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Exploration of tools and equipment used in shrimp and farming and processing

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ABSTRACT

The present study aimed at exploring the different tools or equipment used in shrimp farming and processing and to test the effectiveness of the selected tools based on the usability. An exploratory research design was adopted for the study through field observations in shrimp farms and processing units along with a market survey. The identified tools and equipment were recorded with nature of operation and specifications. The usability of the equipment or tools were rated using a five-point Likert scale. Descriptive statistics weighed mean scores and ranks were used for the study. In shrimp farming equipment, disease-treatment kits recorded the highest overall mean score (4.20), followed by water-quality testing kits (4.10), maintenance tools (4.08) and aeration devices (3.80), while in processing sorting machines ranked highest (4.58), followed by chilling (3.98), cleaning (3.63), deveining (2.67) and peeling tools (1.92). The mechanised equipment recorded higher scores when compared to manual tools. The findings emphasized the need for improvement in the manual systems in farming. Adaptable and adjustable tools help to improve the efficiency of the workers involved in processing activities.

Keywords: Shrimp farming, Aquaculture, Pre-processing, Comfort, Usefulness, Efficiency

Introduction

Shrimp production and processing contain series of steps which requires specialized tools or equipment-based on their specialised function and efficiency as per working methods. Shrimp farming involves several equipment-dependent activities, including feeding, aeration, water-quality monitoring, disease management, maintenance and harvesting, while processing requires equipment and tools for cleaning, chilling, sorting, grading, de-heading, peeling and deveining.

The use of technologies in shrimp farming depends on the nature of operation in production systems. Lekshmi *et al.* (2011) [1], in a study of 120 shrimp farmers, reported increased adoption of technologies related to health and water management, with high adoption also observed for harvesting, pond-bottom management and feed management. A semi-intensive shrimp-farming case study in Nellore, Andhra Pradesh, reported the use of six paddle-wheel aerators per hectare and two to four check trays per pond for aeration and feed management, respectively. Similarly, FAO reported on shrimp culture reported the use of feeding trays and automatic feeders, with tray size and placement varying according to pond conditions and feeding requirements.

In shrimp-processing facilities machinery and tools differ as per the nature of operations, including cleaning, de-heading, peeling, deveining, grading, chilling and packing. Although mechanised equipment is available for several operations, manual tools continue to be used widely for pre-processing activities. Standardized manual peeling methods has shown improvements in work methods that can enhance productivity in labour-intensive shrimp processing (Chamchang *et al.*, 2024) [2]. Therefore, mechanised systems offer advantages in processing efficiency, manual tools remain important in operations where workers perform repetitive peeling and deveining activities which require precision, careful handling and constant attention. Thus, exploring the equipment and tools used in shrimp farming and processing is important to identify types, sizes, availability, affordability, ease of use, adaptability and constraints, which can support the selection of suitable equipment for field and processing conditions.

The present study explored different equipment or hand tools used in shrimp farming and processing facilities operations and assessed based on ease of use, efficiency, durability and maintenance requirements. The assessment was undertaken to identify usability and their limitations requiring for future improvement. The nature of equipment used varies according to the operation, scale of production and level of mechanization.

Materials and Methods

An exploratory field survey and market survey was adopted to identify the existing equipment and tools used in shrimp farming and processing. Field observations were carried out in 10 locations i.e 3 regions each in Andhra Pradesh and Telangana comprising shrimp farms and shrimp processing facilities. The observations were recorded to explore the equipment or tools used in shrimp farming and processing based on the activi

ties performed and usability. A market survey was conducted through visits to local shops and online sources to identify the equipment or tools available. The efficiency of the tools or equipment's were evaluated using a Likert scale based on the rating given by the subjects ranging from 1 to 5, where 1 = Poor, 2 = Bad, 3 = Average, 4 = Good and 5 = Very good based on the following characteristics like ease of use, efficiency, durability and maintenance requirements of the selected equipment or tools in shrimp farming and processing. Descriptive statistics, weighed mean scores and ranks were adopted for the study

Results and Discussion

The study results were presented to find different tools or equipment that are available in the market to understand the tools or machinery that were used based on the nature of activities with features in shrimp farming and processing, based on observations and workers' feedback.

3.1. Identification of the tools/ equipment

Market survey was undertaken through visits to local markets and through online websites, equipment dealers, suppliers and other sources of fisheries and processing equipment to identify the tools/

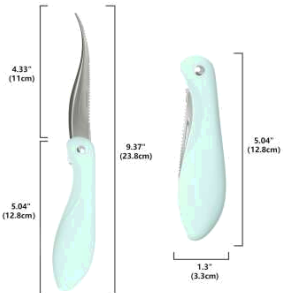
equipment available in the market shrimp farming and processing. The tools/equipment were documented with respect to type, nature of operation, material, dimensions, weight and cost and showed in Table 3.1. & 3.2.

The market survey in processing facilities aimed at exploring the tools manually operated tools at processing facilities. The most common tools used by the processing workers for manual activities like peeling, be-heading and deveining were scissors, knives and foldable blades. Cent percent of the processing facilities used scissors as the primary tool for various pre-processing activities for de-heading, peeling and deveining operations. Despite the availability of tools, it was observed that most women workers performed the operations manually using both hands, indicating that the available tools were not comfortable to operate and expressed that these tools intervene their speed and efficiency. The other activities in processing facilities were mechanised and required minimal intervention, apart from regular maintenance. Processing facilities purchase imported machinery from countries like China, Thailand and Japan to meet the production demands and standard requirements. Hence, there is a need to identify the needs of the workers for better efficiency and adaptability.

Table 3.1. Market Survey of Selected Tools/ Equipment in Shrimp Processing

S.No	Category	Product Name	Brand	Product Features	Cost	Picture
1.	Peeler	Manual Shrimp Opener and Peeler	HANDZY Handle Eazy,	Model no. HZ02, Stainless Steel	Rs. 679	
A	5 in 1 Multifunctional Shrimp Line Fish Maw Knife	xianNv	Stainless Steel and 50 Gms weight	₹2,948		
B	Shrimp Peeler, Deveiner, Stripper	ATORSE®	Stainless Steel and Wooden spade.	₹730		
C	Portable Prawn Peeler, Deveiner	I J Dz	Plastic, Size: 21 x 5, 9.5 cm	Rs. 1,290		
	Stainless Prawn Peeling	UJEAVETTE®	S.Steel, Size(Lxw) 21X6.5Cm,8.27X2.56"	₹980		
D	Shrimp Peeler	Winco SDS-3	Length (Inch) 6, Width (Inch) 11.1, Height (Inch) 0.5, Weight (Lbs) 0.300000, Stainless Steel	\$9.99		
E	Portable Shrimp Peeler Deveiner Tool	China	Plastic, Food Grade, 17 cm (Approx.)	\$1.67		

(continued on next page)

2.	Scissors	Shrimp/Prawn Deveiner, Peeler, 1 EA	Norpro 6518	16.5L x 8W Centimeters, Stainless Steel	₹1,199	
3.	Deveiner	Shrimp Deveiner	OXO Good Grips	Non Slip	₹2,887	
A		Shrimp Deveiner Tool (Prawn and Seafood Peeler with Butterfly Blade, Frogmore Shrimp Cleaner)	Toadfish	32 Fluid Ounces, Stainless Steel, Plastic, Weight 0.1 Kilograms	₹6,094	
B		Shrimp Peeler & Deveiner 8-Inches,	Maine Man	20.3L x 20.3W Centimeters, Plastic	Rs.1880	
C		Shrimp Deveining Tool	Luvan, China	5.04 x 1.3 x 0.78 inches, Weight 2.89 ounces	\$9.99	Product Dimensions  (continued on next page)

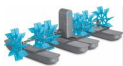
4. Folding knife Portable Kitchen Cutting Tool Local made zirconium oxide and stainless steel Rs 249.00



Table 3.2. Market Survey of Selected Tools/ Equipment in Shrimp Farming

S.No	Category	Product Name	Brand	Product Features	Cost	Picture
1	Feeding Systems	Plastic Solar Auto Feeder for Shrimp Pond	Thai-Taiwanese-Suzhou Thai sun Biotechnology company, PLC	Plastic and metal, with 5–7 days battery life, 8–15 m distribution range	₹51,000 – ₹65,000	
B	360 Degree Auto Feeder for Shrimp Pond	MONA	ABS plastic, weighing 80 kg, solar powered	₹86,366.50 30-49 sets		
C	Automatic shrimp feeder	Nanrong	100 kg capacity, 35 kg/hr, HDPE/304 stainless-steel, 220V, 15–20 m jetting distance.	₹ 50,000		
2	Water Quality Testing Kits	API Pond Master Test Kit	API	Test kit (pH, ammonia, nitrate and other water-quality)	₹5,216	
3	Harvesting Nets	Fishing Net	medtstore	15mm300ft Nylon fishing net height 2.5ft	₹718	
B	Check nets	Local	75X75 cms	Rs. 550		
		Feed nets	Local brand	1X 1mt	Rs. 450	
4	Aeration Devices	1 HP Paddle Wheel Aerator	Sagar Aquaculture	120V, frame Weight, 6.5Kg, frequency, 50Hz, Impeller Weight- 2.4Kg, 0.75kW, 80 kgs	₹28,000	
A	2 HP Paddle Wheel Aerator with Four Wheel	Nandini Gears(TM)	5.25FeetX3.25FeetX3Feet, 220V±10V ~ 415V±10V, air flow rate 3 (m³/h), 3 mm	₹ 33,000		
B	2 HP Paddle Wheel Aerator	Sagar Aquaculture	HDPE 3 floats, Plastic, 1440 rpm, Motor Power (HP)2	₹35,000		

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C	3 HP Six-Paddle Aerator	Sagar Aquaculture Model/Type-STD-B36	3.7 kg O ₂ /hour, with a 7 kg float weight, 15 kg frame weight, 2.4 kg impeller, HDPE paddle wheels, 106 RPM speed, 30 m flow	₹43,000		
D	2 HP Four-Paddle Aerator	Bindhu Industries	PVC & Steel, Plastic ABS	25,500 INR/ Unit		
5.	Maintenance Tools	Sludge transfer Pump	CRI / Kirloskar	2 HP, Flow Rate 3000 LPH, Cast Iron, 2000 LPH, 1200 RPM, Solid Size 25 mm	₹20,000	
	Pond Vacuum Cleaner (Sludge removal unit)	Hailea PC8000	8,000 L/h suction capacity.	₹22,280.00		

The market survey revealed that shrimp farmers purchased aerators ranging from ₹25,000 to ₹30,000 per set, with the price varying according to the capacity and specifications of the aerator. Most farmers used 2–3 HP aerators, while the number of aerators installed varied from approximately 2 to 10 sets or more depending on the size of the pond and aeration requirement. Locally available brands such as Nandhini and Royal were preferred by majority of the farmers, particularly because of the availability of obtaining spare parts and servicing facilities. Small and marginal farmers who were unable to make the initial investment commonly obtained aerators on a lease basis, with the leasing cost generally ranging from ₹2,000 to ₹3,000, depending on the type and capacity of the aerator or purchase second hands. Farmers operating larger pond holdings purchased aerators in bulk and maintained additional units or spare components for future use, enabling replacement according to pond level aeration requirements. Check nets were usually prepared by the farmers themselves using materials purchased from local markets, providing a low-cost and easily adaptable option for monitoring feed consumption and shrimp activity in the ponds. Feeding systems, aerators and sludge-removal equipment or motors pumps were available in different design specifications and power capacities. Smallholder farmers

preferred to buy local brands of aerators, pumps and mechanical small parts for easy availability, at affordable prices and through other farmers reviews.

The market survey indicated that low-cost manual tools had greater practical adaptability, while higher-priced automated farming equipment required greater investment and technical support, which influence its adoption among farmers.

3.2. Effectiveness on the usability of tools/ equipment used in shrimp farming and processing facilities

The effectiveness of the selected tools or equipment used in shrimp farming and processing facilities was assessed. The assessment was conducted established on the user's ratings with the following criteria such as ease of use, efficiency, durability and maintenance requirements to understand the improvements and gaps.

3.2.1. Mean scores and criterion-wise ranking of shrimp farming equipment

The scores provided by the subjects were analysed using weighed mean scores and ranking system to assess the performance and serviceability and shown in table 3.

Table 3. Distribution of Mean scores of shrimp farming equipment

S.No.	Equipment	Ease of use	Rank	Efficiency	Rank	Durability	Rank	Maintenance	Rank	Total mean	Overall rank
1	Feeding systems	4.20	5	4.00	4	3.40	4	3.50	3	3.78	5
2	Water quality testing kits	5.00	1	4.10	3	4.00	1	4.10	1	4.30	1
3	Harvesting nets	4.10	6	4.70	1	3.30	5	2.00	6	3.53	6
4	Aeration devices	5.00	1	4.40	2	4.00	1	2.80	5	4.05	3
5	Disease treatment equipment	4.40	4	4.40	2	4.00	1	4.00	2	4.20	2
6	Maintenance tools	4.60	3	4.00	4	3.30	5	3.40	4	3.83	4

Note: Mean scores were calculated using five-point rating scale where rank 1 represented highest mean score within each criterion

The results revealed that water quality testing kits and aeration devices received the highest rating for ease of use (mean 5.0), which

may be due to easy operation and availability by the farmers. Ulhaq *et al.* (2022) [3] reported that perceived ease of use influenced the adop

tion of information and Communication technologies (ICT) among intensive shrimp farmers. Harvesting nets recorded the highest efficiency score (4.7) because of the skill acquired, the usage and repairs were taken care by the workers. In feeding systems and maintenance tools had comparatively lower efficiency scores (4.0), which related to the size of the farm and manual effort while performing the activities. The importance of farm inputs and labour in shrimp-farm efficiency was also reported by [Thriveni et al. \(2022\)](#) [4].

For durability, water quality testing kits, aeration devices and disease treatment equipment received the highest score (4.0), whereas harvesting nets and maintenance tools recorded lower scores (3.3). The lower durability rating of harvesting nets may be associated with repeated pulling, stretching and exposure to water and pond edges dur-

ing harvesting. Frequent use and exposure to moisture may contribute to wear and tear of maintenance tools. For maintenance requirements, water quality testing kits received the highest score (4.1), while harvesting nets recorded the lowest score (2.0) due to its maintenance before or after use. Aeration devices received a lower score (2.8), because of their mechanical components require regular cleaning, inspection and servicing. [Jayanthi et al. \(2021\)](#) [5] highlighted the importance of appropriate aerator selection and operating conditions in shrimp farming.

3.2. Mean scores and criterion-wise ranking of shrimp processing equipment or tools

The mean scores revealed differences in worker's perceptions across the processing equipment evaluated and shown in [table 4.2](#).

Table 4. Mean scores and criterion-wise ranking of shrimp farming equipment

S.No.	Equipment / Machinery	Ease of Use	Rank	Efficiency	Rank	Durability	Rank	Maintenance Requirements	Rank	Total Mean Score	Overall Rank
	Sorting & Grading Machines	4.9	1	4.7	1	4.9	1	4.8	1	4.83	1
2.	Cleaning Equipment	4.0	2	4.2	2	4.6	2	3.8	2	4.15	2
3.	Chilling Units	4.0	2	4.2	2	4.1	3	3.6	3	3.98	3
4.	Deveining Tools	2.2	4	1.9	4	3.9	4	2.7	5	2.68	4
5.	De-heading Tools	2.3	3	2.0	3	3.0	5	2.8	4	2.53	5
6.	Shelling and Peeling Tools	1.7	5	1.7	5	2.0	6	2.3	6	1.93	6

Note: Mean scores were calculated using five-point rating scale where rank 1 represented highest mean score within each criterion

The findings showed that sorting/grading machines recorded the highest total mean score (4.83), with consistently high ratings for ease of use (4.90), efficiency (4.70), durability (4.90) and maintenance (4.80). This may be due to the standardized operation and reduced need for continuous manual handling. [Zhao et al. \(2015\)](#) [6] reported that mechanization of shrimp-processing operations could improve processing efficiency and reduce dependence on manual operations. Cleaning equipment (4.15) and chilling units (3.98) received moderate to high overall scores, indicating comparatively better usability and performance. The higher ratings were associated with standardized functions, while the relatively lower maintenance scores may reflect the need for regular cleaning, sanitation and servicing. [SEAFDEC \(2014\)](#) [7] emphasized that seafood-processing equipment should be designed for effective cleaning, sanitation and maintenance. Further, deveining tools (2.68) and de-heading tools (2.53) received lower overall scores for ease of use and efficiency. This was related to due to manual effort required during these operations. Shelling and peeling tools recorded the lowest overall score (1.93), mainly because of very low ratings for ease of use (1.70) and efficiency (1.70). The repetitive nature of peeling and the need for continuous hand manipulation may have contributed to these lower ratings. [Chamchang et al. \(2024\)](#) [2] reported that adopting a standardized shrimp-peeling method improved productivity, while [Zhao et al. \(2015\)](#) [6] highlighted mechanization as an important approach for improving shrimp-peeling efficiency.

Conclusion

The study revealed that significant variation was observed in the performance of equipment or tools used in shrimp farming and processing. In farming, water quality testing kits recorded the highest overall

mean score (4.30), whereas harvesting nets recorded the lowest (3.53); in processing, sorting/grading machines ranked first (4.83), while shelling and peeling tools recorded the lowest score (1.93). Mechanized equipment received higher scores, while manually operated processing tools showed greater constraints in ease of use and efficiency. The findings highlighted the need to develop suitable ergonomic assessment and interventions to improve work efficiency and reduce physical strain on workers.

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