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Freshwater Snail (Viviparus sp); Its Potential to Use in Fish Feed Formulation

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Abstract

The present study was concerned with emerging culture systems of freshwater snail, (*Viviparus sp*) at the farmers level highlighting its potential to use in fish feed formulation. The study was conducted over a period of 7 months from May to November in Rupal Integrated Farm Chothrasia, Muktagacha Upazila of Mymensingh district, Bangladesh. Emerging culture systems of freshwater snail, its collection methods, proximate composition of snail mixed feed and comparative economic efficiency of snail mixed feed versus traditionally used fish feed were the focal points under the present study. The pond for freshwater snail culture was rectangular in shape with an area 4855㎡. The collection of snail from the culture ponds were carried out by the four methods. The production cycle was completed by 40-45 days following the harvest. The production of snail was about 4117 kg/10000㎡ in one cycle. Snail culture pond was used concurrently for rearing fry of carps (*Labeo rohita*, *Catla catla*, *Cirhinus cirrhosus*, *Hypophthalmichthys molitrix* etc), cat fish (*Pangasius hypophthalmus*). Two snail mixed feeds, one commercial feed and single rice bran were analyzed. The crude protein content, lipid content was higher in snail mixed feeds than commercial feed.

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The crude fibre content was lower in snail mixed feeds than commercial feed. Average cost for the production of snail mixed feed comparatively lower than the commercial feed. However, in terms of growth there was no significant differences occurred in both feeds.

***Keywords*:** Freshwater snail; Proximate composition; Economic efficiency.

1. Introduction

The aquatic fauna of Bangladesh is unique and highly diversified due to its high rainfall, wed river fed systems, and for warm temperature. At present the country has an assemblage of 800 fresh and marine water fauna [1, 2]. Like other parts of Asian, non- piscine species, such as mollusk species are very common in our country. In Bangladesh, there are about 362 species of mollusk, of which 336 are marine and 26 are freshwater living in generally low lying marsh lands. Like fish other aquatic organisms, mollusks can play a vital role in supplying protein to human food indirectly In South-East Asia fish and mollusks provide over 50% of all consumed animal protein, but only a few tribal people in Bangladesh use mollusks as food. In addition to human food, mollusks can play and in fact are playing a significant role to the nutrition of other important group of aquaculture species [3].

As an important member of snail group, the freshwater snail, *Viviparus sp* is widely distributed mollusk in Bangladesh which could be cultured in different aquatic systems. In the recent years, at the home of aquaculture, the Mymensingh region some innovative farmers started snail culture within their fish farms in the view of producing snail to use as a protein supplement to preparing of fish feed. The underlying reasons to culture snail are to reduce feed cost for fish production and pressure of natural snail population. However, there are many scientific questions on how the snail farming is going on and ways of using snail as a feed aquaculture production. This is because available literature on snail farming in Bangladesh is very scarce. This current paper is part of a larger plan by the authors to address to understand existing culture systems of freshwater snail at the farmer's level and to assess proximate composition of snail mixed feed being used for fish production along with assessing economic efficiency of snail mixed feed versus traditionally used fish feed.

2. Materials and methods

2.1. Reconnaissance visit

At first, a number of reconnaissance visits had been undertaken to have general idea on snail farming in Chothrasia, Muktagachha Upazila of Mymensingh district, Bangladesh and selected as the study area. The experiment was carried out in the Chothrasia, Muktagachha Upazila of Mymensingh district, Bangladesh during the period from May to November.

2.2. Description of the pond

The freshwater snail culture pond was situated at the middle of the farm. The area of pond was 4855㎡ and rectangular in shape. Liming was done at the rate of 1-1.5 kg/40.46㎡. Then pond was filled up with water

upto 1 ft and then compost was spreaded throughout the pond during noon. Compost was prepared mixing the cowdung, mustard oilcake and urea at the ratio of 1.0 kg, 1.0 kg and 0.5 kg/40.46㎡ respectively. The mixing compost was done manually kept in water for three days. Prepared compost was given into the water. After few days, planktons were grown in the pond and then ponds became ready for snail culture. After 3-4 days, pond was filled up with 3-4 ft water and then snail seeds were released. The pond used for snail culture was also used for rearing fry of carps (*Labeo rohita*, *Catla catla*, *Cirhinus cirrhosus*, *Hypophthalmichthys molitrix* etc), *Pangasius hypophthalmus* to 8.89-10.16 cm.

2.3. Snail seeds collection and stocking of the ponds

For growth of snail, the pond was supplied with compost. The pond was stocked with snail seeds at the ratio of 250 g seeds/40.46㎡. The snail seeds were collected from ditches, *beels* or ponds. The age of snail seeds was 2-3 weeks and size length of 0.7-0.9 cm, diameter of 0.3-0.5 cm. The individual weight of snail seed was 0.8-1.1 g. Snail culture pond was used for rearing fry of carps or *Pangasius* in four months. The stocking density was 1000 fry/40.46㎡. After four months, fry become size of 8.89-10.16 cm and then sold for stocking. It was spread throughout the pond by using silver plate during noon that was observed directly.

2.4. Feeding of snail

A 15 days of interval, compost was provided to the pond for satisfactory growth and breeding of snails. The composition of compost was of 250 g cowdung, 250 mustard oilcake and 100 g urea per decimal. The mixture of compost kept in water for 3 days and then divided into three parts and broadcast into pond. After application of the compost, red earthworms and other chironomid larvae were observed on pond bottom having samples of mud. Those small red earthworms were used as favorable food for snails. Moreover, by applying compost, plankton population was developed in the pond which was used as feed by snail.

2.5. Harvesting of snail

During the observation period of study, farmers were found to use four different methods to enhance growth and to collect snails from the culture ponds. The methods are as follows:-

- By pipe- use of plastic/iron pipe.
- By bamboo pole- use of locally available bamboo pole.
- By netting- use of locally available net.
- By Palm leaf- use of locally available palm leaf.

2.6. Methods to use of snails for fish feed formulation

The collection methods of snail, time of collection, amount of collection were observed at the farm site. The

methods of uses of snail for fish feed preparation particularly as a sole source and partial source of protein were explored with the help of farm operators and owners.

2.7. Proximate composition analysis in fish feed

Supplementing protein in fish feed is the major challenge in Bangladesh therefore being a protein source, snail should be analyzed nutritionally. To make a consistent comparison, four different fish feeds being used were analyzed along with snail-mixed ones. The comparisons of different feeds were reported in **Table 1.**

Table1: Comparison of different type of feed with snail-mixed feed nutritionally

Feed types	Source	Use in the farm
Feed 1 (Rice bran+ Mustarded Oil Cake (MOC) + Mollases + Snail)	Rice bran-Auto rice mills (Netrakona), MOC-India, Mollases-Rajshahi, Snail- Own farm.	Especially for Pangas, Bangla macch etc.
Feed 2 (Snail + Rice bran)	Snail- Own farm, Rice bran- Auto rice mills (Netrakona).	Especially for Tilapia, Shing, Magur.
Feed 3 (Commercial feed)	From market.	Finisher feed for fishes.
Feed 4 (Rice bran)	Rice bran- Auto rice mills (Netrakona).	Use in all types of feed formulation.

Feed samples were collected from different sources and places and then stored in the farm. The nutritional analysis was done at Fish Nutrition Laboratory, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Moisture content was determined by placing an accurately weighed 2.0 g homogenized ground sample in a pre-weighed porcelain crucible in a thermostat oven (Gallenkamp, HOTBOX, Model OVB-306) at 105˚C for 24 hours until constant weight was obtained. The loss of moisture was calculated as percent moisture. The moisture content of the samples was estimated by using the following formula:

$$\% \text{ of moisture content} = \frac{E}{C} \times 100$$

Where, E= Weight of moisture and C=Weight of sample

Total nitrogen content of each of the sample of the smoked fish was determined by Kjeldahl method. In this case, total nitrogen content was determined by digesting the sample with concentrated sulphuric acid (H_2SO_4) in presence of copper sulphate ($CuSO_4$) and selenium powder followed by distillation when ammonia liberated by alkali (NaOH) into boric acid. The total nitrogen value was then obtained by using the following formula:

Total Nitrogen %

$$= \frac{\text{ml. acid titrated} \times \text{strength of standard acid titrated} \times \text{milliequivalent of N}(0.014)}{\text{Wt. of sample}} \times 100$$

The amount of crude protein was then calculated by multiplying the % of total nitrogen with protein conversion factor (6.25).

Lipid content was determined by solvent extraction method using a ground joint Soxhlet Apparatus. Accurately weighed sample of 5 g was taken in a paper thimble and these were placed in Soxhlet Apparatus. The round bottom flask with acetone was placed in a distillation chamber and heated at 70˚C. Lipid from samples was extracted by acetone for 2-2.5 hours. The extracted lipid with acetone is then evaporated by placing in pre-weighted beaker at60˚C in an electric oven.

The following formula was used for lipid determination:

$$\text{Lipid content \%} = \frac{\text{weight of lipid}}{\text{weight of sample}} \times 100$$

Ash content was determined by heating the sample in a muffle furnace at a temperature of 550^{O}C for 6 hours. The sample was then cooled in desiccators. The average weight in percentage of each sample of the remaining material was taken as ash. For determination of ash content the following formula was used:

$$\text{\% of ash content} = \frac{E}{C} \times 100$$

Where, E= Weight of ash and C=Weight of sample

2.8. Assessing economic performance of using snail in fish feed formulation

The economic performance of the use of snail in fish feed formulation is very important to assess as it likely to influence a farmers to decide whether it is important to add snail culture practice in his fish farm. A comparative economic analysis based on the tabular analysis comparing snail- mixed fish with other feeds being used in the farm and commercial feed available were carried out.

2.9. Data analysis

For the statistical analysis of the data, one way analysis of variance (ANOVA) was done to test the significance of variation among the treatments. Significance was assigned at the 0.05% level. Statistical test were performed by computer based statistical software SPSS (statistical package for social science) version 10.00. The findings of the research work were presented in text visual methods including tables and graphs.

3. Results

3.1. *Harvesting of snail*

The production cycle was completed by 40-45 days following by the harvest. About 2000 kg snails were produced from 4855㎡ pond within 30-45 days. The production of snail was about 4117 kg/10,000㎡ in one cycle. About 8 MT snails were produced per year from the farm completing 4 production cycles. During October to November, snails production was finished.

3.2. Efficiency of different snail collecting substrates/materials

The numbers of snails collected from different substrate were given in **Table 2.**

Table 2: Number of snails collected per unit area of different substrate used

Name	Estimating formula	Number/ inch^2
Palm leaf	L×W (length×width)	2-3
Pipe	2 πrh	1-2
Bamboo pole	L×W (length×width)	2
Net	L×W (length×width)	0.1125 kg/ft^2

3.3. Proximate composition analysis in fish feed

The nutritional analysis to figure out proximate composition, laboratory work was done at the sophisticated Fish Nutrition Laboratory under the Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. The proximate compositions of different feed were reported in **Table 3**. ANOVA of Proximate composition was also analyzed of different fish feeds is given at **Table 4**.

Table 3: Proximate composition analysis of different fish feeds

Feed types	Mean ± Std. Deviation					
	Moisture(%)	Ash(%)	Lipid(%)	Crude protein	Crude fibre	Carbohydrate
Feed 1 (Rice bran+ MOC + Mollases + Snail)	11.32 ± 0.19	15.43 ± 0.18	10.35 ± 0.00	25.87 ± 0.40	7.2 ± 0.00	9.84 ± 0.39
Feed 2 (Snail + Rice bran)	10.17 ± 0.29	12.99 ± 0.32	6.83 ± 0.00	24.89 ± 0.18	7.38 ± 0.00	37.75 ± 0.21
Feed 3 (Commercial feed)	11.00 ± 0.14	15.055 ± 0.007	6.8 ± 0.00	23.34 ± 0.08	10.49 ± 0.0	33.32 ± 0.06
Feed 4 (Rice bran)	10.06 ± 0.59	9.49 ± 0.09	15.72 ± 0.00	10.56 ± 0.17	14.23 ± 0.0	39.95 ± 0.247

Table 4: ANOVA of Proximate composition analysis of different fish feeds

Dependent Variable	Type III Sum of	Degree Of	Mean square	Significant level
Moisture	2.30	3	0.7	0.01
Ash	44.39	3	14.80	
Lipid	106.22	3	35.41	
Crude protein	306.35	3	102.12	0.00
Crude fibre	65.43	3	21.81	
Carbohydrate	122.55	3	40.85	

3.3.1. Moisture content

There was a significant difference between the types of feed in terms of moisture content. The highest moisture content was 11.32 ± 0.19 found in Feed 1**,** while in Feed 3, Feed 2, and Feed 4 were presented by corresponding values of 11.00 ± 0.14, 10.17 ± 0.29, 10.06 ± 0.59 respectively.

3.3.2. Ash content

There was a significant difference between the types of feed in terms of ash content. The highest ash content was 15.43 ± 0.18 found in Feed 1, while on Feed 3, feed 2, and feed 4 were presented by corresponding values of 15.06 ± 0.007, 12.99 ± 0.32, 9.49 ± 0.09 respectively.

3.3.3. Lipid content

There was a significant difference between the types of feed in terms of lipid content. The highest lipid content was 15.72 ± 0.0 found in Feed 4, while on Feed 1, Feed 2, and Feed 3 were presented by corresponding values of 10.35 ± 0.0, 6.83 ± 0.0, 6.8 ± 0.0 respectively.

3.3.4. Crude protein content

There was a significant difference between the types of feed in terms of crude protein content. The highest crude protein content was 25.87 ± 0.40 found in Feed 1, while on Feed 2, Feed 3, and Feed 4 were presented by corresponding values of 24.8 ± 0.18, 23.34 ± 0.08 , 10.56 ± 0.17 respectively.

3.3.5. Crude fibre content

There was a significant difference between the types of feed in terms of crude fibre content. The highest crude fibre content was 14.23 ± 0.0 found in Feed 4, while on Feed 3, Feed 2, and Feed 1 were presented by corresponding values of 10.49 ± 0.0, 7.38 ± 0.0, 7.2 ± 0.0 respectively.

3.3.5 Carbohydrate content

There was a significant difference between the types of feed in terms of Carbohydrate content. The highest carbohydrate content was 39.95 ± 0.25 found in Feed 4, while on Feed 2, Feed 3, and Feed 1 were presented by corresponding values of 37.75 ± 0.21, 33.32 ± 0.06, 29.84 ± 0.39 respectively.

3.4. Economic performance of freshwater snail in fish feed formulation

For economic performance of freshwater snail in fish feed formulation, cost estimation of inputs and return of outputs were carried out in **Table 5, Table 6**, and **Table 7**.

Table 5: Compost cost (1^{st} phase) in 40.46$m^2$of pond

Items	Amount (kg)	Unit price (BDT)	Total price (BDT)
Cowdung	1	2.0	2.0
Mustered oilcake	1	20.0	20.0
Urea	0.05	12.0	3.0
Total			25.0

1US dollar = BDT 80

Table 6: Compost cost (2^{nd} and 3^{rd} phase) in 40.46m^2 of pond

Items	Amount (kg)	Unit price (BDT)	Total price (BDT)
Cowdung	1	2.0	2.0
Mustered oilcake	0.5	20.0	10.0
Urea	0.1	12.0	1.2
Total			13.2

1US dollar = BDT 80

In 1^{st}, 2^{nd} and 3^{rd} phase the cost for snail production was 38.2 BDT in 1 decimal of pond. Total cost for snail production was 50.2 BDT in 40.46㎡ of pond. In 4855㎡ of ponds, total cost for snail production was BDT 6024.00. From 4855㎡ of pond, about 120 kg of snails were collected within 40-45 days of culture period. Therefore, average cost for the production of a kg of snail was about BDT 5.00.

Production cost of *Oreochromis niloticus* (Tilapia), *Heteropneustes fossilis* (Shing) and *Clarias*

batrachus (Magur) feed were given in **Table 8.**

Table 7: Total cost for snail production in 40.46m^2 of pond

1^{st} phase	25.0 BDT
2^{nd} & 3^{rd} phase	13.2 BDT
Labour	12.0 BDT
Total	50.2 BDT

1US dollar = BDT 80

Table 8: Use of Snail for preparing Tilapia, Shing and Magur feed

Items	Weight	Number of bag	Total weight	Unit price kg/bag	Total price (BDT)
Rice bran	50 kg	12	600kg	500.0	6000.0
Mustered oilcake	70 kg	1	70 kg	1500.0	1500.0
Snail Crumbled	-	-	300 kg	5.0	1500.0
Vitamin	-	-	1kg	300.0	300.0
Salt	20 kg	-	20 kg	200.0	200.0
Others (labour and machine charge)	-	-	-	-	500.0
Total			991kg		10,000.0

1US dollar = BDT 80

Per kg snail mixed feed price was BDT 10.09 whereas per kg price of commercial feed was BDT 22-24. By using snail mixed feed, farmer saved a considerable amount of money but growth of fishes more or less similar with the commercial feed fed fishes. The production of tilapia was 50-55 kg/40.46㎡, shing was 12-15 kg/40.46㎡ and magur was 25-30 kg/40.46㎡.

Production cost of *Pangasius hypophthalmus* (*Pangasius*) feed was reported in **Table 9, Table 10.**

Per kg feed price BDT 18.51 when only meat and bone used for preparing feed (Table 9). Per kg feed price BDT 16.17 when partial use of snail for preparing feed (Table 10). Per kg feed cost saved BDT 2.34. But in terms of growth, there was no significant differences occurred in both feeds. The production of *Pangasius* was

250kg/40.46㎡.

Table 9: Use of meat and bone for preparing pangas feed

Items	Weight (kg)	Unit price (BDT/kg)	Total price (BDT)
Rice bran	500	10.0	5000.0
Maize	100	15.0	1500.0
Soybean	50	30.0	1500.0
Mustered oilcake	70	21.5	1505.0
Meat and bone	300	30.0	9000.0
Vitamin	1	300.0	300.0
Calcium	50	6.0	300.0
Salt	20	10.0	200.0
Other expenditure			895.0
Total expenditure	1091		20200.0
Per kg feed price = BDT 18.51			

1US dollar = BDT 80

Table 10: Partial use of snails for preparing *Pangasius* feed

Items	Weight (kg)	Unit price (BDT/kg)	Total price (BDT)
Rice bran	500	10.00	500.00
Maize	100	15.0	1500.0
Soybean	50	30.0	1500.0
Mustered oilcake	70	21.5	1505.0
Meat and bone	200	30.0	6000.0
Snails	150	5.0	750.0
Vitamin	1	30.0	300.0
Salt	20	10.0	200.0
Other expenditure			895.0
Total expenditure	1091		17650.0
Per kg feed price BDT 16.17			

1US dollar = BDT 80

4. Discussion

At the onset of snail culture, the pond was dried before the stocking of snail seeds. Pond dykes were renovated where necessary works were required. The excessive bottom mud were removed from the pond and then treated with lime at the rate of 1-1.5 kg/40.46㎡. In the traditional aquaculture system, the lime dose was 1.1 kg/40.46㎡ [4, 5]. After liming pond is filled up with water and then compost was spread throughout the pond during noon for snail culture. Compost was prepared mixing the cowdung, mustard oilcake and urea at the ratio of 1.0 kg, 1.0 kg and 0.5 kg/40.46㎡ respectively. In traditional aquaculture system, pond were treated with cowdung (1235 kg/10,000㎡), urea (14.82 kg/10,000㎡), TSP (22.23 kg/10,000㎡) [6]. Then snail seeds were released at the rate of 250 g/40.46㎡. The individual weight of snail seed was 0.8-1.1 g. In the tropical areas optimum stocking density of giant african snails, *Achatina fulica* and *Achatina chatina* was 100 snails/㎡ for juveniles weighing 0.5-49 g [7]. In snail culture pond, fry of carps or pangas were reared for four months. The stocking density was 1000 fry/40.46㎡. After four months, fry become size of 8.89-10.16 cm and then these were ready for sold. Survival rate on an average was 75% of the total stocked. During the nursing fry in ponds, stocking density was 100,000 fry/10,000㎡. After four months, carps fry become 15.5 cm in length and the survival rate was 75% [8].

There were used different types of substrates to collect snails from the culture pond. These substrates were palm leaf, plastic/iron pipe, bamboo pole, net etc. The uses of those substrates were not difficult because all were locally available and can be easily put in the pond. Normally these substrates did not create problems with other activities in the pond management. During checking of health condition and harvesting of fish fingerlings, substrates were removed from the pond. After checking of health condition and harvesting of fish fingerlings, substrates were set in the pond. Among four substrates, palm leaf was the most effective substrate for the collection of snails because it was cheap, easily available and manageable. This substrate hold huge amount of algae that could attract snail effectively the other substrates. Its surface area was wide. For this reason huge numbers of snails were attached.

Four different fish feeds being used were analyzed. Among them two was snail mixed feeds, one was commercial feed and another one was rice bran. The snail culture season was May to November. About 6 months, snails were harvested from the cultured ponds. About BDT 500,000-700,000 was saved a year using snail being produced from the farm ponds. Two snail mixed feeds had higher crude protein content compared to the commercial feed. The crude protein (%) content of snail mixed feed was 25.87 ± 0.40, 24.89 ± 0.18 respectively. This amount of crude protein content of feed was sufficient in traditional aquaculture systems. Protein is the major growth promoting factor in feed. The protein requirement of fish are influenced by various factors such as fish size, water temperature, feeding rate, availability and quality of natural foods and overall digestible energy content of diet[9,10]. It was estimated the protein requirement for tropical catfish to be 25-35% for grow-out [11].

Two snail mixed feeds had higher lipid content compared to the commercial feed. The lipid (%) content of snail mixed feed was 10.35 ± 0.0, 6.83 ± 0.0 respectively. Lipids are primarily included in formulated

diet to maximize their protein sparing effect by being a source of energy. In general, 10-20% of lipid in most freshwater fish diets gives optimal growth rates without producing an excessively fatty carcass [12]. On the other hand, the lipid level in catfish feeds should be 5 to 6%. Also the dietary lipid levels of 5 to 6% are often used in tilapia diet [13].

When the fibre content is excessive, it results to lower digestibility of nutrients. Two snail mixed feeds had lower crude fibre content compared to the commercial feed. The crude fibre (%) content of snail mixed feed was 7.2 ± 0.0, 7.38 ± 0.0 respectively. The analyzed crude fibre content of snail mixed diets under study was within the safe dietary limit for fish. Such level of fibre content might have positive impacts on the fish digestibility and growth of fish. All plant ingredients contain a certain amount of fibre. Fibre provides physical bulk to the feeds. A certain amount of fibre in feed permits better binding and moderates the passage of feed through the alimentary canal. However, it is not desirable to have a fibre content exceeding 8-12% in diets for fish, as the increase in fibre content would consequently result in the decrease of the quality of an unusable nutrient in the diet.

In fish culture, feed cost accounts for about 60 -70% of the total cost which is very expensive to poor farmers, especially for farmers in Bangladesh [14]. In the market, there are some commercial fish feeds of different protein levels which are used in fish farm. Fish farmers try to avoid those commercial fish feed due to their high feed cost. Traditionally, fish meal, meat and bone meal have been the major source of protein in commercial fish feeds elsewhere in the world. But the use of fish meal, meat and bone meal as main protein source for fish feed are not feasible in Bangladesh because those are not widely available in the country and is of high feed cost [15]. Moreover, there are several competitive uses of such feed ingredients for dairy, poultry and other agricultural production. In the context, freshwater snail can be used as a substitute of fish meal and meat and bone meal. The economic performance of freshwater snail in fish feed formulation was considerable. The cost of producing per kg snail was about BDT 5.00. During study, researcher surveyed different market and found that per kg price of meat and bone was about BDT 30.0. In farm, per kg snail mixed feed price BDT 10.09 which was used as *Oreochromis niloticus* (Tilapia), *Heteropneustes fossilis* (Shing) and *Clarias batrachus* (Magur) feed. The market price of commercial feed was BDT 22-24/kg. In both feeds, the production of fish was more or less same. For preparing *Pangasius* feed, per kg feed price was BDT 18.51 when only meat and bone was used as source of protein. Per kg feed price BDT 16.17 when partial use of snail for preparing pangas feed as source of protein. Using snail in the feed could reduce BDT 2.34 for each kg of feed production. But in terms of production of fish, there was no significant differences occurred in both feeds. As commercial aquaculture production needs a large amount of feed being formulated with high amount of protein, therefore such level of cost reduction showed a substantial financial impact to the farmer.

Animal protein is one of the most important elements for aquaculture in our country. Every year huge amount of meat and bone are imported from foreign country for that, a lot of foreign currency is draining out. Moreover the severity of bird flu, mad cow disease and radio activity were high of those countries, as a result meat and bone which were imported may have those diseases. It is mentionable that, in our country dry fishes are used as a source of protein. During preservation of dry fishes and meat and bone different harmful chemicals were used. These harmful chemicals can affect the aquaculture and moreover can affect the human

health.

5. Conclusion

From the aforesaid findings, it can be concluded that by culturing snail, farmer can be self sufficient and does not depend on meat bone and fish meal. Therefore, the snail culture and the use of snail in commercial feed in the developing aquaculture practices in Bangladesh have great possibility.

6. Recommendations

- This was a preliminary research and more research should be carried out for development of culture and harvesting techniques.
- Experimental research is needed to develop snail culture package to promote at the farmer level for broader benefits.

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