



Research in

ISSN : P-2409-0603, E-2409-9325

AGRICULTURE, LIVESTOCK and FISHERIES

An Open Access Peer Reviewed Journal

Open Access
Research Article

Res. Agric. Livest. Fish.
Vol. 4, No. 1, April 2017: 29-36

COMPARATIVE MARKET SUPPLY OF PROTEIN FROM LIVESTOCK AND FISH IN THE SELECTED URBAN AREAS OF RAJSHAHI DISTRICT IN BANGLADESH

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ARTICLE INFO

ABSTRACT

Received
03 April, 2017

Accepted
24 April, 2017

Online
30 April, 2017

Key words

Livestock
Fish
Biomass supply
Protein supply
Rajshahi

The study was conducted with the objectives to determine the market availability of animal sourced foods (ASF) and fish, and their share in the supply of biomass and protein through visiting the wet markets of metropolitan and municipality areas of Rajshahi district, Bangladesh. A preset questionnaire was used for recording the biomass weight of different ASF and fish in every four days interval in March, 2016. It was found that the supply of ASF (beef, chevon, chicken and egg) and fish in the metropolitan markets (80.20 and 35.89 t/d, respectively) was significantly higher ($P < 0.05$) than any municipality wet market in the district (7.66 and 3.03 t/d, respectively). The market supply of biomass and its protein value of ASF were 3.64 and 4.33 times higher than fish. The chicken shared the highest amount of protein (28.19 %) followed by fish (26.8%), beef (26.21%), eggs (11.46%) and chevon (7.34%) during the study period. However, this initial work does not include milk, and the wet market of ASF and fish may have seasonal variations which needs to be explored through further research. In addition to them, socioeconomic status of consumers and regional variations are important which needs to be studied for addressing resource base safe food production help the strategic reduction of food insecurity in the country by 2030.

To cite this article: Rahman MM, KS Huque, NG Das and MYA Khan, 2017. Comparative market supply of protein from livestock and fish in the selected urban areas of Rajshahi district in Bangladesh. Res. Agric. Livest., Fish., 4 (1): 29-36.



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INTRODUCTION

Animal sourced foods (ASF) include food items come from an animal source such as, meat, milk, eggs and their products. Both ASF and fish are the sources of six critical micronutrients (vitamin A, vitamin B12, riboflavin, calcium, iron and zinc) and essential amino acids required for human health. An inadequate intake of these nutrients is associated with negative health impacts (Murphy and Allen, 2003). The generally accepted daily dietary allowance of total protein is 0.8g/kg live weight (Shane and Mann, 2006) of human and thus, an adult person of 60 kg requires 48g protein daily, of which an average of 24g (50%) animal protein may come from ASF and fish sources.

The per caput ASF (milk, meat and egg) production in 2014-15 was 121.8 ml, 102.4 g and 9.61 g, respectively (BER, 2016), and they may supply daily about 26.06 g protein/head, while the production of fish was 64.4 g that yields 10.94 g protein (considering average 17% protein of different fish of Bangladesh, Bogard *et al.*, 2015). Thus, ASF & Fish sharing 70.4% and 29.6%, respectively, may daily supply 37.0 g/head of animal protein, almost 1.54 times more than the animal protein requirement (24.0 g) for an average person of the country. The Household Income and Expenditure Survey, 2010 (HIES- 2010) in BBS, (2014), on the other hand, reported per caput protein intake of 6.76g and 9.70g in 2010 from ASF and fish and they may stand to 7.94 g and 12.85 g in 2015 sharing 38.0% and 62.0%, respectively, of the two sources if an extrapolation is made considering the average annual growth rate of livestock & fisheries sub-sectors during the five years period (BER, 2015). This does not conform with the production of ASF and fish and their shares (70.4% vs 29.6%) in total animal protein production described above, and opposes the claim of about 60% of the daily animal protein supply of a person comes from fish made by the Department of Fisheries (MoFL, 2016).

This divergent and anecdotal evidence of the two different documents of the public sector requires a thorough field study by the concerned authority on the production and supply of ASF and fish to different classes of consumers considering seasonal and regional variations in the country. Recently, the United Nations Statistical Commission also requested all member countries to collect and analyze their own experience-based food insecurity data to achieve indicator 2.1.2 of Sustainable Development Goal (SDG) 2.1 and use them for national, regional and global reporting (FAO 2016). Considering the above data oscillation and to gain experience-based protein shares of the ASF and fish, the present initial field research was undertaken with a simple objective of estimating the market supply of ASF and fish in a certain season of a year in a selected area of the country.

MATERIALS AND METHODS

Study area

The study was conducted at ten municipality areas of Rajshahi district, a High Ganges River Floodplain agro-ecological zone in the north-western area of the country (Figure 1). Three wet markets of Boalia of Rajshahi metropolitan area and of each municipality area (Tanore, Mohanpur, Paba, Godagari, Durgapur, Puthia, Bagmara, Charchat and Bagha) of Rajshahi district were randomly selected for this study. The total area and household number of the metropolitan and municipality areas according to BBS (2014) are shown in Table 1.



Figure 1. Metropolitan and municipalities under the study

Data collection

The total wet markets and the number of traders interviewed in each municipality and the metropolitan area was recorded and reported accordingly (Table 2). The amount of ASF and fish marketed in every four days interval in randomly selected three wet markets were weighed and recorded through visiting and recording the weight of ASF and fish biomass. Under the direct supervision of district livestock office, Rajshahi a preset

questionnaire was used for recording the biomass weight of different ASF and fish and responses of the wholesalers and retailers; seven visits were made during the total period of 31 days in March, 2016. The daily average supply of ASF and fish in each municipality was calculated by multiplying the daily average supply in selected markets by the total number of wet markets.

Table 1. Area and number of households in different municipalities of Rajshahi district

Name of municipalities	Area (sq km)	Households
Rajshahi metropolitan (Boalia)	38.11	42602
Mohanpur	9.25	2590
Paba (Katakhal and Noahata)	49.59	20998
Godagari	14.29	8008
Puthia	13.50	5188
Durgapur	24.83	7109
Tanore	27.22	7976
Charghat	18.72	9105
Baghmara (Bhawaniganj and Taherpur)	24.18	7231
Bagha	11.69	7044

Calculation of protein supply

The daily protein supply of beef and chevon biomass was calculated according to the following equation: Protein (kg) = biomass of beef/chevon (kg) × meat (%) of total biomass × average protein (%) (Roy *et al.*, 2013; Sumarmono *et al.*, 2002); while that of chicken was calculated according to the equation: Protein (kg) = supply of chicken biomass (kg) × dressed weight (%) × meat (%) of total biomass × protein (%) (Połtowicz and Doktor, 2011). The supply of protein from eggs was calculated by multiplying biomass with the protein content of whole egg according to Bashir *et al.* (2015). In case of fish the biomass was converted into edible portion according to Akther (2015) and then multiplied by the average protein content of fish in Bangladesh according to Bogard *et al.* (2015).

Data analysis

Any significant difference in the supply of biomass and protein of different ASFs and the fish in addition to their share between the metropolitan and municipality areas were tested statistically using Student T-test. A computer package program of SPSS-11.5 was used for data compilation and analyses.

RESULTS AND DISCUSSION

The supply of ASF and fish biomass

The daily market supply of ASF and fish biomass in a wet market of the Rajshahi metropolitan and of municipality areas are presented in Table 3. It was seen that the market availability of all ASF and fish biomass was significantly ($P < 0.01$) higher in Rajshahi (Boalia) metropolitan market compared to municipalities of the district. The daily supply of beef in a wet market of Rajshahi metropolitan area was 16.49 t compared to 3.49 t in a municipality area, and it was 4.72 times higher. Similar to beef, the daily market supply of chevon was 7.01 t and 0.59 t, respectively. The higher supply of beef and chevon resulted in a total daily red meat supply of 23.05 t in the metropolitan market and 4.08 t in a municipality market, and the difference between the market sources was significant ($p < 0.05$). Including 40.79 t daily supply of poultry meat (white meat) the total daily meat supply in a wet market of Rajshahi metropolitan area was 64.29 t and the supply of both poultry meat (2.10 t) and the total meat (6.18 t) was significantly ($p < 0.05$) lower in the municipality markets.

The market supply of eggs at Rajshahi (Boalia) metropolitan and municipality area were 15.91 and 1.41 t/d, respectively, and they resulted in a total market ASF supply of 80.20 t and 7.66 t/d, respectively. The difference between the two sources were significant ($p < 0.01$). The daily supply of fish, on the other hand, was 35.89 t and 3.03 t, respectively in Rajshahi (Boalia) metropolitan and other municipality markets.

An increased number of consumers due to a higher concentration of households in a unit metropolitan area (average 1118 households) coupled with a higher income (HIES - 2010 in BBS, 2014) compared to that of municipality area (280 to 602 households, Table1) increased the number of consumers for ASF and fish. A positive income elasticity of demand of food of livestock origins (Gandhi and Zhou, 2010) and a higher number of consumers may have increased the market demand of ASF and fish in the former area. This provided an increased opportunity of ASF and fish trading in the metropolitan area. The relationship between the number of traders and supply of meat and fish in the market shows that the market biomass supply of meat or fish increased linearly ($r = 0.84$, $P < 0.01$, Figure 2) with the increase of trader number (Figure 2). It was calculated that the daily market supply of meat by a trader of the studied areas, irrespective of red or white meat, was about 4.05 kg, and that of fish was about 4.90 kg ($r = 0.84$, $P < 0.01$, Figure 2 and 3).

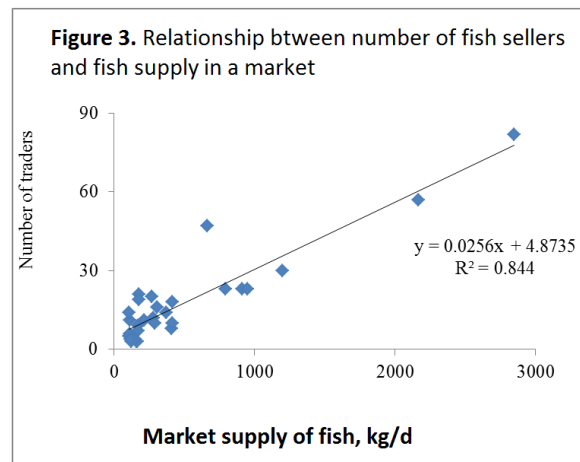
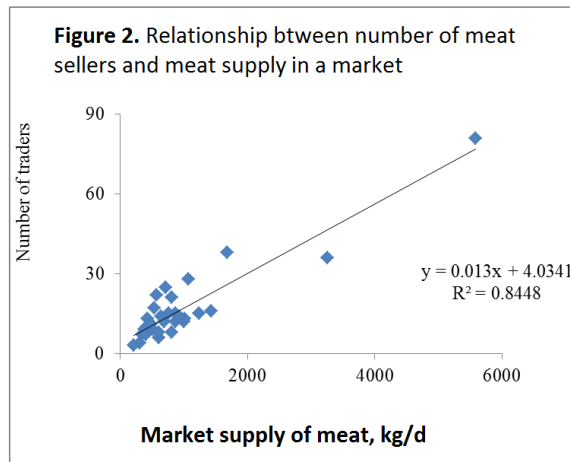
Table 2. Total number of different wholesalers/retailers interviewed

Name of municipalities	Number of wet markets	Number of whole sellers & retailers					
		Beef	Chevon	Chicken	Egg	Total ASF	Fish
Rajshahi metropolitan (Boalia)	20	51	28	59	51	189	153
Mohanpur	10	9	2	37	7	55	50
Paba (Katakhal and Noahata)	10	21	8	10	14	53	56
Godagari	11	10	0	5	22	37	22
Puthia	10	17	6	16	26	65	88
Durgapur	6	11	4	16	19	50	45
Tanore	3	11	5	14	9	39	9
Charghat	9	15	8	8	19	50	18
Bagmara (Bhawaniganj and Taherpur)	11	13	14	13	23	63	36
Bagha	8	32	42	17	32	123	40
Total traders	98	190	117	195	222	724	517

Table 3. The average market supply of ASF and fish biomass between Rajshahi metropolitan (Boalia) and municipality areas (t/d)

Food sources	Market biomass supply (t/d)		SE	P- values
	Metropolitan (n = 3)	Municipality (n = 27)		
Beef	16.49	3.49	2.90	<0.01
Chevon	7.01	0.59	2.62	<0.01
Total red meat	23.50	4.08	4.49	<0.01
Poultry meat (White meat)	40.79	2.10	9.36	<0.01
Total meat supply	64.29	6.18	13.19	<0.01
Eggs	15.91	1.48	6.30	<0.01
ASF	80.20	7.66	18.70	<0.01
Fish	35.89	3.03	7.43	<0.01

SE=standard error; $P > 0.05$, not significant; ASF, beef, chevon, chicken and egg



The protein value of ASF and fish biomass

The supply of protein of ASF and fish in the market of Rajshahi metropolitan and municipality area is presented in Table 4. Similar to biomass supply, the market supply of protein of all ASF and fish sources was significantly higher in Rajshahi (Boalia) metropolitan areas compared to that of the municipality area of the district ($P < 0.01$). The protein value of beef and chevon marketed daily at the wet market of Rajshahi (Boalia) metropolitan was 2.62 t and 1.22 t, respectively, compared to only 0.55 t and 0.10 t of the municipality area. The protein content of the total red meat supply was calculated to be 3.83 t and 0.66 t, respectively. The protein value of poultry meat in Rajshahi (Boalia) metropolitan wet market was 5.53 t and it was significantly ($p < 0.01$) higher than that (0.29 t) of the wet market in the municipality area, and the difference in protein value of market poultry between the two area was about 19.07 times. The protein value of the total daily meat supply was 9.37 t and 0.94 t, respectively, in the wet market of Rajshahi (Boalia) metropolitan and the municipality area. The protein content of eggs supplied in the markets of Rajshahi (Boalia) metropolitan per day was 1.78 t compared to 0.17 t of that supplied daily in the markets of municipality areas of the district. The total protein value of the ASF daily supplied to Rajshahi (Boalia) metropolitan wet market was 11.15 t and that of the municipality markets was 1.11 t. At the same time the protein value of fish marketed daily in Rajshahi (Boalia) metropolitan wet market was 4.41 t compared to 0.37 t in the wet market of municipality area.

Table 4. Protein supply from ASF and fish at Rajshahi (Boalia) metropolitan and other municipality markets (t/d)

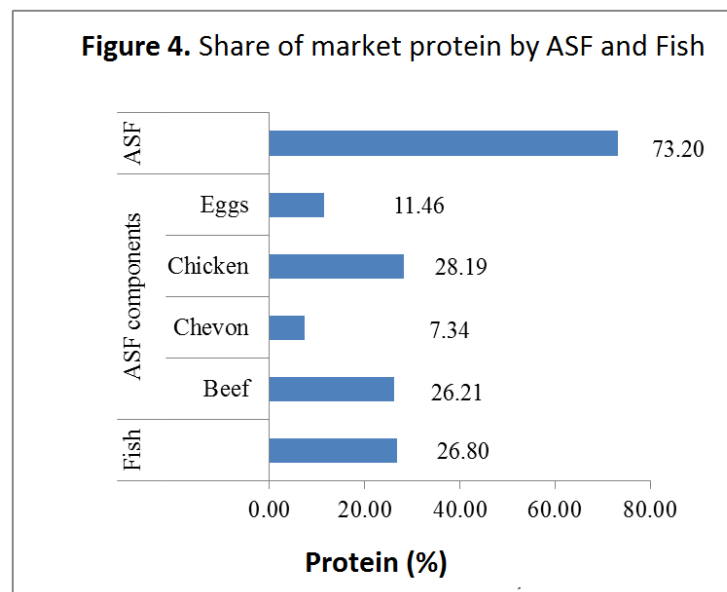
Food Sources	Protein supply (t/d)		SE	P- values
	Metropolitan (n = 3)	Municipality (n = 27)		
Beef	2.62	0.55	0.46	<0.01
Chevon	1.22	0.10	0.46	<0.01
Total red meat	3.83	0.66	0.74	<0.01
Poultry meat (white meat)	5.53	0.29	1.27	<0.01
Total meat supply	9.37	0.94	1.92	<0.01
Eggs	1.78	0.17	0.70	<0.01
ASF	11.15	1.11	2.53	<0.01
Fish	4.41	0.37	0.91	<0.01

SE= standard error; $P > 0.05$, not significant; ASF, beef, chevon, chicken and egg

Table 5. Share of different ASF and fish in the supply of biomass and protein

Food sources	Ratio of ASF components and fish supply				
	Metropolitan (n =3)	Municipality (n = 27)	SE	P- values	Total (n = 30)
Biomass components					
Total meat: fish	1.88	3.32	2.35	0.324	3.18
Red meat: fish	0.86	2.12	1.73	0.242	1.99
Chicken: fish	1.02	1.20	0.88	0.736	1.18
ASF: fish	2.28	3.79	2.45	0.321	3.64
Protein components					
Total meat: fish	2.26	4.09	2.93	0.313	3.91
Red meat: fish	1.13	2.76	2.26	0.246	2.60
Chicken: fish	1.12	1.33	0.97	0.734	1.31
ASF: fish	2.62	4.52	3.02	0.311	4.33

SE=standard error; P>0.05, not significant; n, number of replication; ASF, beef, chevon, chicken and egg



The comparative share of biomass and protein of different ASF and fish

The ratio of market biomass and protein supply from ASF and fish are presented in Table 5. It was found that the share of ASF components and fish biomass marketed in the metropolitan and municipality area and their protein values did not differ significantly ($P>0.05$). The total meat supply in metropolitan and municipality areas of Rajshahi was 1.88 and 3.32 times higher than fish. Compared to the market supply of fish biomass, the supply of red meat and chicken in both metropolitan and municipality area was 0.86 and 1.02 times in the metropolitan area and 2.12 and 1.20 times in the municipality area. However, the market supply of ASF in former markets was 2.28 times compared to 3.79 times in the latter. The average biomass supply of total meat, red meat, chicken and AFS compared to that of fish, irrespective of areas, was 3.18, 1.99, 1.18 and 3.64 times higher, respectively.

The supply of protein of total meat, red meat, chicken and AFS was 2.26, 1.13, 1.12 and 2.62 times, respectively, and 4.09, 2.76, 1.33 and 4.52 times, respectively, higher than that of fish in metropolitan and municipality area, respectively; and their average, irrespective of metropolitan and municipality, was 3.91, 2.60, 1.31 and 4.33, respectively in the study area. The global average per caput meat (both red and white meats) consumption is found to be always higher (43.2 Kg in 2015) than fish (20.3 Kg) (FAO, 2016).

The development of database on the consumption of per caput meat of different animals, not considered here, is much more important, and it has to be species, region and season wise in one hand and on the other consumer categories have to be taken into consideration. Moreover, milk and value added products of different meat and fish should also be taken into consideration. Value additions, in one way, support the widening of gross domestic product basket, and on the other, it supports safe food production from field to forks. The highest share of protein value of fish and different AFS marketed during the study period was found by chicken (28.19 %) followed by fish (26.8%), beef (26.21%), eggs (11.46%) and chevon (7.34%, Figure 4), and it resulted in a total ASF share of 73.20% in Rajshahi district.

CONCLUSION

It may be concluded that the daily market supply of total meat and ASF (64.29 t and 80.2 t) or their protein value (9.37 t and 11.15 t) were higher than that of fish (35.89 t) or its protein (4.41 t), irrespective of areas. The share of protein of chicken marketed daily was the highest (28.19 %) followed by fish (26.8 %), beef (26.21 %), eggs (11.46 %) and chevon (7.34 %). However, considering the importance of ASF and fish for addressing the food insecurity of the people, further research may be conducted on the production, marketing, value additions and their per caput consumption according to season, region and socioeconomic conditions. This will enable formulation of livestock and fisheries resource based strategic development plans in the country.

CONFLICT OF INTEREST

The author declares that there is no conflict of interests regarding the publication of this paper.

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