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Analysis of Marketing Efficiency, Value Addition and Spatial Co-Integration of Mozambique Tilapia (*Oreochromis mossambicus*) Fish in Some Selected Areas of Bangladesh

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Abstract
A study was undertaken to examine the value chain, value addition, marketing cost & margin, marketing efficiency and market integration of tilapia fish in selected areas of Bangladesh during the month of June-July 2013. The objectives of the study were to estimate costs and margins and to test market integration of tilapia fish. Primary and secondary data were used for this study. The higher marketing cost was incurred by paiker and the lowest by retailer. On the other hand, retailers earned the highest net marketing margins. Chain II was found the most efficient chain. Analysis of market integration shows that tilapia fish market in Bangladesh was well integrated. 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: Value addition, marketing cost & margin, marketing efficiency and spatial co-integration

Introduction

The role of fisheries in Bangladesh in supplying animal protein, in providing employment, in earning foreign exchange and in supporting multifarious ancillary industries at the rural levels is well-known. The total annual fish production is estimated at 2.98 million tonnes in 2010-11 (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 (18.75%) from marine fisheries (DoF, 2012). 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 Mozambique tilapia (*Oreochromis mossambicus*) was introduced to Bangladesh from Thailand in 1954 (Ahmed et al., 1996). 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 2012, of which 992,049 tons (39%) were obtained from inland aquaculture, 996,686 tons (43%) from inland capture fisheries, and 569,810 tons (24%) from marine fisheries (DOF, 2009). 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.

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 present study aimed to identify, particularly the marketing chains, to analyze the market integration. 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.

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The specific objectives of the study are to:

- identify different marketing chains of tilapia fish
- determine the extent of value addition in terms of costs in successive stages of tilapia fish movement,
- examine marketing margins of the intermediaries of tilapia fish and
- analyse the market integration of tilapia fish

Materials and Methods

The present study was conducted 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 25 *Paiker*s, 10 *Aratdar*s and 35 retailers were selected as respondents for the study. Among them two *Aratdars, ten Paiker* and twenty retailers from Muktagacha, three *Aratdar*s, *ten Paiker* and fifteen retailers from Trishal were selected. The data were collected intensively by using structured interview schedules.

The monthly average wholesale prices of Talapia fish of various markets like Dhaka, Chittagong, Khulna, Sherpur Comilla, Bogra, Rangpur Dinajpur, Mymensingh, Sylhet, Noagaon and Noakhali during 2000 to 2012 were collected from Department of Fisheries (DOF).

Analytical Techniques

Farmer's net prices, farmer's gross share farmer's net share and Marketing efficiency were calculated by using following formulas:

- **Farmer's net price** = Farmer's sale price - Farmer's marketing cost
- **Percentages of total value addition cost/net profit calculated =**

$$\frac{\text{Marketingcost/Netmarketingmargin}}{\text{Totamarektingcost/netmarektingmargin}}\times 100$$

- **Farmer's net share** = $\frac{\text{Farmer's net price}}{\text{Retail price}}\times 100$
- **Gross margin** = Sale Price – purchase Price.
- **Net margin** = gross margin – marketing costs
- **Marketing efficiency was calculated using Acharaya's formula:**

$$\text{ME} = \frac{\text{FP}}{\text{MC} + \text{MM}}$$

Where,
ME = Marketing efficiency.
FP = Net price received by farmers
MC= Total marketing cost
MM= Total net marketing margin of intermediaries.
A higher value of ME denotes higher level of efficiency and vice versa.

Market Integration

Market integration was measured by co-integration method.The bulk of econometric theories have been based on the assumption that the underlying data process is stationary. 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.Aapplying regression models to non-stationary data may arise the problem of **"**spurious or nonsense**"** correlation (Gujarati, 2003, p. 792). To overcome such problems, the concept of co-integration was used becauseit offers a means of identifying and hence avoiding the spurious. 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 C**o-integration **T**est

The individual price series were tested for the order of integration to determine whether or not they are stationary which is known as the unit root test (Gujarati, 2003, p.799). A number of tests for stationary 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:

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

Y_t is a random walk with drift or constant:

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

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

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

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 in the time series i.e. the 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:

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

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, $\Delta\varepsilon_t = \beta \varepsilon_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$

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

Characteristics of Market Participants

In the chain of fish marketing of the study areas, the product moves from farmers to consumers through market intermediaries such as Fish farmers, *aratdar paiker*, *Faria* and retailer.

Fish farmers and fishermen are the first link in the fish marketing channels. The fish Farmers (producers) of rohu fish usually sell their fish to the local *aratdar*.

The *aratdars* sale the fish through an auctioning system and get a commission of 3% to 4% depending on fish species. Most of the time *aratdars* recruit *koyal* (person who organizes auction by uttering and offering different prices for buyers for sale). They hire necessary salaried persons or labourers depending upon their volume of business.

Paiker* or *bepari is conceptually same but used interchangeably in different fish marketing system in Bangladesh who transacts large volume of product.. Some *paikers*/*beparis* receive money in advance from the *aratdar* on condition that they would sell their fish through them.

***Faria* is** another type of intermediary in the marketing system. They purchase a small quantity of fish form distant fishermen far away from the market and carry it to the terminal point and sell it to *aratdar* or retailer in the study areas.

Retailer the last intermediaries of fish marketing channel, do not have any permanent establishment but they have fixed places in the market centre or are wandering with *hari* (aluminium pot) on head from door to door. In spite of being self-financed, the retailers often borrow money from non-institutional sources at the time of need

Buying and selling

An efficient marketing system is essential for earning fair profit for the fish farmers and traders. Marketing functions may be defined as major specialized activities performed in accomplishing the marketing process of concentration, equalization and dispersion (Kohls, 2005). The activities involved in the transfer of goods are completed through buying and selling functions. *Aratdar*s do the functions of negotiation between buyers and sellers of fish and help them at their own business premises on receipt of commission. They do not take the ownership of the products. Tilapia fish farmers sell 85% of their fish to *paiker through aratdar*, 12% to *paiker* directly and the final 3% to retailer. *Paikers* sell 77% of their fishes to retailers and 23% to retailers through *aratdars*. Retailers sell the entire fish to ultimate consumers. *Paiker* of tilapia fish purchases 92% from farmers through *aratdar* and 8% directly from farmers. Retailer purchases 89 % from farmers through *aratdar* and 11% from farmers. Consumer purchases 100% of tilapia from the retailers in the study area (Table 1).

Table 1. Percent of Tilapia Fish Transacted by Value Chain Actors

	Purchase from (%)				**Sold to (%)**				
Value chain actor	**Farmer**	**Farmr via *aratdar***	***aiker***	**Retailer**	***aiker***	***Paiker* via *aratdar***	**Retailer**	**Retailer via *aratdar***	**Consumer**
Farmer	-	-		-	2		3	-	-
Aratdar	*Aratdar*s negotiate between buyers and sellers of fish and help them at their own business premises on receipt of *Aratdar*i commission.								
Paiker	8	92		-		-	77	23	-
Retailer	11	89		-		-	-		100
Consumer	-	-		100		-	-	-	-

Marketing Chains

Marketing chains are the alternative routes of product flows from producers to consumers (Kohls and Uhl, 2005; p. 501). Value chain may be long or short for a particular commodity depending on the qualities of products, size and nature of consumers and producers and the prevailing social and physical environment. Dominant supply chains of tilapia in the study areas are shown below:

Value chain - I Fish Farmer → *Aratdar* → *Paiker* → Retailer → Consumer
Value chain - II Fish Farmer → *Paiker* → Retailer → Consumer
Value chain - III Fish Farmer → *Faria* → Consumer
Value chain - IV Fish Farmer → Village market → Consumer

Two major value chains are identified for tilapia in Mymensingh district. These are:

Value chain - I Fish Farmer → *Aratdar* → *Paiker* → Retailer → Consumer
Value chain - II Fish Farmer → *Paiker* → Retailer → Consumer

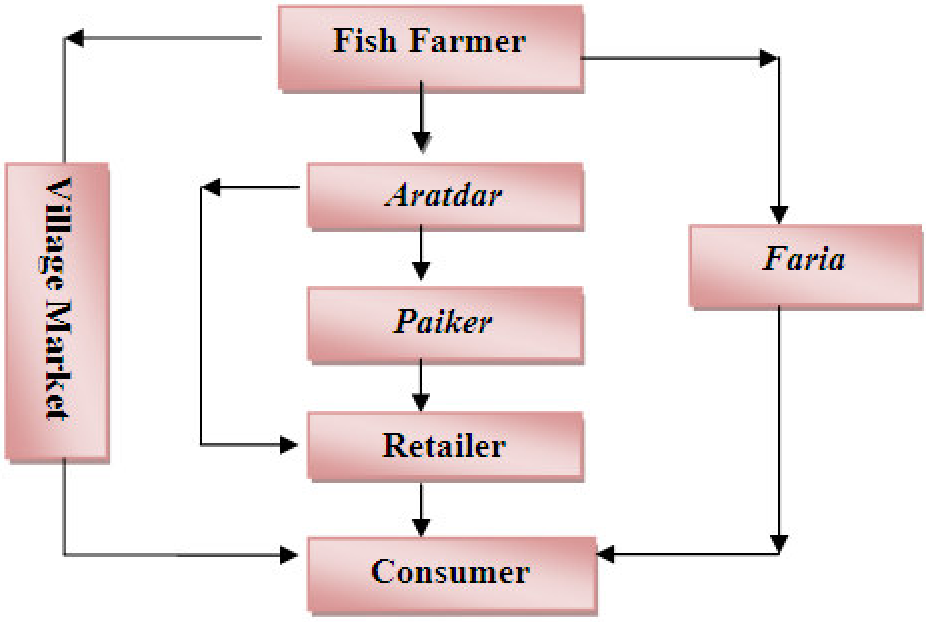

Fig1: Value chains of *tilapia* in Mymensingh district

Value Addition Costs by Different Actors

The cost incurred to transport the product from producers to consumers is ordinarily known as marketing cost. In other words, the cost of marketing represents the cost of performing various marketing functions (Kohls and Uhl, 2005; p.96). Marketing costs are incurred when commodities are shipped from the farm to the final market. Intermediary-wise marketing costs are discussed below:

Table 2. Total marketing cost of different intermediaries involved in tilapia marketing (Taka per maund)

Cost items	Farmer	*Aratdar*	*Paiker*	Retailer	Total
Transportation	39.6	-	276.49	70.35	386.44 (40.54)
Baskets	-	1.66	26.38	15.07	43.11 (4.52)
Icing	-	-	48.15	29.31	77.46 (8.13)
Wage and salaries	-	22.75	23.23	-	45.98 (4.82)
Aratdar's commission	88.08	-	168.55	-	256.63(26.92)
House rent	-	5.37	1.01	19.84	26.22 (2.75)
Security	-	0.10	0	1.89	1.99 (0.21)
Electricity	-	0.30	0.14	7.20	7.64 (0.80)
Telephone bill	3.85	3.26	13.07	16.10	36.28 (3.81)
Personal expenses	2.22	6.52	11.76	20.69	41.19 (4.32)
Tips and donation	4	0.70	0.52	1.02	6.24 (0.65)
Wastage	-	-	14.74	-	14.74 (1.55)
Others	-	0.26	4.71	4.25	9.22 (0.97)
Total	137.75	40.92	588.75	185.71	953.13(100.00)

**Figures in the parentheses indicate percentages of total cost, 1 maund = 40 kg*

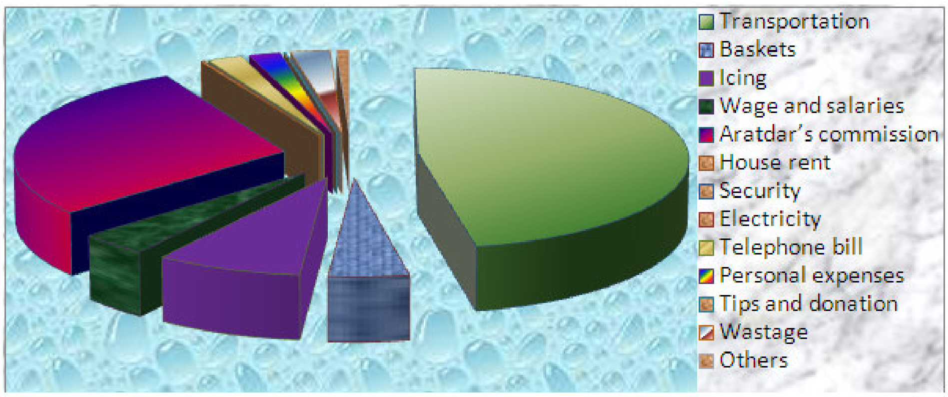

Figure2: Total marketing cost of different intermediaries involved in tilapia marketing

Total marketing cost of fish includes all costs incurred by different intermediaries like *paikers*, *aratdar*s, retailers and farmers who perform some marketing functions in the study areas. Products get value added during their movement across items. Share of transportation cost is the highest (40.54%) followed by *aratdar's* commission (26.92%), icing (8.23%), wages and salaries (4.81%) and tips & donations (4.32%) for tilapia fish marketing (Table 2) and (Figure2). Total value added cost per maund is Taka 953.13 from production point to consumption point. Amongst them, *Paiker's* value added cost is the highest while *aratdar*'s value added cost is the lowest.

Marketing Margin

A marketing margin is the percentage of the final weighted average selling Price taken by each stage of the marketing chain. The margin must cover the costs involved in transferring produce from one stage to the next and provide a reasonable return to those doing the marketing activities. (Crawford, 1997). It is also termed as Price spread as it represents the difference between the buying and selling Price. Total marketing margin is the difference between the Price received by the fish Farmers and the Price paid by the final consumers. Marketing margins of fish are calculated separately for different intermediaries. Gross marketing margin of each type of intermediaries is calculated by deducting the purchase Price of fish from their sale Prices while net margin or profit component is calculated by deducting the marketing cost from gross marketing margins.

Table 3. Average net marketing margin of different intermediaries for tilapia fish marketing (Tk/maund)

Intermediaries	Purchase Price	Sale Price	Gross marketing margin	Marketing cost	Net marketing margin
Farmer	-	3394.53	3394.53	137.75	3256.78
Aratdar	-	-	94.59	40.92	53.67
Paikar	3360.91	4003.63	642.72	305.31	337.41
Retailer	4030.82	4849.95	819.13	185.71	633.42

Average net marketing margins of all intermediaries tilapia are presented in Table 3and Figure 3. Farmer average marketing cost is Taka 137.75 per maund for all fishes. Amongst all intermediaries, profit of retailers is the highest of Taka 633.42 per maund of fish. Profit of intermediaries varies due to variation in their costs; purchase Price and sales Price.

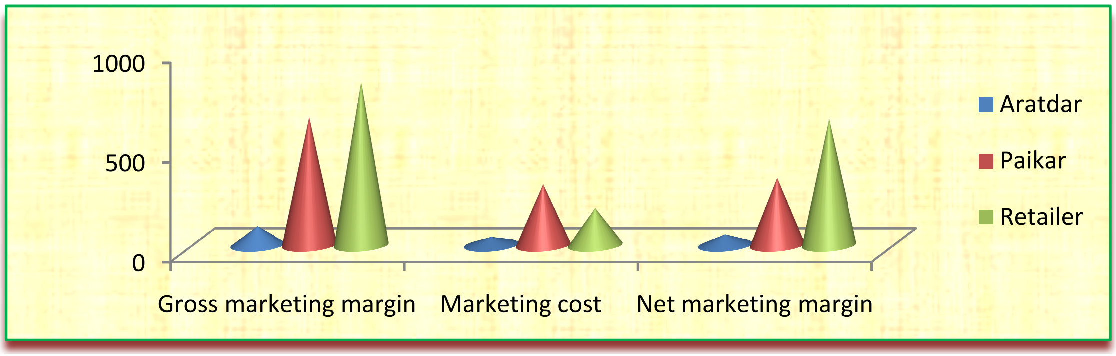

Figure3: Gross marketing margin and net marketing margin of different intermediaries for tilapia fish marketing (Tk/maund)

Marketing Efficiency

Marketing efficiency is essential for measuring the degree of marketing performance. On the basis of three methods for measuring marketing efficiency, chain 2 is more efficient (Table 4). In chain 2 the consumer paid lower price per maund tilapia fishes compared to chain 1.though in practice chain 1 is mainly used for selling tilapia fishs in the study area. **:** Considering two value chain on the basis of product flow it was found that value chain-1 is more efficient than value chain-2. Consumer paid lower price in value chain-1 compared to value chain-2.

Table 4.Marketing efficiency of tilapia fish in Mymensingh market

Particulars	Unit	Amount Chain 1	Chain 2
1. Total marketing cost	Tk/Maud	669.69	364.38
2. Total net margins	Tk/Maud	1024.50	687.09
3. Net price received by farmers	Tk/Maud	3394.53	3394.53
Marketing efficiency (MME) [3/1+2]	**Ratio**	**2.01**	**3.23**

Distribution of Value Addition Cost and Net Profit

Table 5 and Figure 4 shows the percentages of total value addition cost and total net profit by different intermediaries for different fish marketing system in Bangladesh.

Table 5 Percentage distribution of value addition cost and profit by intermediaries and marketing system

Intermediaries	% of total cost	% of total profit
Farmer	14.45	1.75
Aratdar	4.29	4.40
Paikar	32.04	27.69
Retailer	19.45	51.98

For tilapia, major cost is borne by *paikers* (32.03% of total cost) and major net profit is earned by retailers (51.98% of total net profit). For tilapia, major cost is borne by the *aratdar*, *paikers* and fishermen but major net profit is earned by retailers and processing plant owners. Farmers, in tilapia marketing, bear the major marketing cost (23.70% of total cost) because they have to pay *aratdar's* commission which ultimately increases their marketing cost.

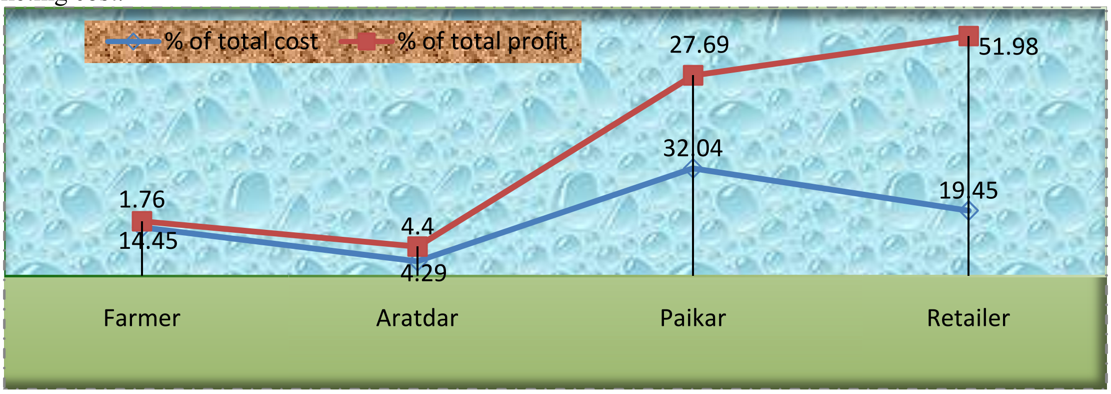

Figure4: Percentage distribution of value addition cost and profit by intermediaries

Tilapia Market Integration

To test the stationary of the data, the ADF (Augmented Dickey Fuller) test with 13 lags of tilapia Prices for Dhaka, Chittagong, Khulna, Sherpur, Comilla, Bogra, Rangpur Dinajpur, Mymensingh, Sylhet, Noagaon and Noakhali were performed over 2000 to 2012 period and the estimated tau) (τ statistics and P values in their level and first difference are presented in Table 6 Real Price data were used and data were transformed into natural log. Real Price was calculated by multiplying nominal Price with the corresponding consumer price index (CPI) and dividing by the last CPI of the series. The tau) (τ statistics which were compared with p values indicate that all the tilapia Price series data were non stationary at level. This set of regression was run once more after differencing all the markets. The tau) (τ statistics on the lagged first difference terms are significantly negative indication that the series are stationary after first differencing. The study revealed that the tilapia Prices are stationary after differencing once that is they are all (1) processes.

Table 6: Unit root test for wholesale Price of tilapia markets in Bangladesh

Markets details	Level Y_{t-1} ln Coefficient	ADF (τ)	P values	Decision	First difference ΔY_{t-1} ln Coefficient	ADF (τ)	P values	Decision
Dhaka	0.072	1.89	0.12	Nonstationary	0.142	4.64	0.00	Stationary
Chittagong	0.013	1.32	0.18	Nonstationary	0.032	3.36	0.00	Stationary
Comilla	0.007	0.79	0.42	Nonstationary	0.44	8.02	0.00	Stationary
Khulna	0.08	1.37	0.17	Nonstationary	0.19	5.20	0.00	Stationary
Sherpur	0.04	0.72	0.47	Nonstationary	0.23	5.89	0.00	Stationary
Bogra	0.009	0.94	0.34	Nonstationary	0.29	5.39	0.00	Stationary
Rangpur	0.08	1.62	0.13	Nonstationary	0.20	5.18	0.00	Stationary
Dinajpur	0.06	2.32	0.02	Nonstationary	0.13	4.06	0.00	Stationary
Mymensingh	0.05	1.56	0.11	Nonstationary	0.24	6.67	0.00	Stationary
Noagaon	0.04	1.42	0.15	Nonstationary	0.17	5.59	0.00	Stationary
Sylhet	0.06	2.40	0.01	Nonstationary	0.13	3.94	0.00	Stationary
Noakhali	0.02	0.13	0.02	Nonstationary	0.04	2.92	0.00	Stationary

ADF= Augmented DickeyFuller,
Test critical values:
1% level 3.455096
5% level 2.872328
10% level 2.572592

Co-integration regression test results for tilapia price in Bangladesh

To examine whether bivariate co- integration exists between different Prices of tilapia market, Dhaka wholesale market was considered as reference market, Dhaka is a capital market and the largest city and it would appeared to be the dominant influences on inter districts tilapia markets in Bangladesh. The reference market is a dominant market serving as a hub in a sort of "radial market structure" where different feeder (local) markets are at the rim. The reference market dominates the Price formation in the feeder markets. Every individual feeder market was affected by the reference market Price, though it alone cannot affect the reference markets Price.

Table 7: Co-integration regression test results for tilapia price in Bangladesh

Markets details	EG ($\ln U_{t-1}$)	P values	AEG ($\mathrm{del}\ln U_{t-1}$)	P values	Decision
Dhaka-Chittagong	-3.47	0.00	-3.41	0.00	Cointegrated
Dhaka- Comilla	-3.49	0.00	-3.29	0.00	Cointegrated
Dhaka-Khulna	-9.10	0.00	-7.24	0.00	Cointegrated
Dhaka-Sherpur	-3.83	0.00	-3.65	0.00	Cointegrated
Dhaka-Bogra	-3.51	0.00	-3.40	0.00	Cointegrated
Dhaka- Rangpur	-7.67	0.00	-6.02	0.00	Cointegrated
Dhaka-Rajshahi	-3.96	0.00	-3.62	0.00	Cointegrated
Dhaka- Mymensing	-3.52	0.00	-3.39	0.00	Cointegrated
Dhaka- Sylhet	-4.15	0.00	-4.18	0.00	Cointegrated
Dhaka-Gazipur	-3.75	0.00	-3.35	0.00	Cointegrated
Dhaka-Noakhali	-3.42	0.00	-3.39	0.00	Cointegrated

AEG = Augmented EngleplGranger test
Test critical values: 1% level 3.455096
5% level 2.872328
10% level 2.572592

Normally, the reference markets has a high turnover so that supply and demand shocks originating in the individual feeder markets are absorbed without creating much effect on the Price prevailing in the reference markets (Ravallion, 1986). As there will be different combinations of the given 12 wholesale tilapia Price markets, all combinations in a systems of bivariate relationships. The Engle Granger (EG) and Augmented Engle Granger (AEG) tests of residual equation confirm the stationarity of the residual series. Thus ADF results of unit root equation indicate that the real tilapia Price series are I(1), while Engle Granger (EG) and Augmented Engle Granger (AEG) results of residual equation indicate that the residual series (which are linear combination of above tilapia real Price series) are I(0).Thus above fact that the Price series being I(1) and their linear combination being I(0) point out that the series are co integrated without any exception. According to the Engle Granger (EG) and Augmented Engle and Granger (AEG) test tilapia markets of Bangladesh are statistically significance at 1% level (Table 7). An important finding of the study is that Dhaka market is significantly integrated to all regional markets of tilapia markets in Bangladesh due to having the facility of information technology, which closely connected the markets to each other. This study strongly supports marketing efficiency in the selected tilapia markets. Price move in the unison in all the markets together. Central Price policy making will be effective in these markets.

Strong forms of Market Integration

For testing strong form of tilapia markets integration, the null hypotheses were applied to find tilapia market integration against alternate hypotheses where tilapia markets might not be integrated. The result of strong form of market integration in selected tilapia markets is given in Table 8. It is seen from Table 8 that strong form of market integration was observed all the tilapia markets in Bangladesh due to congenial atmosphere existed in these markets. This empirical finding strongly supports marketing efficiency in the markets.

Price move in the unison in all the markets together. Central Price policy would be effective for these markets. For the estimation of strong form of market Integration we used the following restriction.

Table 8: Testing strong form of integration (β =1, α = 0) in selected tilapia markets in Bangladesh ($\Delta Y_t = \alpha + \beta\Delta X_t + \partial e_{t-1} + \mu_t$)

Dependent variable $\ln \Delta Y_t$	Independent variable $\ln(\Delta X_t)$	When if β =1 Than: $\Delta Y_t - \Delta X_t = \alpha + \partial e_{t-1} + \mu_t$ Coefficient e_{t-1}	Standard Error	t value β = 1 for	P values	t value for α = 0
Dhaka	Chittagong	0.90**	0.11	8.03	0.00	8.06**
Dhaka	Comilla	0.09**	0.04	2.09	0.03*	2.10*
Dhaka	Khulna	1.31**	0.11	11.00	0.00	11.03**
Dhaka	Sherpur	0.20**	0.06	2.98	0.00	2.99**
Dhaka	Bogra	0.85**	0.15	5.67	0.00	5.69**
Dhaka	Rangpur	0.10	0.21	0.47	0.63	1.47
Dhaka	Dinajpur	1.95**	0.12	15.92	0.00	15.98**
Dhaka	Mymensingh	0.59**	0.16	3.58	0.00	3.59**
Dhaka	Noagaon	0.82	0.10	7.77	0.00	7.80**
Dhaka	Sylhet	0.25	0.47	0.54	0.58	3.55*
Dhaka	Noakhali	0.07	0.04	1.67	0.09	1.68
Dhaka	Chittagong	0.48**	0.10	4.52	0.00	4.53**

**** and* indicate 1% and 5% level of significance**

To calculate pair wise regression of the selected 12 domestic tilapia markets prices, the time period was considered from January 2000 to December 2012 and the results are presented in Table 9. Monthly wholesale market price and Log linear model used for the study.

Table 9: Pair wise regression analysis in the selecting domestic tilapia markets

Dependent markets $\ln Y_t$ =	Constant α	P values	Independent markets (Coefficients) $+ \beta \ln X_t$	P values	R^2
ln Dhaka	2.69** (0.79)	0.001	+0 .66**lnChittagong (0.10)	0.00	0.37
ln Dhaka	3.83** (.83)	0.00	+0.51**lnComilla (0.10)	0.00	0.29
ln Dhaka	0.83** (0.21)	0.00	+0.89** lnKhulna (0.02)	0.00	0.90
ln Dhaka	3.63** (0.43)	0.00	+0.54** lnSherpur (0.05)	0.00	0.52
ln Dhaka	4.26** (1.02)	0.00	+0.46** lnBogra (0.12)	0.00	0.21
ln Dhaka	1.44** (0.22)	0.00	+0.82**ln Rangpur (0.02)	0.00	0.87
ln Dhaka	3.27** (0.50)	0.00	+0.59**ln Dinajpur (0.06)	0.00	0.50
ln Dhaka	4.82** (0.76)	0.00	+0.39**ln Mymensingh (0.09)	0.00	0.24
ln Dhaka	4.03** (0.74)	0.00	+0.49** ln Noagaon (0.09)	0.00	0.30
ln Dhaka	2.12** (0.42)	0.00	+0.73ln Sylhet (0.05)	0.00	0.64
ln Dhaka	3.60** (0.83)	0.00	+0.54 **ln Noakhali (0.10)	0.00	0.30

The coefficient of Log linear model indicates the elasticity of prices. The entire coefficients are significant at 1 % level. If price of Chittagong market increases 1 per cent then the price of Dhaka market increase 0.66 per cent and vice versa. And if the price of Comilla market increases 1 per cent then the price of Dhaka market increases 0.51 per cent and vice versa. Interpretations of all other coefficients are similar.

Conclusion

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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