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Seasonal Price Variation and Market Intregration of Tilapia *(Oreochromis Niloticus)* 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 tilapia fish in selected areas of Mymensingh district of Bangladesh during the month of March-May 2012. The objectives of the study were to estimate costs and margins, seasonal price variation and to test market integration of Tilapia 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 Tilapia fish market in Bangladesh was well integrated. The study identified some problems related to economic, technical, marketing, social and natural calamities aspects and suggested some measures for solving these problems. The findings of the study revealed that the marketing of tilapia was a profitable business and some recommendations were provided for the improvement of tilapia marketing in the country.
Keywords: Engle Granger co-integration, Market integration, marketing system, price behavior, Tilapia.

INTRODUCTION

The most important food crops for the 140 million people of Bangladesh are rice and fish. Fish play an important role among the population in Bangladesh for providing protein, essential vitamins, minerals and fatty acids. Fish account for about 70% of the animal protein intake with annual fish consumption of about 14 kg per person (ADB, 2005a). The average per capita fish consumption is lower than the world average of 16.1 kg a year (Hishamunda et al., 2008). Nevertheless, the importance of aquaculture as a source of food has been well recognized in Bangladesh. Bangladesh is considered one of the most suitable countries in the world for freshwater aquaculture, because of its favorable agro-climatic conditions. A sub-tropical climate and vast areas of shallow water provide ideal conditions for fish production. The total annual fish production was estimated to be 2.82 million tons in 2011, of which 892,049 tons (38%) were obtained from inland aquaculture, 956,686 tons (41%) from inland capture fisheries, and 479,810 tons (21%) from marine fisheries (DOF, 2007). The main production systems for freshwater aquaculture in Bangladesh are extensive and semi-intensive pond polyculture of Indian major carps and exotic carps which accounts or 80% of the total freshwater aquaculture production. The remaining 20% were mainly from catfish (*Pangasianodon hypophthalmus* locally known as pangas), tilapia, small indigenous fish species and rice-fish farming (ADB, 2005a). In order to meet the soaring demand for food, there is a huge potential of tilapia farming in Bangladesh. Tilapia farming is widespread in many Asian countries including China, Indonesia, Philippines, Thailand and Vietnam due to its rapid growth rate, high market demand and increasing consumer acceptance (ADB, 2005b). With increasing popularity among consumers, tilapias have become the world's second most important cultured fish after carps. There is a long history of tilapia farming in Bangladesh and it was expected that tilapia would act as a miracle fish in aquaculture. The Mozambique tilapia2 (Oreochromis mossambicus) was introduced to Bangladesh from Thailand in 1954 (Ahmed et al., 1996). However, this species was not widely accepted for aquaculture because of its early maturation and prolifically breeding lead to overcrowd in ponds. The present study aimed to identify, particularly the marketing channels, to analyse the market integration and to analyse seasonal price variation of Tilapia in Bangladesh. The study would make recommendation and suggestions to improve the organization and operation of Tilapia fish marketing with a view to enhancing efficiency by analyzing the present marketing problems. In view of these, the survey was conducted to examine marketing and price behavior of tilapia fish in selected areas of Mymensingh district. Thus the study was conducted for understanding the present situation of marketing system of tilapia fish in different regions of Bangladesh with following objectives.

Objectives

i. To examine the nature of marketing system and marketing cost of tilapia fish.

ii. To analyse the market integration of tilapia fish and

iii. To examine price seasonal price variation of tilapia fish

MATERIALS AND METHODS

The present study was conducted based on field survey method where in 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 Mymensingh district there were a number of successful Tilapia producers, trader's i.e.*Aratdar*, *Bepari*, *Paiker* and retailer etc. The study area is confined to two Upazilas namely Trishal and Muktagacha upazilas in Mymensingh district, where the cultivation of Tilapia fish was concentrated. Purposive sampling techniques were used for selecting the sample. Total sample size of the study was 100 .Selected samples consisted of 30 fish farmers and 70 traders. For this study, 30 stocking ponds were selected from Muktagacha and Trishal *upazila*s. The intermediaries dealing with Tilapia marketing were categorized into three groups, namely, *Aratdar*, *Paiker* and retailer. From different stages of fish marketing 20 *Paiker*s, 10 *Aratdar*s and 40 retailers were selected as respondents for the study. Among them two *Aratdars*, *five Paiker* and ten retailers from Muktagacha, three *Aratdar*s, *five Paiker* and ten retailers from Trishal, and ten *Paiker*s, five *Aratdar*s and twenty 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 Talapia fish of various markets like Dhaka,Chittagong, Sylhet, Bogra,Rangpur and Mymensingh during 2000 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

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:

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

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

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

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

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

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:

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

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:

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

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.

RESULTS AND DISCUSSION

Marketing system of tilapia fish

From the result of the study, a complete tilapia marketing system in Mymensingh region were found, which include fish farmers, channel of Muktagacha,Trishal, and Dhaka city.

Marketing functions of tilapia fish

In Muktagacha, fish farmers sold 87.5% of their fishes to *Paiker*s, 12.1% to *Aratdar* through retailers and rest0.4% were kept for own consumption and gift. *Paiker*s purchased 87.5% of their fish from fish farmers and sold64.5% of their fishes to *Aratdar*s through *Paiker* at district level and the rest 35.5% to retailers. Retailers purchased 12.1% of fish from farmer's and35.5% to *Paiker*s and sold the entire fish to ultimate consumer (Table 1). In Trishal, fish farmers sold 89.7% oftheir fishes to *Paiker*s, 9.6% to *Aratdar* through retailers and rest 0.7% were kept for own consumption and gift. *Paiker*s purchased 89.7% of their fish from fish farmers and sold 78.5% of their fishes to *Aratdar*s through *Paiker* at district level and the rest 21.5% to retailers. Retailers purchased 9.6% of fish from farmers and 21.5% to *Paiker*s and sold the entire fish to ultimate consumer. On the other hand in the Dhaka city, *Paiker* procured 100% from the farmers of two selected areas through the local *Aratdar*s and they sold the entire amount to retailers through *Aratdar*s. Retailer sold the same to consumers (Table1).

Table 1. Percentage of fish transacted by fish farmers and intermediaries in Muktagacha, Trishal, and Dhaka City

Region	Group	Purchased from (%)		Sold to (%)			
		Farmer	Paiker	Retailer	Paiker	Retailer	consumers
Muktagacha,	Farmer	-	-	-	87.5	12.1	-
	Paiker	87.5	-	-	64.5	35.5	-
	Retailer	12.1	35.5	-	-	-	100
Trishal,	Farmer	-	-	-	89.7	9.6	-
	Paiker	89.7	-	-	78.5	21.5	-
	Retailer	9.6	21.5	-	-	-	100
Dhaka city	Paiker	100	-	-	-	100	-
	Retailer	-	100	-	-	-	100

Pricing for tilapia

In the study areas all intermediaries who were involved in the buying and selling of Tilapia 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 and Margins of Tilapia Fish Traders

Total Marketing Cost of all Intermediaries at Muktagacha

Total cost of marketing of tilapia fish includes all costs incurred by different types of intermediaries standing between the fish farmers and ultimate consumers. It appears from Table 8 that the total cost of marketing at Muktagacha was Tk. 309.82 per quintal. Among at costs items, icing were the highest amounting to Tk. 57.38 (18percent), followed by personal expenses and wastage (Table 2).

Total Cost of Intermediaries at Trishal

Total cost of marketing tilapia fishes includes all cost incurred by different types of intermediaries standing between the fish farmers and the ultimate consumers. It has been seen from Table 5, that the total cost of marketing fish at Trishal was Tk.334.78 per quintal. Among all the cost items, wastage cost was the highest amounting to 65.98 (25 %), followed by icing and personal expenses (Table 2).

Table 2. Marketing cost of intermediaries per quintal of fishes at Muktagacha & Trishal (Tk./quintal)

Cost Items	Muktagacha				Trishal			
	Types Of Intermediaries				Types Of Intermediaries			
	Aratdar(Tk.)	Retailer(Tk.)	Total Cost	%	Aratdar(Tk.)	Retailer(Tk.)	Total Cost	%
Transportation		26.78 (10.87)	29.78	8.64		30.32(10.58)	30.32	8.56
Wages& Salary	28.93(40.49)		28.93	8.37	26.86 (37.01)		26.86	7.42
Personal Expenses	10.69(13.67)	43.79 (17.78)	48.29	15.6	11.74(14.5)	38.84(14.54)	49.58	14.51
Icing	4.5(7.07)	48.82 (19.8)	57.38	18.5	5.23(7.79)	56.34(21.05)	61.57	18.39
Market Tolls	5.18(8.15)	17.86 (7.25)	23.04	7.43	5.8(8.63)	14.12(5.28)	19.92	5.95
Phone Charges	6.90(10.85)		6.9	2.23	6.81(10.14)		6.81	2.03
Electricity	2.36(3.7.1)	8.60 (3.49)	10.96	3.54	3.56(5.3)	6.94(2.59)	10.5	3.14
Entertainment	8.56(13.47)		8.69	2.80	9.54(14.2)		9.54	2.85
Basket		18.34 (7.44)	18.34	5.92		17.85(6.68)	17.85	5.33
Packing & Materials		16.56 (6.72)	16.56	5.34		16.64(6.12)	16.64	4.97
Wastage		36.58 (14.85)	36.58	11.8		65.98(25.06)	65.98	19.70
Cleaning	0.63(0.99)	28.95 (11.75)	29.56	9.54	0.85(1.26)	22.52(7.85)	23.43	6.99
Total	65.56(100)	248.20 (100)	311.85	100	67.17(100)	267.61(100)	335.25	100

Total Marketing Cost of all Intermediaries in Dhaka City

The total marketing cost of all intermediaries in Dhaka city was estimated to be Tk. 1284.9 per quintal (Table 4) which was very high compared to other selected areas. In Dhaka, Aratdar's commission was found the highest cost comprising nearly one third of the total cost. The other cost items in descending order were transportation (27 %), wages and salary (8 %), personal expenses (7 %), electricity (5 %), packaging materials (4%), icing (4 %), wastage (3 %), market toll (3 %), rent (2%), watering (2%), entertainment (2%), loading and unloading (2 %), tips and donation (1 %) and telephone charge (1 %).

Table 3. Marketing cost of intermediaries per quintal of fishes in Dhaka city (Tk./quintal)
Marketing Margin of Intermediaries

Cost Item	Types of Intermediaries				
	Paiker	Arathdar	Retailer	Total Cost	Percentage
Arathdar Commision	400(49.75)			400	31.31
Transportation	288.83(35.55)		58.36(15.57)	347.19	27.09
Wages& Salary	54.26(6.75)	45.95(43.23)		100.2	7.789
Wastage	17.38(2.16)		25.32(6.76)	42.7	3.32
Icing		7.87(7.4)	40.28(10.75)	48.15	3.75
Entertainment		6.98(6.57)		25.58	1.99
Personal Expenses	5.72(0.71)	25.58(24.07)	76.84(20.5)	89.54	6.97
Market Tolls		12.28(11.56)	28.76(7.68)	41.04	3.19
Phone Charges	4.80(0.59)	4.20(3.95)		9	0.70
Loding & Unloding	17.44(3.4)			20.70	1.61
Tips and Donation		1.8(1.69)	12.69(3.39)	14.49	1.13
Electricity		1.58(1.48)	40.56(10.82)	59.94	4.66
Packing & Materials	15.58(1.94)		34.56(9.22)	50.14	3.9
Watering			27.11(7.23)	27.11	2.1
Rent			30.22(8.02)	30.22	2.35
Total	804.01(100)	106.23(100)	374.7(100)	12.84.94	100

Marketing Margin of Intermediaris

In the study area, Aratdar's did not perform buying and selling function. They sold the product on behalf of fish farmers for which they received commission (Tk.2 kg-1) that considered as income. Aratdar's net margin or profit was estimated at Tk. 136.4 per quintal of fishes. Because the marketing cost of Aratdar was Tk. 63.56 per quintal and the profit was calculated by deducting the marketing cost from gross margin or commission received. The marketing margin of retailers at Muktagacha is shown in Table 5. The retailers who purchased fish from Aratdar's and sold to consumers earned a gross margin of Tk. 1091.6 per quintal and after deducting marketing cost of Tk. 309.8 per quintal, the net margin earned by them was Tk. 781.8 per quintal.

Table 4. Marketing cost and Marketing Margin of Various intermediaries in Mymensingh and Dhaka city (Tk./quintal)

Area	Intermediaries	Purchase Price	Sale Price	Gross Margin	Marketing Cost	Net Margin
Muktagacha	Aratdar	-	-	200	63.56	136.44
	Retailer	6175	7180.50	1005.50	311.85	693.65
Trishal	Aratdar	-	-	200	67.17	132.83
	Retailer	6366.66	7250	883.34	335.25	548.09
Dhaka City	Paiker	6166.66	7483.33	1316.67	805.05	511.62
	Aratdar	-	-	400	106.23	293.77
	Retailer	7610.66	8885.66	1274	374.7	899.3

Seasonal price variation of tilapia fish in Mymensingh and Dhaka market

The monthly wholesale price indices of tilapia for Mymensingh and Dhaka market have been presented in Table 5. It is evident from Table that the price index of tilapia was the highest (105.3) in June and the lowest (94.55) in December. The important feature of tilapia fish prices was more or less same during November to February. This implies that during this period the supply matched the demand for tilapia fish. After slight increasing in the March it continue up to the month of the June. The difference between highest and lowest indices was 10.83. The co-efficient of variation of monthly price indices of tilapia in Mymensingh market of that period was 4.09. In the Dhaka market the highest price index was 102.126 in the month of July and the lowest price index of 96.17 in the month of October. Price of tilapia 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 tilapia in Dhaka market of that period was 2.11.

Table 5. Seasonal price variation of tilapia fish in different markets

Month	Seasonal indices in Mymensingh	Seasonal indices in Dhaka
January	95.8	100.9
February	96.38	100.35
March	98.38	101.26
April	99.08	102.02
May	101.39	102.03
June	105.38	101.09
July	104.94	102.13
August	105.23	100.85
September	103.79	98.41
October	99.83	96.17
November	95.22	97.46
December	94.55	97.11
Highest	105.38	102.13
Lowest	94.55	96.17
Range	10.83	5.95
C.V.	4.09	2.11

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 June. 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 Tilapia 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. Converse of this theorem also holds, i.e., if an error correction model (ECM) provides an adequate representation of the variables, they must be co-integrated. The rationale behind the error correction model is that economic variables often exhibit long run equilibrium while retaining disequilibrium in the short-run. However a proportion of disequilibrium in one period can be corrected in the next period. 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 Tilapia Fish

To test the stationary of the prices of Tilapia Fish, the DF and ADF tests for wholesale price of Tilapia 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 Tilapia fish prices of Dhaka district contained unit root that is the price series is non-stationary. Similarly, it is found that prices of Tilapia fish of all the selected districts are non-stationary.

The next step is to examine whether bivariate co-integration exists among different districts Tilapia 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 Tilapia fish for Dhaka, Chittagong, Rangpur, Bogra, Sylhet, and Mymensingh 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 Tilapia 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-integ

Table 6: Unit Root Test (Test of Stationarity/Non-stationarity) for the Prices of Tilapia fish

Market	Method	Condition	Intercept	Coefficient of	Coefficient of	Coefficient of	Coefficient of trend	d-value	Decision
Dhaka	used	used		Pt-1	Δ Pt-1	Δ Pt-2	(t)		Non-stationary
	DF	Without constant		0.007 (-1.256)				2.12	
		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	
Bogra	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	
Rangpur	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	
Mymensingh	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 2000-2012)

Table 7. Spatial Price Relationships between different Markets for Tilapia fish from May 2000 to December 2012

Markets	Co-integrating Regression	Co-integration Test: Engle-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-Rangpur	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-Bogra	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-Mymensingh	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 2000-2012)

As mentioned earlier, Mymensingh is surplus area in Tilapia 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 Tilapia 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

It is recognized that tilapia marketing contributes a range of economic benefits at different levels. At the local level, tilapia farming and marketing activities provide employment and income for the rural poor. At the national level, tilapia marketing systems make an important contribution to food supply. Apparently, as a small fish of tilapia provides large amounts of calcium, iron, zinc and other micronutrients (Roos etal., 2003). Conversely, large fish species such as Indian major carps and exotic carps are actively promoted for aquaculture although polyculture of these species have not been provided more nutrients (Bouis, 2000).The findings of this study indicated that the marketing of tilapia fish is a profitable business. Thus, the selected Tilapia 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. It also suggests that there is wide scope for the development of tilapia farming and trading in this country. In this study the profit of retailer was higher than that of other intermediaries. To make the business more profitable, efficient marketing system should be developed by reducing marketing cost and increasing marketing services**.**

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