.05	-0.58 (-2.417)	0.239		6.597	1.94	
Sylhet	DF	Without constant		0.006 (-1.267)				2.02	Non-stationary
		With constant	38.24	-0.137 (-1.89)				2.1	
		With constant & trend	74.36	-0.248 (-1.825)			3.239	1.98	
Gazipur	DF	Without constant		0.004 (-0.75)				2.09	Non-stationary
		With constant	25.61	-0.117 (-1.524)				1.79	
		With constant & trend	93.5	-0.28 (-1.789)			4.205	1.98	
Chandpur	DF	Without constant		0.004					Non-stationary
		With constant		-1.345				1.39	
		With constant & trend	35.01	-0.128 (-1.537)				1.34	

Note: Figure within ( ) shows t-values of the regression coefficient.

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)

Table 8. Spatial Price Relationships between different Markets for Hilsha fish from May 1997 to December 2012

Markets	Co-integrating Regression	Co-integration Test Engel-Granger	Decision
Dhaka-Chittagong	P_D= 17.316+ 0.869P_C R^2= 0.891 (32.57)	ΔU_t= -0.743 U_{t-1}*** (-8.893)	Co-integrated
Dhaka-Rajshahi	P_D=3.53+ 0.985P_R R^2= 0.892 (32.664)	ΔU_t= -0.628 U_{t-1}*** (-7.632)	Co-integrated
Dhaka-Khulna	P_D= 16.202+ 0.96P_K R^2= 0.895 (33.248)	ΔU_t= -0.716 U_{t-1}*** (-8.581)	Co-integrated
Dhaka- Sylhet	P_D= 18.93+ 0.87P_S R^2= 0.886 (21.75)	ΔU_t= -0.567 U_{t-1}*** (-7.30)	Co-integrated
Dhaka-Chandpur	P_D= 2.234+ 0.979P_M R^2= 0.884 (31.413)	ΔU_t= -0.832 U_{t-1}*** (-9.701)	Co-integrated
Dhaka-Gazipur	P_D= 12.702+ 0.978P_G R^2= 0.801 (22.90)	ΔU_t= -0.582 U_{t-1}*** (-7.27)	Co-integrated

Note: Figure within ( ) shows t-values of the regression coefficient.
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.
Source: Department of Agricultural Marketing (DAM 1997-2012)

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.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 perish ability of fish is checked, which would enable the assembling canters to make bulk sell/transfer to the next destination. This could reduce post harvest loss and provide better price for the fishers/farmers.

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