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PRESENT STATUS OF BIOLOGICAL WASTE MANAGEMENT OF SHRIMP PROCESSING INDUSTRIES IN KHULNA DISTRICT

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Abstract: The study reflects the present status of biological waste management of 35 shrimp processing industries out of 43 in Khulna district. A total of 367 MT of shrimp was purchased in the selected thirty five plants in a day which produce 135.2 MT of waste product during processing. About 80% plants discharged waste in the river and about 91.42% of the processing plants treated the waste water before discharge. Results revealed that about 80% of the plants sold their waste product. The ratio of total number of employee engaged in waste management was found male: female 1.73:1. It was found that the buyer sold head of golda for human consumption and head of bagda were used mainly in fish culture pond. The people (48.57%) consumed golda's head was cooked in "Dip-oil-fry". Positive and negative effects were also assessed to use waste material as alternative feed for fish. Results revealed that most of the plants (62.85%) had no future plan of waste management; while the rest plants (37.14%) had a plan to produce fish meal, poultry feed and fertilizer from shrimp waste materials. However, the shrimp processing waste offers an excellent source of protein replacement in shrimp feed formulation.

Keywords: Shrimp, Processing, Waste, Management.

Introduction

Shrimp export sector has grown over the past thirty years in response to expanded global demand. Commercialization of shrimp culture and processing has lead to profitable venture of this industry (Pokrant and Bhuiyan, 2001). Expansion of shrimp processing industry has resulted in increased discharge of waste (Chandrkrachang *et al*., 1991). In this regard, value addition to shrimp processing wastes might provide extra income to the local workers, who constitute the workforce in the shrimp processing industries and various processing intermediaries. Shrimps are normally sold headless and often peeled of the outer shell, thus the waste generated comprises mainly of the shrimps head, shell and tail. Peeling process involves removal of shell from prawn, increase the total waste production up to 45% (Subasinghe, 1999). It is reported that about 80% original weights of raw materials are discarded from shrimp and other crustacean in processing plants (Shahidi and Synowiecki, 1991).

Shrimp waste could be processed in drying, fermentation, ensilation for recycle use such as shrimp meal, fish meal, poultry meal**,** a natural source of carotenoids and human foods. Shrimp meal is an important product of shrimp waste (Widarto, 1989). Shrimp meal is valuable in tropical fish, poultry and bird diets where properties or pigment enhancement are of greater importance (Meyers, 1986). Shrimp waste meal has higher mineral, protein and calcium content than fish meal, as well as some amino acids such as aspartic acid, glutamic acid, leucine, lysine and argentine. Shrimp waste could be processed as several human food such as pettis (shrimp paste), terasi, shrimp crackers (Suparno and Poernomo, 1992), shrimp waste could also converted to shrimp loaves with 20% wheat flour and 30% fat emulsion (Suparno and Nurcahya, 1984). Chitin and chitosan is another value added product from shrimp waste (Suparno and Poernomo, 1992). Shrimp waste could also be used as agricultural purpose such as fertilizer (Chandrkrachang *et al.*, 1991).

Although no systematic studies have so far been done on the total amounts of wastes produced and their utilization in Bangladesh, it is estimated that about 114,000 MT/year of shrimp head is produced annually from the shrimp processing industries located in the coastal region (Khan and Hussain, 1996). Since these are frequently not edible, processing streams containing these by-products are often merely discarded to reduce the storage and handling charges. There is a great potential of utilization of shrimp processing bio-waste in Bangladesh, if it could done in a suitable and feasible method. This could also help boost countries economy if proper attention paid to it.

The study intends to investigate into the present status of biological waste management in shrimp processing industries of Khulna with a view to obtaining some knowledge about their waste management system and to provide some guidelines which would be economically acceptable by utilizing this waste in fishmeal production which reduce shrimp production cost down to a sustainable level through waste reclamation.

Materials and Methods

The study was conducted among thirty five shrimp processing industries randomly selected out of a total forty three industries in Khulna. Khulna district has the great potential of shrimp culture, processing and thus waste delivered. Among total lincensed processing plants in Bangladesh, about 80% are situated in this region.Therefore the waste sample were collected from this region. The data was collected by using structured questionnaire interviews. The director and managers of the industries were interviewed to know the overall waste management system of the industries. The amount of the waste production and their system of utilizing and management of those waste in different industries were noted during personal visit to each of the industries. Data collected from one industry was cross-checked with those collected from other industries to rule out and/or solve any inconsistency in the data through follow-up visits. All the collected information from the different processing industries were accumulated and analyzed by MS Excel. The data were then presented in graphs, figures and tables.

Result and Discussion

Production volume per day: The production volume of different industries is shown in figure 1. The production of most of the industries (31.42%) was 6 to 10 MT/day. About 20% of the industries whose production was comparatively less than others (1 to 5 MT/day). The highest production was found among 20% of the industries and the production was in between 20 to 25 MT/day. The total production of the 35 industries was estimated to reach at 367 MT/day. The average production was calculated from the data and the production was 10.48 MT/day/industries.

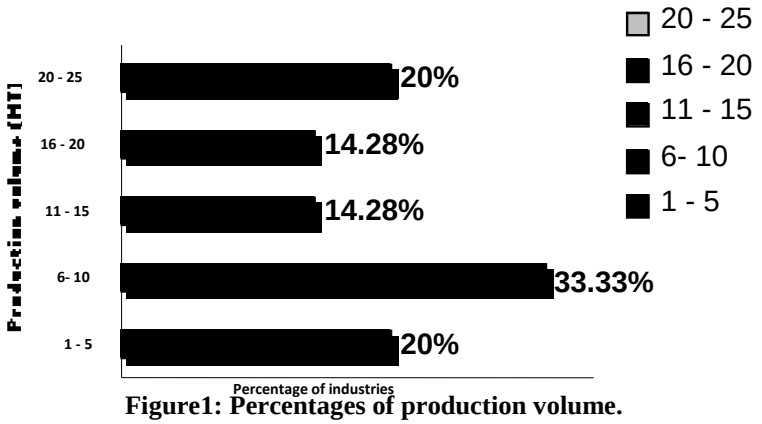

Figure1: Percentages of production volume.

Waste production per day: The total waste production of the 35 processing plants was 135.2 MT/day. From the data it was found that the total shrimp production of the 35 processing plants was 367 MT/day whereas the total waste production was 135.2 MT/day which showed that the waste production is about 37% of the total shrimp production. It implied that from different types of shrimp average 37% weight of waste was produced which was discarded.

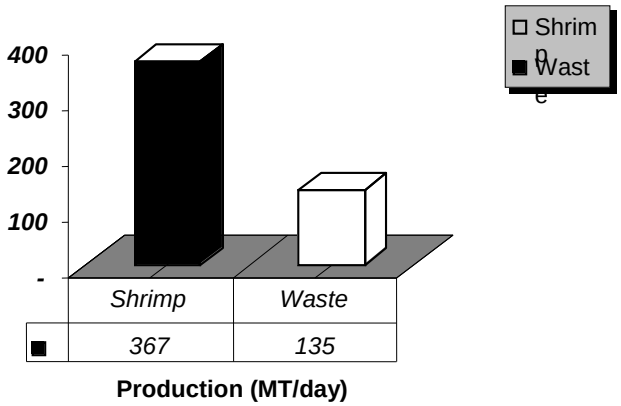

Figure 2: Comparison graphs of shrimp & waste production.

Waste production from different body parts: The waste production of body parts of shrimp is shown in table 1. The table showed that from Golda about 45% waste was produced comparison to the whole body weight whereas from Bagda about 35% waste was produced. Both of those 45% and 35% waste was produced from the head of the shrimp. From the other parts of the body, waste was produced as 18% from the tail and legs and 1.5% from the other body parts.

Table 1. Percentage of waste produced from different body parts.

Type	Percentage
Head, Golda	45.0
Head, Bagda	35.0
Tail	18.0
Others	1.5

Table 2. List of different types of waste disposal area.

Water used for washing Shrimp: The survey result revealed that before using the water for washing shrimp it was pretreated following different stages. The overall treatment system was nearly same among the processing plants; very few were following different chemicals or materials whereas others followed the same chemical ingredients.

Where they discharge waste water?

Waste water disposals area is one of the important things taken in consideration for each of the processing plants as there is a consequence of environmental pollutions. The survey results revealed that most of the plants discharged their waste water in river (80 %) as the plants were situated beside the river. The others discharged their waste water in nearby drains (8.57 %), canals (5.71 %) and low-lying agricultural fields (5.71 %).

Type	Frequency	Percentage
Drain	3	8.57
Canal	2	5.71
River	28	80.00
Crop-field	2	5.71
Total	35	100

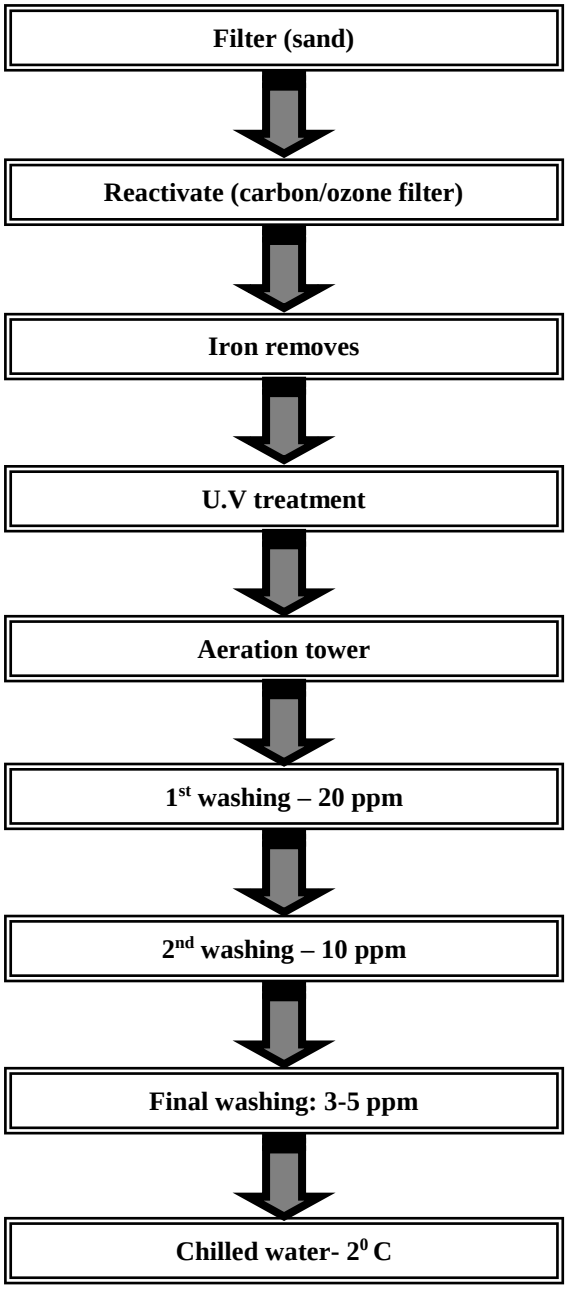

Figure 3. Flow chart of water treatment system for washing shrimp.

Pretreatment of waste water before discharge:
Survey was conducted to find out whether the plants usually treat their waste water before discharging. The survey results revealed that most of the plants (91.42%) treated their waste water before discharging whereas the rest of 8.57% of plants did not treat their waste water before discharging out of their industries. It was good news for us that the plants have taken the environmental issues in their consideration. However, in many Asian and other advanced countries, this waste water are used for extracting many commercially valuable organic materials like as taxanthin, enzymes and so on. Unfortunately, in our country no such activities were found.

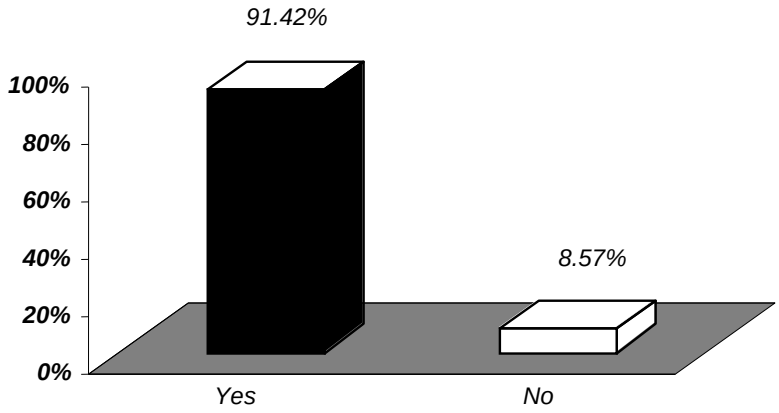

Figure 4. Percentages of pretreatment of waste water discharge.

Fate of the waste product: The results on the fate of solid waste product are given in Table 3. The survey result showed that most of the (80%) waste products were sold out at different prices. 14.28% plants was found who gave it to the people who were interested to take it. The rest of 5.71% of the plants discarded their waste product. As there was no opportunity for selling out those waste products, the plant managers discarded it anyway.

Table 3. List of different types of waste management system.

Type	Frequency	Percentage
Sell	28	80
Discard	2	6.66
Give away	5	13.33
Total	35	100

Price of waste products: The average value of waste was calculated from the 35 industries and the price was Tk 1.42 per Kg. The price of shrimp waste per Kg fluctuated from the highest 1.75 Tk/Kg to a lowest 0.8 Tk/Kg.

Discarded place of shrimp waste: From the study it was found that some of the plants discarded their shrimp waste at different place. The discarded places were identified and were used as fish feed ingredients in fish culture pond, directly through it to cat fish (Magur, Pungus etc.) culture pond. Sometimes the owners preserve it for utilizing during preparation of fish silage. Sometimes they dump it in nearby fellow land and discarded these into the pool at adjacent area.

Number of employee engaged in management waste product: Information on the number of employee engaged in management of waste product at 35 plants was collected. The survey result revealed that a total of 303 employees were engaged in management of waste product in the 35 plants. Among them 192 employer were male and the rest of 111 employer were female. It is worth mentioning that no child labor was found engaged in this related work in the plants. The ratio of male: female employee was found at 1.73:1 whereas the total number of female worker was found higher than the male working in the processing plants.

What the buyer do after receiving waste from industries? The use of waste was depending on the buyers how they used it. The information was taken during the survey by following a prepared questionnaire and by photographs. The survey results showed that in these following ways they used waste.

- Sell head (mainly Golda) for human consumption.
- Directly through to cat fish culture pond as alternative feed for use.
- Sell waste product to the fish farmer.
- Sometimes it is used in white fish culture pond after drying and grinding.
- Use to prepare poultry feed for commercial purpose.
- Use to prepare fish feed for commercial purpose.
- In a few case, chopped heads are thrown to culture pond of shrimp as alternative feed. In such case mainly head of Bagda is used.

Mode of human consumption: One of the methods of utilizing shrimp waste was human consumption. Not all types of shrimp waste like part of head were consumed by human, only head of Golda were consumed. The method of consumption was found different among people during the survey. The survey report showed that most of the people (48.57%) consumed in a way like dip-oil-fry. Twenty percent of the people consumed it with curry. Lowest percentage (8.57%) of people consumed it like paste and the rest of 22.85% of people consumed it in other way (potato balls).

Table 4. List of different modes of human consumption.

Type	Frequency	Percentage
Curry	7	20
Dip-oil-fry	17	48.57
Paste	3	8.57
Other	8	22.85
Total	35	100

Knowledge on HACCP concept: HACCP means hazard analysis critical control points. Systematic approach to the identification and assessment of the hazards and risk associated with a feed preparation and means of risk control. Food hygiene is the most important factor in a food industries and its safety is much needed which can be easily regulated by HACCP within a very short period of time. From the survey report it was found that cent percentage of the industries followed HACCP concept. As it was a matter of ensuring quality of the product in hygienic way and precondition for getting international market they were bound to follow HACCP condition.

Major problem in waste management: Problem in waste management was one of the important considerations taken in account to overcome the problem. Survey was conducted to

find out the major problem faced by the processing plants. The survey report revealed that no major problem was pointed out by the interviewee. Because they can sell it to the buyers as the price was not a fact. The buyers himself bought the waste willingly. The plants had taken responsibility only to sell it to the buyers. After then what was happening with the waste materials was not a headache of them. Sometimes they used it for different purposes like producing bio-gas from the waste or feeding to their own fish culture pond. If there was no customer to sell it then they usually give it to the interested people who wishes to take it at free of cost. Problem arouse when no interested people are found. This may be taken as a minor problem as a very few of the plants were faced such a problem. When they faced such a problem then they manage to bury the wastes into a pile beneath the ground or thrown it to the unused closed water body area adjacent to the plants which may cause a problem. This type of problem can be considered as a minor problem because it happens only a few times. Besides, no other problem was identified during the survey period.

Future plan for waste management: It was necessary to find out if they had any future plan about waste management as government can play important role if it plays an important role in our economy which was happening in advanced country like Norway, Japan. The survey result revealed that about 62.85% of the plants had no such type of plan for management. The rest of 37.14% of plants had a future plan for waste management. Their plans were for producing fish meal, poultry feed, organic fertilizer and bio-gas from the waste.

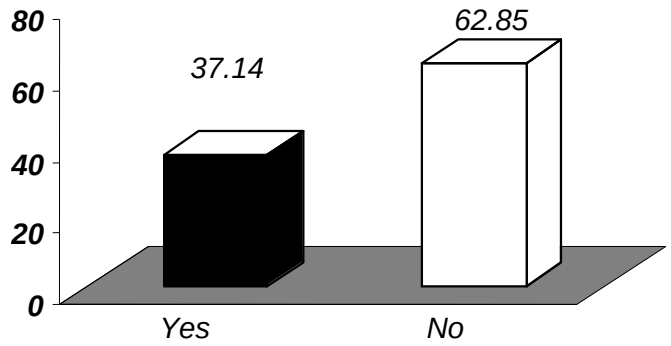

Figure 5. Percentages of future plans for waste management

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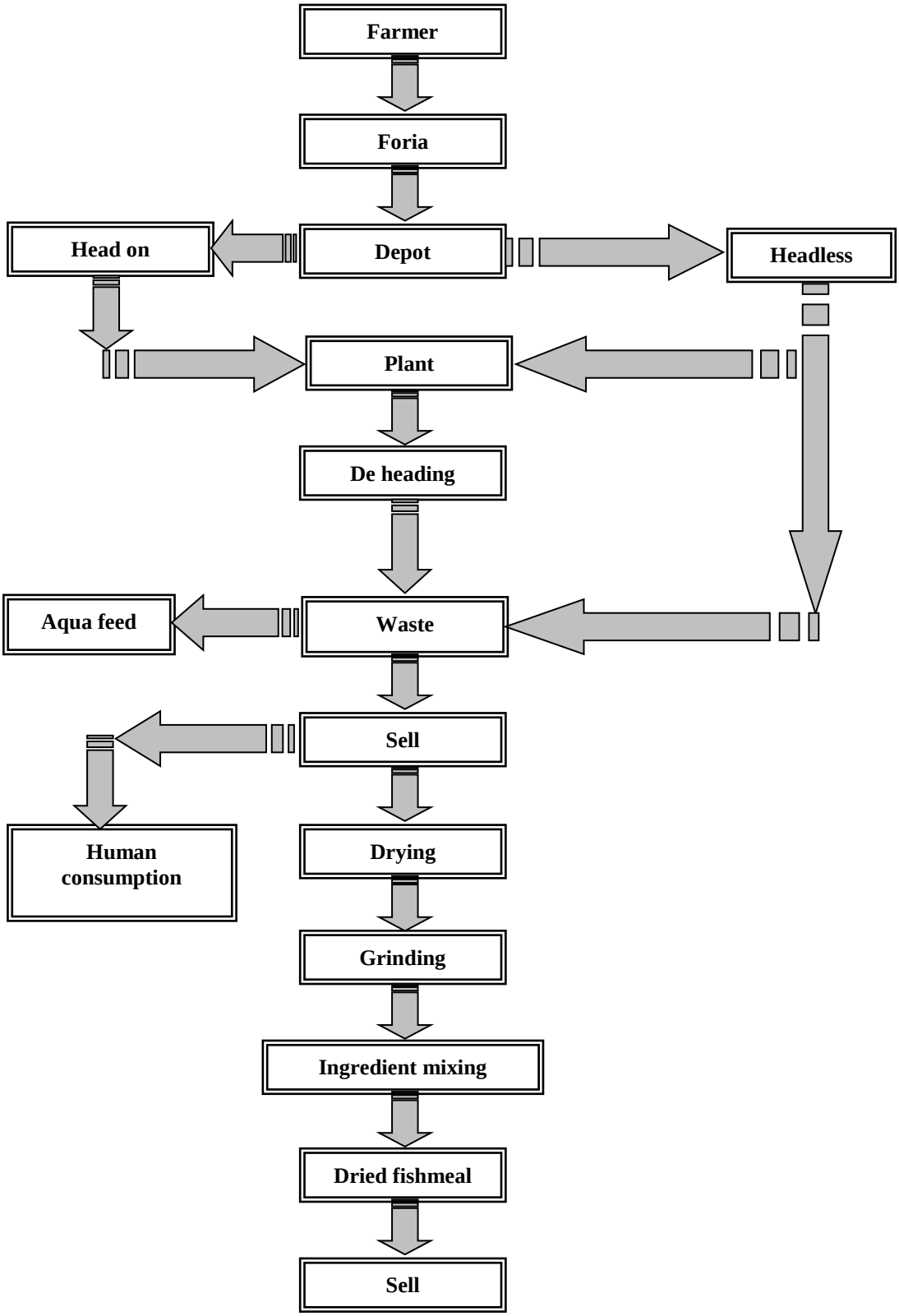

Figure 6. The overall flow chart of waste management system