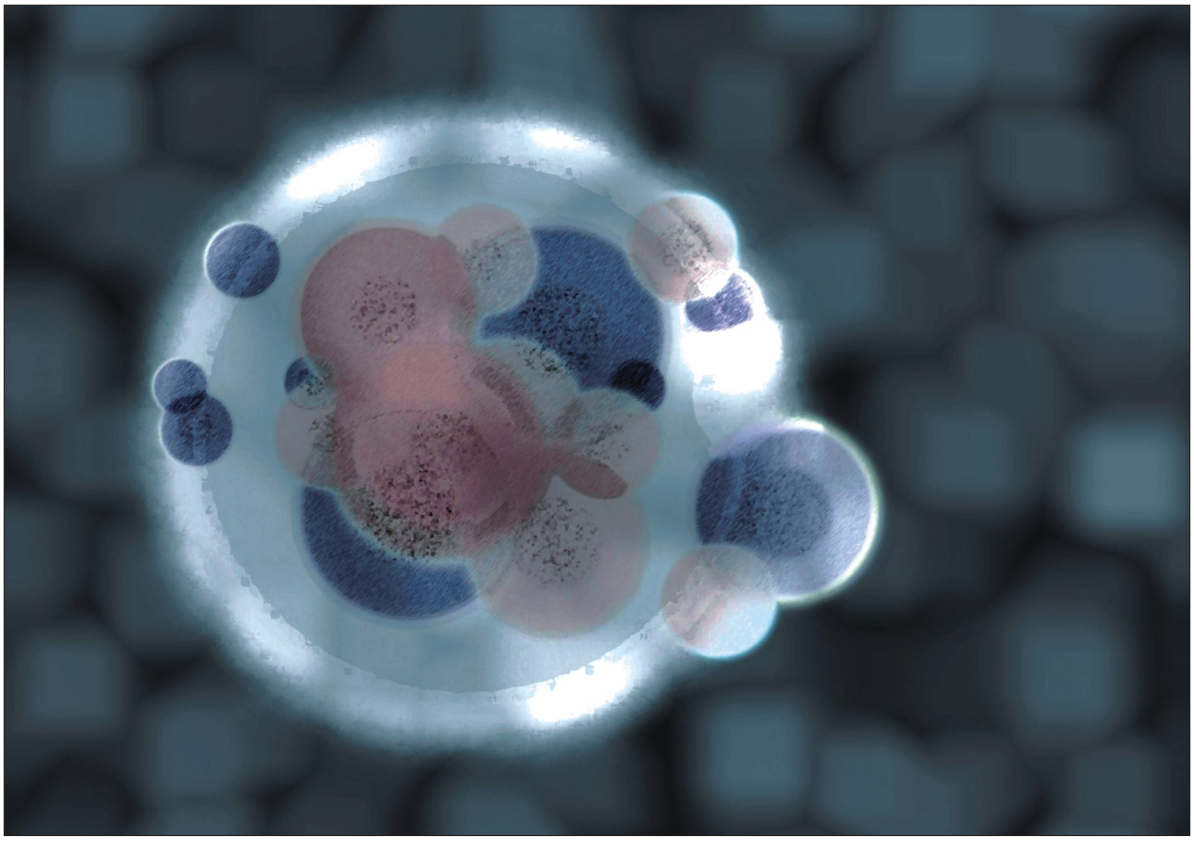

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Identification of Cause of Shrimp Quality Loss Due to Farm Operation and Post Harvesting Handling at Depots and Markets of Bangladesh

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Abstract: The study was undertaken in eighteen selected shrimp farms, fifteen depot and fifteen markets of different locations, viz. Paikgacha, Rampal and Shaymnagar of greater Khulna district to observe the variation in quality and quantity of shrimp production of the farms operated by trained manpower with the application of improved management aspects at different degrees to that of the traditional farms and to identify the causes of post-harvest quality losses of shrimp produced from the farms at depot and market levels. Data reveals that a significant higher production 398.50 kg ha^{-1} can be achieved from the improved managed farms against the low yielded traditional shrimp farms (170.80 kg ha^{-1}) with a positive impact of management on the quality of shrimp. For post harvest quality loss of produced shrimps at depot and markets, the major causes identified were poor quality non-chlorinated water, non-maintenance of personnel hygiene, poor drainage and sanitation system, unscientific holding system, poor quality of ice and ice shrimp ration, long time transportation in unscientific packet material, defective infrastructure of the market place etc. The estimated loss due to improper handling, icing and transportation calculated as about 8-25% in the coastal shrimp producing area of greater Khulna district.

Key words: Shrimp, quality, handling, depot, market

Introduction

Shrimp culture as an industry has been contributing significantly to the export earning, employment generation poverty alleviation and to the economic development of Bangladesh. Though it is assumed that rapid expansion of shrimp culture in the past few decades is the most remarkable development in the fisheries sub sector particularly for Bangladesh, but unfortunately, the quality loss of production due to farm management and post-harvest handling were not taken into account seriously by the farmers and traders. As a result, a considerable amount of quantitative loss due to low-grade final product has been reported to occur every year. So, the possible high level of good product could not be achieved because of traditional farming system where the average production rate varies from 197.4 - 225.6 kg ha^{-1} (Hoq *et al.*, 1997) and the poor quality of the product that arises as the major hindrance for export earnings (Ahmed *et al.*, 1999). In Bangladesh, generally a considerable post-harvest losses both qualitatively and quantitatively were reported to occur with the farmed shrimp both prior to arrival at the processing plants and pre-plants. Such post-harvest losses and problems were occurred at different stages of production and handling at farm sites, collection and receiving centers, and depots or peeling sheds before reaching the processing plants. Though delayed and improper post-harvest handling exerts serious threat on the quality (Fieger *et al.*, 1958) but there is no precise information on the volume of post-harvest quality losses in Bangladesh. Therefore, to increase cost-effective production level of shrimp as well as to quantify post-harvest losses of shrimp at different stages of production, handling, transportation and marketing, the study was undertaken in the shrimp growing and trading south west coastal region of Bangladesh.

Material and Methods

Management impact study: For study the impact of management on shrimp production and its quality a total of eighteen shrimp farms from three different location of greater Khulna district, *viz*. Paikgacha, Rampal and Shaymnagar thana were selected. Six farms of each of the location are of traditional nature and rests are of improved managed farms. The management shortfalls from farm preparation to harvesting of each of the nine studied improved managed farms were identified in the previous yearly conducting a detailed survey. All those selected farm managers were trained with improved shrimp farming system prior to culture start of the study year. Feature of farm preparation, management, production and benefit cost ratio of both improved traditional and traditional shrimp farms are presented in Table 1 and 2.

Study on post harvesting handling, transportation and marketing: Quality loss of the shrimp produced from both traditionally and improved managed farms, due to production management, post harvesting handling and transportation, depot operation, market infrastructure and other processing fault at various stages of operation was identified and the causes of technical loss and its extend was estimated by physical verification and survey by a pre-tested questionnaire. A questionnaire was also used to gather information on the sanitation and hygiene condition of the ice plant of the three study areas. Information on post-harvest quality loss of shrimp at depots and market infrastructure are presented in Table 3 and 4.

Results and Discussion

Significant increase in amount of shrimp production from the improved managed farms to that of the traditionally managed farms was obtained during the study period where the average rate of production from the managed farm was recorded as 398.50 kg ha^{-1}, while for traditional farm it was 170.80 kg ha^{-1} (Table 1). Though established techniques for improved shrimp farming are being practicing in many areas of neighbor countries but in

Table 1: Features of shrimp farm preparation, management and production performance

Type of Culture	Av. Area of Gher (h)	Liming kg/h	Gher Preparation aspects			Stocking rate (PL ha^{-1})	Feeding	Water exchange	Production kg ha^{-1}
			Fertilization (kg ha^{-1})			*P. monodon* (PL ha^{-1})			
			Organic	Inorganic					
				Urea	TSP				
Improved managed farm	3.20	In all farms 150-200	Not applied	10-20	10-20	15,560	Occasionally	Partial and irregular	398.50 (288.7-418.5
Traditional farm	15.02	In 20% farms 12-30	Cowdung guess basis	Not applied	Not applied	9055	Not applied purpose only	For harvesting	170.80 (153.5-207.3

Table 2: Application and level of different aspect management of improved traditional and traditional shrimp farms

Items	Improved managed shrimp farming	Traditional Shrimp Farming
Dewatering	80%	5%
Drying	80%	Natural
Lime application (kg ha^{-1})	150 -200	12-30
Flushing	O.K	Occasional
Seed source		
a) Natural	60%	50%
b) Hatchery	40%	50%
Stocking rate (No. ha^{-1})	1.5 m^2	below 1 m^2
Feed application	Occasional (50%)	Nil
Fertilization	80%	20% (organic)
Water exchange	Natural	Natural
Harvesting nature	Lunar cycle (cast netting)	Lunar cycle (cast netting)
Total Av. production (kg ha^{-1})	398.50	170.80
Total cost involved (Tk ha^{-1}/year)	85,308	34,200
Total return (Tk ha^{-1}/year)	1,88,000	93,575
Net benefit	1,02,600	59,375
Cost benefit ratio	1:2.20	1:2.73

Table 3: Causes of post- harvest quality losses of shrimp at depot in south-eastern region of Bangladesh

Items	Paikgacha	Rampal	Shymnagar
1.Floor/ Platform Condition	Cemented but ruptured (50%)	Cemented (Almost all)	Cemented (Almost all)
2. Water Supply	Tube-well	River	Tube-well
3. Chlorinated Water/ Water treatment	Nil	Nil	Nil
4. Personnel Hygiene Maintenance (%)	20	below 20	50
5. Holding System of Shrimp just after receiving	Stacked on the floor	Insulated box	Insulated box
6. Shrimp- ice ratio	1: 1/3	1:1/2	1:1/2
7. Ice form	Crushed	Crushed	Crushed
8. Container during transportation	Bamboo basket	Bamboo basket	Bamboo basket
9. Time between receiving & final transport (hr.)	5-12	7-20	5-8
10. Approximate technical loss (%)	25	15	8
11. Causes of technical loss	Load shedding of electricity, insufficient transport, mishandling	Lack of ice supply in time, mishandling	Mishandling

Table 4: Infrasructural status of market and post-harvest quality aspect of shrimp in different location of south-eastern region of Bangladesh

Items	Location of Market		
	Paikgacha	Rampal	Shymnagar
1. Market place	RCC Casting (open)	Earthen (open)	Earthen (open)
2. Nature of market stage	Nil	Wooden frame	Nil
3. Height of market stage	-	10 inches	-
4. Drainage facility	Nil	Nil	Nil
5. Water supply	Tube-well	River	Tube-well
6. Icing/ re-icing	Occasional	Nil	Occasional
7. Ice form	Crushed	-	Crushed
8. Shrimp- ice ratio	1:1/3	-	1:1/3
9. Transporting system to depot/processing plant	Van/pick up/track/bus	Van/pick up/track/bus	Van/pick up/track/bus
10. Time between receiving and final transport (hr.)	5-8	8-10	3-5

Bangladesh, it is very difficult even in some cases impossible to effectively apply any shrimp farming management techniques because most of the traditional farms are unmanageably large in size, shallow in depth and irregular in shape (Karin and Aftabuzzaman, 1995). However in such a circumstance, the present improved farming system were considered for those farms where the managers were well acquainted with improved techniques of farming, they prepared and managed their farm as per advises of the experts considering the existing farm situation. For partial adaptation of farming technique, farms of average small size (3.20 ha) were considered

while the traditional farms were of average size range of 15.0 ha. The proper growth and development of shrimp needs a suitable culture environment, which is obvious. Therefore, the oxygen saturation, pH, water salinity, alkalinity and the level of toxic substances must be kept in control within desired level. To neutralize the soil and water pH and to reduce the toxic level, lime plays a very vital role. In the study farms, a great variation in lime application rate was observed where the range for improved farm was 150-200 kg ha^{-1} and for the traditional farms was 12-30 kg ha^{-1}. Though Corre (1987) estimated the standard rate of application of lime to the shrimp farm as 200 kg ha^{-1}, but depending upon the farm condition (soil and water pH), the application rate was less for same farms. The same author also recommended application of organic fertilizer at a rate of 1-2 tons ha^{-1}. But in the study as almost all the study farms located near the mangrove areas, where they are suppose to contain high level of organic substances in pond soil, so no application of organic fertilizer was recommended and applied in the managed farms, but some traditional farms were found to treated with little amount of cowdung. For other aspects, like inorganic fertilization, feed application and water exchange, variation was also observed between the management system. No urea and TSP were found to apply in the traditional farms of any place. But for managed farms the rate was very low (10-20 kg ha^{-1}) for each. Irregular but partial water exchange was found to practice in the managed farms. Water exchange possibly played an important role for buffering the pond water, reduces and balance the plakton and toxicity of water that made the environment more friendly and allowed to stock with seed of *P. monodon* at a high density (1.5 pl/m^2) compare to traditional stocking rate. In the managed farms, water exchange preferably done during high tide. In the traditional farms harvesting of shrimp also done during lunar cycles. Because due to genetic cause, adult shrimps generally tends to move against current, when water is allowed to enter the farm during lunar cycle, where from they can be separated and collected, according to shrimp size.

In case of traditional shrimps where the farm manager did not get any training about the drawbacks/shortfalls of farm management and the process of overcome, it is found that in those farms almost all the water was not completely drained out and not allowed to dry before stocking with *P. mondon* PL and also land was not ploughed and only in 20% of the farms liming done at various rates ranging from 12-30 kg ha^{-1}. The application of lime was much more practiced in traditional farms of Paikgacha than that of Rampal and Shaymnagar. None of the farmers of those ghers was applied any inorganic fertilization but organic manure (cowdung) was applied without any basic judgement. A wide range of variation of stocking in different region was also observed for those farms. The average range of stocking density of *P. monodon* was maintained 9055 PL (2010-13, 560 PL ha^{-1}). Proper screening were not maintained in the inlet of those farms to prevent entry of predators and feeding was not reported to practice in such ghers. Water exchange was not a usual practice but after seventy five to ninety days of stocking when a considerable portion of shrimp become harvestable, water was introduced in to the ghers during high tides to facilitate harvesting. The average production from such ghers was recorded 170.80 kg ha^{-1} (Fig.1).

Better production performance was observed with improved management practice of traditional farms at high stocking density (Fig. 1). Because the farms having an average area of less than 5 ha where the management aspect were applied and supervised more closely to intensify the productivity of such ghers. On the other hand, traditional farms were unmanageably large (above15 ha) and un-uniform. The shrimp farming with large areas were mostly done in leased-land obtained from landowners. Long term leasing was not practiced and any excavation or topographic changes in land normally not allowed. The farmers were quite hesitant to invest money on site development, secondary dykes or other permanent structures. Applications of improved management techniques in such farms were haphazard and incompletely adopted.

Wholesome, quality based production of shrimp for exporting to the international market is always essential. Quality based finished or processed product is always depended on quality of raw materials (raw shrimp). That's why in addition to production of shrimp through appropriate health management and environment keeping system, post-harvest quality maintenance is also mostly needed which is invariably depend upon post harvesting handling, preservation, transportation, marketing facilities. The data on investigated the quality status of traditional depot in different region like Paikgacha, Rampal and Shaymnagar showed that the floor of all most all the depot were cemented in every region (Table 3). But 50% of the depot in Paikgacha were found ruptured or cracked and uncleaned which might be the cause of microbial contamination of shrimp and may contribute to the quick deterioration process.. The depot owners of paikgacha region were found to kept/stacked the whole lot of shrimp carelessly on the floor in unhygienic condition for several hours (5-12 hrs.) which is also mostly responsible for accelerates the decomposition process. Because quick decomposition of shrimp can be attributed to delayed post-harvest handling and mishandling (Chung and Lain, 1979). Used water was one of the most prime factors for bacterial contamination in shrimp. In Paikgacha and Shaymnagar region almost all the depot had facility to use hand tube well water. But in Rampal region river water was found to use without any kind of treatment which might be a threat for the quality of shrimp. On the other hand crushed ice those are being applied having pointed edge can cause mechanical injury to shrimp and ultimately deteriorate the quality by secondary infection in the injured area. In every study areas it is observed that crushed ice are main preservation material.

Shrimp and ice ratio were maintained at 1:1/2 in Rampal and Shaymnagar areas and in Paikgacha area, it was 1:1/3.

Usually bamboo baskets were used to carry shrimps but in case of large size bamboo baskets containing bulk amount of shrimps was reported to cause physical damage during transportation. The shrimp was reported to transport by road, rail and water to distant places from landing/collection centers using bamboo baskets, wooden boxes and hessian bags but shrimp was often packed under pressure causing damage to products (Hussain and Uddin,1995). Due to load shedding of electricity,

mishandling and transportation problem higher technical loss (approx. 25%) was estimated in Paikgacha whereas lowest technical loss (8%) was found in Shaymnagar (Fig. 2). Improper handling and delay process encourages bacterial function in most of the above study areas which

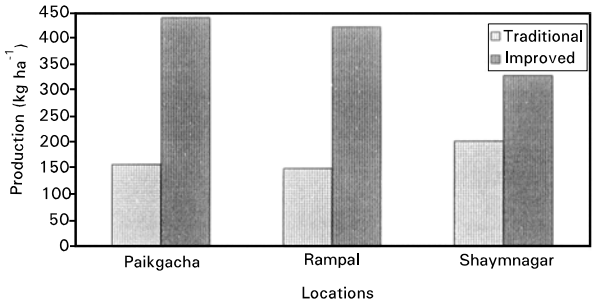

Fig. 1: Production performance of traditional and improved Managed sgrimp farm in different locations

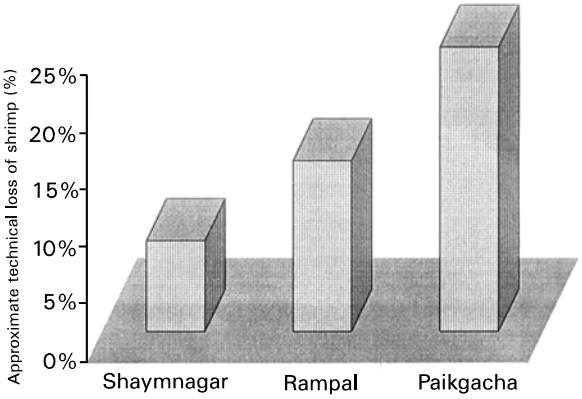

Fig. 2: Approximate technical loss of shrimp in three different location of coastal region of Bangladesh

could be retarded by proper handling and prompt transportation (Ho *et al.*, 1986).

A considerable post-harvest loss both qualitatively and quantitatively was reported to occur with the farmed shrimp at market level also (Table 4). Pre-plants and post-harvest loss problems were occurred at different stages of handling at market before reaching depot or processing plants. Almost all the market place of Rampal and Shaymnagar areas were found with earthen floor without any shed. But in Paikgacha the floor of the market place in RCC (reinforced cement-concrete) casting made. In both Paikgacha and Shaymnagar there having no market stage to keep shrimps. But in Rampal, wooden framed market stage was found with very dirt uncleaned condition. In Rampal region direct river water was used for washing and no drainage system was found any where which could be a another possible mean for the quality deterioration of shrimp. In market of Paikgacha and Shaymnagar occasional use of ice was noted without maintaining any ice-shrimp proportion and no awareness was observed regarding the quality of ice. During study it is observed that shrimp-ice ratio of Paikgacha and Shaymnagar markets were approximates at 1:1/3.In the market of Rampal the study demonstrated that generally there kept/stacked a bulk amount of shrimp without ice and then allowed to final transport with addition of considerable amount of ice to carry to the processing plants. About 8-10 hrs time is recorded between receiving shrimp and final transport. But in case of Paikgacha and Shaymnagar it required only 5-8 hrs.

Maintenance of hygiene and sanitation practice at ice plant was not found satisfactory at all. Because it is observed that about 80% of ice plant of Shaymnagar use low quality water with high iron content and hardness for preparation of ice and sometimes pond water without any treatment were found to use for ice making. Similarly in Paikgacha and Rampal, iron containing underground water without any treatment was found to use for ice making. As a result when shrimp come in contact with that ice causes discoloration of the product that ultimately degrade the overall quality of the products.

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