Shrimp (*Macrobrachium rosenbergii*) Farming in the District of Gopalganj, Bihar

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Abstract

Shrimp (*Macrobrachium rosenbergii*) farming has great potential production and income in Gopalganj (Bihar), but production has significantly declined in recent years due to civil conflicts, some unsustainable practices and devastating outbreaks of disease. The farming of shrimp in fresh water is gaining momentum of Bihar. A survey on many shrimp farms (12 operational and 6 non operational) was conducted within the Gopalganj District over 42 weeks comprising a series of three-day field visits from August 2018 to October 2019, covering two consecutive shrimp crops. Fundamental deficits in disease control, management, and biosecurity practices were found. Farmers had knowledge of biosecurity but the lack of financial resources was a major impediment to improved disease control. Smallholder farmers were disproportionately constrained in their ability to enact basic biosecurity practices due to their economic status. Basic breaches in biosecurity will keep disease as the rate limiting step in this industry. Plans to support this industry must recognize the socioeconomic reality of rural Gopalganj aquaculture.

Introduction

Farmed shrimp export accounts for approximately 40% of the total export earnings practice. The shrimp production expanded in the Gopalganj district.

The dual problems of WSD and YHD caused an approximate 12% drop in exported shrimp product. Illegal use of state lands, mangrove habitat destruction and poor farm construction lead to a variety of environmental and socioeconomic effects that further impacted the growth and sustainability of shrimp farming in Gopalganj. The industry has still not recovered from these impacts and thus its promises as a means for rural economic development have been left unfulfilled.

Prevention and control of disease in farmed shrimp is a priority for the growth and sustainability of this industry for two main reasons: First, to maintain consumer confidence. There is increasing public concern about the use of antimicrobial drugs and chemicals in shrimp farms. Some have suggested insufficient ronderstanding of appropriate antimicrobial use coupled with an inadequate legislative framework has lead to misuse of antimicrobials in many shrimp farming countries. This perception may threaten industry sustainability due to its impacts on consumer confidence. Reducing the need for antimicrobials through reduced rates and impacts of disease is a key to removing this threat.

Our objective was to investigate shrimp farming practices in the Gopalganj district that may affect disease prevention and control in order to identify targets for extension services that could support the sustainability .

Methodology

A list of licensed operating and non-operational shrimp farms was obtained from the National Aquaculture Development Authority (NAQDA). We undertook a complete survey of 12 farms within the Gopalganj district over 42 weeks, including all of the operating farms and 18 abandoned or nonoperating farms. A series of three day field visits were conducted from August 2018 to October 2019 covering two consecutive shrimp crops. Five hundred and sixteen people, of them 383 owners, 46 managers, 83 supervisors, and 11 other people, were interviewed using a standard questionnaire. Questions focused on general management practices, health management and control points for biosecurity. Areas covered included farm infrastructure; water sources and pond management; movements of people, animals, and feed; use and access to health services; use and access to vaccines, medications, or other compounds used to prevent or treat disease; sources of stock; and production costs. Participation of farmers and staff was voluntary. The interviews were supplemented with on-farm veterinary visits aimed at collecting observation of the farming sites and operations as well as the surrounding environment.

Fig: *Macrobrachium rosenbergii* **(Scampi)**

Fig: Fresh Water Prawn

Results

The number of farms (operating and nonoperating) reported in Gopalganj. To the study of the different ponds**:**

> **(1) Deorha Pond, Maiirwa Pond Kuchai Coat Block**

> **(2) Shiv Mandir Pond Shanichani Bzar Kucghai Coat Block**

> **(3) Thawe Temple side of pond.**

> **(4) Marwari Pond Hathua.**

> **(5) Aurai Pond Kuchai Coat Block.**

> **(6) Hathua Raj pond Hathua.**

> **(7) Ghosh & Sinha Pond Gopalganj.**

Some of this difference was explained by the practice of subdividing farms. Most of the abandoned farms were permanently abandoned and converted to salt production, with only a few being used intermittently for farming.

The designation of these subzones did not consistently reflect biological considerations, such as shared water sources. Sometimes, physical structures, such as roads, separated zones. Fifty-four percent of farms of the Gopalganj district were less than 1 hectare and 12% of farms were less than 2ha. The functioning large scale farms of >5ha represented 9% of surveyed farms with the remaining 18% being between 2 and 5ha. Most of the family members of these regions were involved in shrimp farming and used it as their major source of income. Many of these farmers rented their ponds and relied on loans or pawning personal possessions to purchase PL and feed. These farmers could not afford hired labor. Electricity was less expensive than diesel or kerosene but had an initial investment for infrastructure that could make it an unaffordable alternative, especially to small scale family farms. Many farms of medium to large scale which did not have electricity had closed due to the high fuel cost. Economic pressures lead to increasing numbers of farmers harvesting at 3–3.5 months for the domestic market. The usual production target was 30g shrimp within 4 month of pond culture. However, when the market price was favorable, many farms did a partial harvest after the 3rd month when an average shrimp weight was 20g. In recent years, the lower export price and reasonable local market price caused many farmers to sell their harvest to the local market. During the time of our survey, 197 farms (33%) shifted to this shorter production cycle. Forty percent (n = 21) of the 53 large farms and 19 of the 222 medium-sized farms (9.6%) had reduced the scale of production.

Farmer complained about poor shrimp growth rates in recent years and attributed this to poor PL or feed quality, although there has been no investigation of its cause. They also reported increase variation in body size and weight of shrimp at harvest. The poor weight gains resulted in lengthening the crop period, increasing costs and further lowering the profit margin. Some farmers were shifting to lower stocking densities to reduce feed costs and labor costs associated with the needs for water changes and aeration.

Fresh water input to the three lagoons increased during the rainy season of November to December and caused local flooding. Many roads in the area disappeared or became damaged due to the rising water level creating difficulties in transporting crops, feed, and personnel. Flooding altered water quality, in particular it changed salinity, alkalinity and turbidity. Large scale farms consumed large quantity of water during the dry period reducing the amount of water available to smaller family farms and the local community. During the late dry period from August to September, the salinity levels exceeded 50ppt in brackish water around the Gopalganj district. This is substantially higher than salinity for optimal shrimp growth, which varies by species but is typically <30ppt and for P. monodon can be closer to freshwater-brackish water values [11]. Many farmers had constructed tube wells as freshwater sources for use in this period. Stocking times were adjusted to address delayed harvests, lack of PL and diseases.

Ninety percent of farms (n = 122) practiced open system culture with direct pumping of water to the ponds. The majority (n = 154, 78%) obtained water out of canals that connected to the water source with the remainder (22%) pumping water directly from

the water source. The construction and connections of the canals was complex in community farm regions where family farms were subdivisions of larger farms. The remainder, consisting of medium and large scale farms, used a semi closed system of water management. Semi-closed systems had separate water intakes and outlets and had a stock tank into which water could be pumped and treated before entering ponds. Only 9.6% (58) of farms used stock tanks, which are spare tanks used to hold water in reserve for later use. Stock tanks served as water sources to replace evaporated water from the pond and for water changes. Even though 23% of farms had abandoned ponds, most farmers did not maintain stock tanks due to added costs of diesel to operate the pumps. Semi-closed operations could temporarily close the system by stopping water change. They maintained water levels by additions from the stock tank. This method was used during disease outbreaks, however, the high biomass of high-density farms and increasing biomass due to the growth rapidly degraded water quality.

Farmers using stock tanks could treat the water before using it in their ponds in semi closed systems but 78% of farms did not use any chemical disinfection, largely due to economic constraints. Eighty-four farms (14%) used chlorine as disinfectant solution 49 (8%) farms used pesticides and 12 (2%) used both. Treatments were applied after the ponds were filled and kept empty of PL for 7days for chlorine and 15 days for pesticides. The principle pesticide found was (RS)-œ-cyano-3-phenoxybenzyl(1RS,3RS;1RS,3RS)-3-2,2dichlorovinyl)-2,2-dimethylcyclopropane carboxylate 25%. Application rates varied with brand name.

Only 90 farms (14.9%) used nets for filtering incoming water. The small-scale farms that filtered water, largely restricted filtration to the beginning of the culture period. Few farms (n = 52, 9%) used filter nets throughout the culture period. Growth of small crustaceans and fish were observed in farms not practicing adequate water filtration. Twenty-five percent (n = 148) of farmers used tea seeds to destroy fish in ponds after 2.5 months. Neither open nor semi-closed systems treated effluent water before release. Medium-to large-scale farms tended to have better separated inlets for influent water and long outlet canals that allowed sedimentation of outflow water. Although some farmers tried to maintain separate water inlets and outlets, they ultimately mixed in the water source. Irregular and sometime unapproved constructions of ponds and water canals caused difficulties in separating incoming and outgoing water, especially in family and small-scale farms. The density of farms in regions with predominately small scale farms was 1.3–1.6farms/ha.

Pond water pH, alkalinity, and salinity were checked once a week by the consultants from feed and chemical supply companies. Only 7 small-scale farmers reported that this service was not available to them. Consulting service providers measured dissolved oxygen, turbidity, pH, and salinity routinely on 596 farms, but ammonia was only checked when there were signs of problems in the shrimp. Ammonia problems were typically not encountered until the 3rd month of production. Oxytetracycline was used on 15% (92/603) of the functioning farms. Farmers added commercially prepared probiotics to ponds to combat what they call "white fecal syndrome" which they attribute to environmental bacteria in the ponds.

Water changes typically started after 30–45 days of PL stocking n 81% off arms while 9% of farms started to change water before day 30. Farmers typically changed 15–45cm of water for ponds that were 100–140cm deep. Occasionally, farmers changed 1/3 to 2/3 of the water in a pond. The amount of the water changed and frequency of changes increased through the production cycle, water changes were done once or twice a week at the start but increased to every day or every other day near the end of production. Amounts and frequencies of water changes were altered to address water quality issues. Sometimes, water changes could not be done in areas where family farms were densely packed, when there was a harvest, or when water change took place in the adjacent farm. Paddle wheels were the main method of aeration on farms using aeration. Farmers usually used 4 paddle wheels per 0.4ha of pond-for 4–18 hours. Aeration increased with the increasing age of the shrimp, on cloudy and less windy days and at night.

Ponds were built with mud banks and mud floor. The stocking seasonality was planned by NAQDA to achieve a minimum of 2 month period between two consecutive crops to allow the ponds to dry. Pond bottoms were dried until cracks appeared in the sediment layer. This kind of drying could not be attained during the rainy season from October to January. The seasonal crop calendar was prepared by getting comments from a technical committee comprised of experienced farmers representing farmer societies of different farming zones and NAQDA extension officers. Each subzone was assigned a period of time for stocking shrimp. There were two seasons of shrimp culture. This period varied with weather, delays in harvests, and disease outbreaks.

Of the 12 functioning farms, 13 completely removed organic wastes from the ponds. The rest used the organic waste from pond bottoms to repair their pond banks. They did not remove the cracked layer properly during pond preparation. Farmers removed the wastes using machinery or manual labors. Harrowing of the pond bottom was seen in some farms especially those with sand bottoms. Lime and/ordolomitewasusedon481farms(80%),44(7%)used dolomite only, 7 (1%) used lime only, and the remainder (12%) used neither. Although the main objective of these chemical applications was to correct the pond bottom pH, only 21% (n = 129) of farmers checked soil pH or calculated the amount of lime and dolomite to be applied. The amount applied depended on the farmers' experience and economic factors. None of the farms had vehicle tire baths at the entrance. Shrimp farmers often also reared or owned cattle, goats, birds, and some companion animals. The little cormorant is a troublesome predator on Sri Lankan shrimp farms but only 25% of farms (n = 147) had proper bird nets. Small scale family farms generally lacked bird netting over ponds. The additional cost of installing the nets was cited as a disincentive for their use. We saw many attempts to place one or two plastic strips across ponds to discourage birds, but these were often too far apart or too few to be effective deterrents.

All farms used commercially prepared feeds imported from Thailand. Feed or feed supplements were not screened for pathogens by the farmer or any regulating body before delivery to the farms. Feeding frequency varied from three times/day at the beginning of production to five times/day a day at the end. The amount of feed provided increased with the age of shrimp but was usually measured by observing the consumption of feed in the

feed tray within two hours after feeding. A variety of proprietary vitamin, mineral, and probiotic mixes were added to the feed in the second month of production.

Acknowledgments

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