Jahangirnagar University Journal of Marketing (JUJM) ISSN: 2308-6238
Vol 7, June 2019

Shrimp Value Chain in Bangladesh

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Abstract:

It is often perceived that a value chain approach in most instances is an inclusive model of market development, ensuring a win-win situation for all the value chain actors particularly for those at the bottom of the pyramid. This article is based on a qualitative research predominantly grounded in primary data. It attempts to portray both the actor-based and action-based perspectives of shrimp value chain in Bangladesh. In order to offer a complete picture of the context, value addition is also traced along the marine shrimp value chain perspective. This article also examines the major vulnerabilities and possible scopes of value addition along the shrimp value chain in Bangladesh.

Keywords: shrimp value chain, Bangladesh, freshwater shrimp, marine shrimp

1. Introduction

Shrimp farming in Bangladesh has been expanding rapidly following huge demand in the international market. However, this fast development is accompanied by a lack of adequate planning and regulation at the national policy level which is gathering considerable debate due to its negative environmental and socio-economic consequences. Nonetheless, shrimp of Bangladesh is a popular item in the global market and the country exports shrimp to more than 50 countries now (GoB 2017). The country produces over 36 shrimp species and in 2016-2017 shrimp production contributed to 5.97% of the total fish production (Gob 2017, ICAPMS, 2004). Although shrimp farming is expanding in the country complying with the good aquaculture practices (GAP), most of the farmers are not producing shrimp following a semi-intensive method of shrimp production because it requires some investment for input materials for production which they struggle to manage. This low production is related to the persisting lack of technological know-how in the areas of production and diseases.

The coastal area of Bangladesh is the second largest delta of the world, implicating potentials for marine shrimp production with geographical competitive advantage (Datta, Gupta & Subramanian 1999). However, Afroz and Alam (2013) argue that unplanned and unregulated coastal shrimp farming has become a destructive form of resource use over the last few decades in Bangladesh. They suggest that long-term benefits from shrimp farming can only be achieved through ensuring adequate planning, based on the concept of Integrated Coastal Zone Management.

Value chain implicates a sequence of activities required to offer any product to the target customer including final disposal of that (Kaplinsky & Morris 2000). This concept might aid analysis and policy formation if three issues are addressed: it includes activities

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carried out by different actors, activities add values to varying extents, and some actors have power over others (Schmitz 2005). Shrimp value chain implicates the different activities carried out throughout the processes starting from hatching by the mother shrimps to consumption of shrimp or processed shrimp or using shrimp disposal (the shrimp shells) to make fish or poultry feed (Gammage, Swanberg, Khondkar, Hassan, Zobair, & Muzareba 2006a). The intermediary processes include a range of activities which, based on respective objectives, can be classified into two types - production related processes and marketing related processes (Gammage, Swanberg, Khondkar, Hassan, Zobair, & Muzareba 2006b). Value chain might also incorporate different institutional arrangements spread among producers, processors, marketers, distributors, and consumers (Gammage *et.al*. 2006b). However, the value addition scenario is intricate which can be comprehended by analyzing addition of values by each process, and it is spread along socioeconomic, commercial, political, and climatic dimensions (Béné 2005, Belton 2016, Hossain, Uddin, & Fakhruddin 2013, Islam 2003, Paul & Vogl 2011, Stonich & Bailey 2000, Swapan & Gavin 2011). Despite researches on overall shrimp value chain in Bangladesh (Afroz & Alam 2013, Gammage *et.al*. 2006a, Gammage *et.al*. 2006b), there exists dearth of research that focuses particularly on value additions with respect to actor-based and action-based perspectives developed on ground realities. This research is an attempt to address this gap by means of empirical qualitative evidences intricately embedded in sociocultural realities.

2. Objectives and Methodology

The objective of this article is to identify and present a holistic perspective of the shrimp value chain incorporating both the different actors of value chain and the different activities or actions performed throughout the chain. It also aims at identifying and discussing vulnerabilities and proposing possibilities scopes of further value addition in the value chain. Epistemologically, the authors' position is subjective because they believe that actors' lived realities need to be studied to understand the holistic perspective of shrimp value chain regarding actors and their respective actions. This philosophical worldview leads to pursue a qualitative approach.

In order to meet the objectives, we adopted a qualitative research framework and used in-depth interview, focus group discussion (FGD), and observation to collect qualitative data. This research focuses mostly on primary data though secondary data were used to inform designing of this research and to make sense of the empirical findings. Secondary data were also useful in data verification as part of triangulation approach. The coastal belt of Bangladesh and noncoastal area were selected for data collection so that both saline water and freshwater shrimp value chain can be explored. Satkhira, Bagerhat, Khulna, Chittagong and Cox's Bazaar were selected to cover the value chain for saline water shrimp while Noakhali and some areas in Satkhira and Bagerhat were selected to cover the value chain for freshwater shrimp. Snowball sampling approach was used to identify the respondents. A total of 132 respondents were interviewed and 18 FGD were conducted with an average number of five participants for each session. Authors used audio recorders and notetaking tools during interview and FGD sessions and played the roles of facilitators for the latter. Audio recorded data were transcribed, and preliminary

analysis was performed. Observation as a data-collecting tool was particularly helpful to grasp the details, some of what often were technical and subtle and thus were not easy to comprehend through interview and FGD sessions. Observation was particularly significant for this study due to the conventional content analysis (Hsieh & Shannon 2005) which was pursued for qualitative data analysis. Authors translated the transcript into English to derive codes from data for analysis purposes. Results of the analysis are presented in the forms of diagrams with respective explanations, and thematic discussions.

3. Ground Level Configuration of Shrimp Value Chain

Shrimp Value Chain in Bangladesh can be perceived in terms of who takes part in the value addition process and what activities have been performed throughout the chain. These binary focuses on actor and action create avenues for dual perspective of the shrimp value chain in Bangladesh.

3.1. The Actor based Perspective

Empirical data implicate that the realities around shrimp value chain differ considerably, particularly along the way shrimp is produced, based on whether they are produced in the sea or inland arrangements. The value chain actors include sea-fisherman, fry[3] catcher, hatchery owner, hatchery employee, nursery owner, nursery employee, fry *faria*, fry *aratdar*, fry commission agent, farmer, shrimp *faria*, shrimp *aratdar*, shrimp commission agent, shrimp processor, processor-cum-exporter, retailer, domestic buyer, and foreign buyer. The following Figure 1 shows how these different actors, most of whom are male, are interlinked and indicates the major transportation cost variations.

[3] Several post-larvae (PL) phases of shrimp are termed as fry in a generic sense.

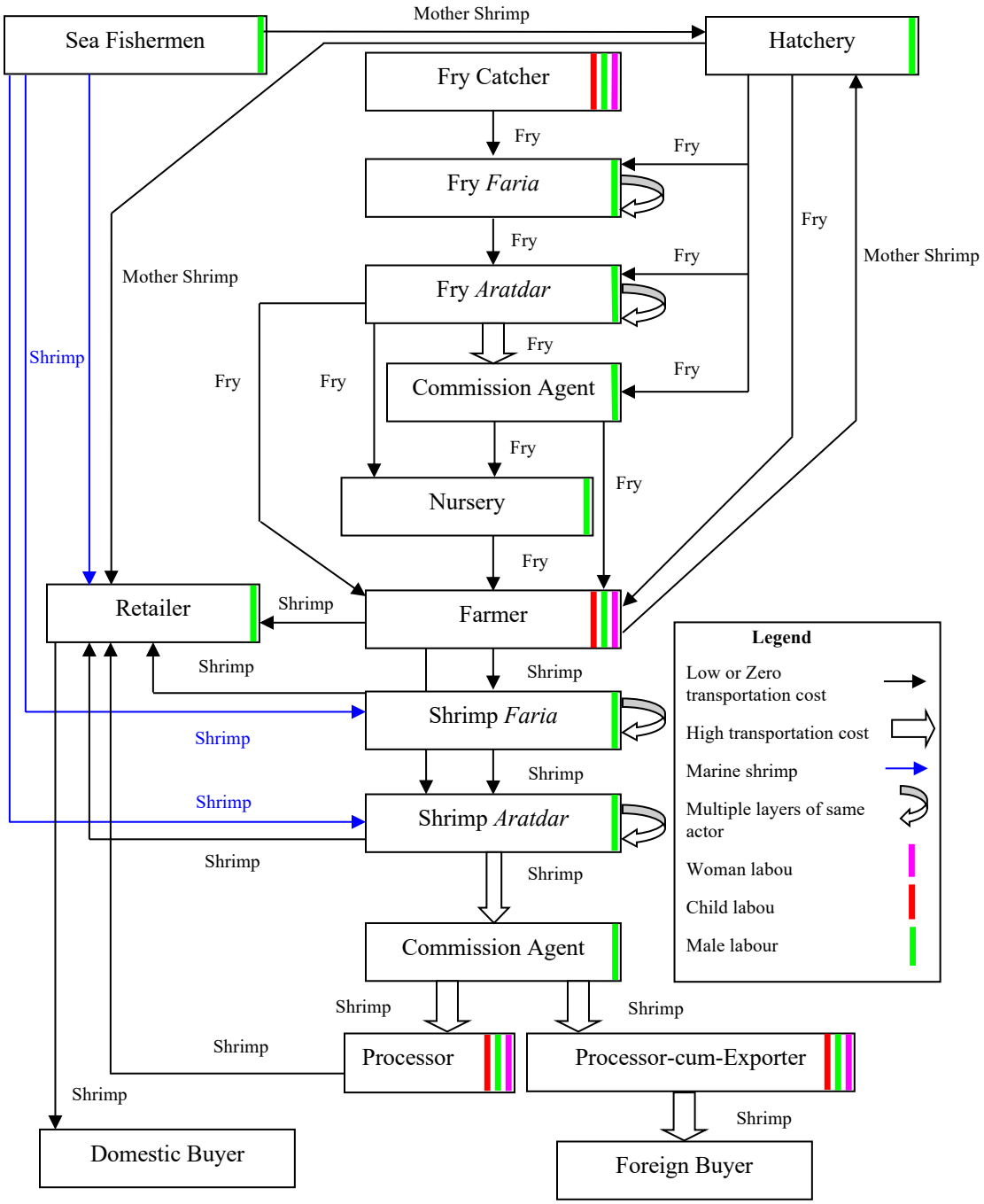

Figure 1: Actor Based Shrimp Value Chain in Bangladesh

Source: Gammage, Swanberg, Khondkar, Hassan, Zobair & Muzareba (2006)

3.1.1. Sea Fishermen

Sea fishermen catch shrimp in the Bay of Bengal and then sell those to retailers, shrimp *faria,* and shrimp *aratdar.* They also sell mother shrimps to hatcheries for breeding and production of shrimp fry. No female or child labour is involved in sea fishing.

3.1.2. Fry Catcher

Fry catchers catch shrimp fry from shores, mostly in Cox's Bazar, Chittagong, and Khulna, and then sell those either to fry *faria* or to fry *aratdar*. They are the most economically deprived participant in the value chain. They do not have any cooperative arrangement among themselves. Most of them reside along the shore while some of them are migrated from other regions. Generally, during peak season women and children participate in fry catching in greater extent and they remain as the predominant labour throughout the year (Ellison 2005). However, women and girls remain busy mostly with fry sorting. Fry catching timing depends on lunar cycle and more fry is available during the full moon day and the new moon day.

3.1.3. Fry Faria

Fry *faria* are small scale traders or middlemen who buy shrimp fry round the year either from fry catcher or from hatchery and sell shrimp fry to fry *aratdars*. However, sometimes one fry *faria* sells fry to another fry *faria*. Most of the fry *faria* prefer to buy the comparatively dearer wild fry as they perceive those as stronger than the fry from hatchery even though those are cheaper. April to September is the peak season for buying shrimp fry and during this period they do business every day and usually twice a day. December to February is off season when, due to resulting financial distress, they take loan from fry *aratdars* and trap themselves into a contract to sell all fry to the lender to evade verbal or physical abuse.

3.1.4. Fry Aratdar

Fry *aratdars* are comparatively large-scale traders or middlemen who deal with shrimp fry that come from either hatchery or natural sources. The fry *aratdars* may buy shrimp fry from fry catcher directly or from another fry *aratdar*. They trade fry in metal bowl or plastic drum but generally do not feed those fry before selling to the commission agents. They keep those fry for a maximum of three days. Some fry *aratdars* also play the roles of farmer who have or can manage land for shrimp production. In most of the cases, shrimp fry are transported from fry *aratdar* to the commission agent by air or road.

3.1.5. Fry Commission Agent

Fry commission agents who are sometimes called *bepari* are medium to large-scale entrepreneurs and live away from where fry *aratdars* live. They hold fry for a short period of time, filter the fry containers to remove the shell residuals and other impurities, sort by fry size, and then sell those to farmers. Usually they do not feed the fry. They also sell fry produced at hatcheries, but they sell wild fry at higher price due to their higher survival rate and popularity. Many fry commission agents these days sell shrimp fry to nearby nurseries from where farmers buy the nourished fry.

3.1.6. Nursery

Nursery is a predominantly male operated place where the fry that has traveled a long way get energised and adapted to the geochemical configuration of the production environment. Technical expertise and some controlling devices are required for the operation of nursery which remains operative usually during the season for shrimp production. Fry arrive at nursery in packed at 12º centigrade. In nursery, fry is kept with controlled care and are nourished through regular three hours interval feeding schedule. Fry is gradually adapted to the temperature and pH[4] level of the water of nearby water body where those will grow. Initially, fry is kept at the packet temperature and then the water temperature is gradually increased to the temperature of the local water body where it will grow. While pH level is adjusted using lime, salinity of the water is also gradually changed if required. An uninterrupted supply of oxygen is maintained, and generator is used to ensure smooth operation with uninterrupted power supply.

A maximum of three days stay of the fry at nursery adds superior value to the shrimp value chain. Nursery services enhance survival rate of fry to about 100%, which also increases price of the fry. This service is a new addition to the shrimp value chain; and it might help overcome the low survival rate of hatchery-produced fry. Introducing nursery may help increasing the total production of shrimp and at the same time can provide employment opportunity. However, institutional provisions for developing the required technical expertise and capital investment opportunities should preexist. Fisheries Department of Government of Bangladesh (GoB) may be of considerable assistance through providing training to meet the required technical expertise.

3.1.7. Hatchery

Hatchery is a place where shrimp fry is produced from mother shrimp with utmost care and using technological supports. The hatchery gets mother shrimp mostly from farmers and/or sea fishermen. Hatcheries that produce *Bagda*[5] fry need to have a well-built system to bring in seawater inside the hatchery and to send it back for disposal. For breeding, mother shrimp is kept in a dark quarantine room at a controlled temperature. Maintenance of cleanliness and calmness are emphasised and are most crucial factors behind successful breeding. Main breeding room has a special sort of sanctity and only the key caretaker can enter that room to perform essential work.

In 2000, there were 44 *Bagda* and 28 *Galda*[6] hatcheries (BFFEA, 2004), and the number of shrimp hatcheries increased to 55 hatcheries for *Bagda* and 70 for *Galda* in 2007 (Gammage *et.al.* 2006b). However, in 10 years these numbers unexpectedly dropped to 49 hatcheries for *Bagda* and 36 for *Galda* in 2017 (BFFEA, 2017). Most of the *Bagda* hatcheries are in Cox's Bazar region and the fry are transported by air or road to the southeast regions. Close to the hatcheries, another shrimp-related supply business has newly been developed, dealing fish feed and other accessories. These sales outlets import

[4] It is a measurement of hydrogen ion concentration, which defines whether a solution/liquid is acidic or alkaline.
[5] Saltwater shrimp variety
[6] Sweetwater shrimp variety

and sell all the products necessary to establish and run hatcheries including shrimp feed. Nonetheless, the decreasing trend in number of hatcheries implicates narrower peripheral business opportunities. However, hatchery owners are praiseworthy entrepreneurs as they take the challenging and important initiative to shrimp fry production and directly contribute to country's shrimp production.

3.1.8. Farmer

Farmers grow shrimp by nourishing fry to marketable sizes in *gher*[7]. The sources of fry for farmers include nursery, hatchery, fry *aratdar*, and fry commission agent. *Bagda* shrimp is farmed mostly in Khulna, Bagerhat, Satkhira districts but *Galda* is farmed in most of the districts, as it requires sweet water. Therefore, hatcheries are operative in almost every district. Households in Khulna, Bagerhat, and Satkhira possessing even a small piece of bare land get involved in shrimp farming. Farmers produce *Galda* and different varieties of *Bagda* including Black Tiger, White *Harina*, and Brown *Harina*. Sometimes shrimp *faria* and shrimp *aratdar* influence which variety farmers would grow exploiting the lender-borrower power relationships imposed through *Dadon*[8].

Availability or ownership of land is a pivotal factor in shrimp value chain as it influences production cost. Although most of the farmers are male, which is also reflected by gendered ownership of land, there also exist female and child labour who work throughout the year. Generally, in case of a large *gher* which is connected to sea, intensive production is not pursued which is why feed is not required, but in case of a small *gher* (sometimes called Pocket *Gher*) intensive production is a common practice requiring feed and thereby encountering feed cost. However, production of *Bagda* shrimp does not require any feed as the channeled seawater carries microflora and fauna. Although traditionally farmers produce either *Galda* or *Bagda*, but now a days both are produced at the same time in the same *gher* and most often with other carp fishes. This mixed production is now popular as farmers can earn more and can diversify the risks of financial losses due to diseases or viral infections often in epidemic form.

Farmers sell shrimp either to shrimp *faria* or directly to the shrimp *aratdar*. Sometimes they also sell to retailers when they overproduce or there exists shortage of buyer. They face challenges in pricing shrimp due to monopsony and their inability in storing shrimp for deferred selling at a better price. In addition to regular shrimp, some farmers also sell de-headed and de-vained shrimp at a higher cost. Most of the farmers also produce vegetables alongside the *gher,* which sell in the market after domestic consumption.

3.1.9. Shrimp Faria

Shrimp *faria* buys shrimp from farmers and sells mostly to shrimp *aratdar* but sometimes to another shrimp *faria* and retailers. They generally trade round the year though the peak season is only for five months. Sometimes they enjoy economic advantages through favorable price fixing by offering loans to respective farmers. They cannot preserve shrimp for a longtime and therefore need to sell on the same day to *aratdar*. As they do

[7] A polder which is larger than a pond
[8] Informal loans offered to farmers

not keep shrimp over a day, they do not need to feed them. Even during contingency when they need to keep shrimp over a day, for instance for natural calamity or countrywide strike, they use ice within the box/metal drum where shrimp is kept.

3.1.10. Shrimp Aratdar

Shrimp *aratdar* buy shrimp directly from farmers or from shrimp *faria and* sell to either shrimp commission agent or retailer. Sometimes there exist multiple levels of shrimp *aratdar* where one shrimp *aratdar* sells shrimp to another shrimp *aratdar*. Shrimp *aratdar* sometimes use a platform for auction selling which is popularly known as *Chatal*. This auction selling can ensure a better price for the shrimp *aratdar*. However, sometimes this selling approach might not offer price advantage to shrimp *aratdar*, which they would enjoy by selling properly sorted and graded shrimp.

3.1.11. Shrimp Commission Agent

Generally, shrimp commission agents buy shrimp from shrimp *aratdar* and sell mostly to formal processors who are also shrimp exporters. They also sell shrimp to processors who do not export. They generally enjoy superior power, as they are the only link between supply of shrimp and the frontend export entities. Although their activities are more formal and institutionalised but there exist allegations of lack of transparency.

3.1.12. Processor and Processor-cum-Exporter

Processor and processor-cum-exporter are institutionalised value chain actors and are generally located at urban areas with convenient transportation facilities. All categories of labour including male, female and children are involved in processing activities. While processors sell processed shrimps to retailers, processor-cum-exporters sell high-quality processed shrimp to exporters. Sometimes a few shrimp processors also sell semi-processed shrimp to domestic buyers, which also include shrimp heads and deshelled shrimp. Shrimp is processed for export following Hazard Analysis and Critical Control Points (HACCP) procedures guided by EU and USA suggested traceability regulation (GoB 2017). However, maintaining traceability system is particularly difficult for Bangladesh due to involvement of a large number of small-scale suppliers (farmers, *faria*, *aratdar,* retailers, and commission agents) and their informal processing which varies and are complex in nature. Processor-cum-exporters need to conform to all required compliance guidelines and get approval from both local and foreign buyers' representative quality checkers. Processor-cum-exporters usually sell shrimp under their own brand. However, they also export with a customised brand name as per buyers' demand. It is a common practice among most of the processor-cum-exporters to maintain multiple brands and they generally do it to achieve the portfolio advantages and minimise the risks.

3.1.13. Shrimp Retailer

Shrimp retailers sell shrimp in local or domestic markets. Generally institutional buyers make majority of the local purchase. Shrimp retailers have low scale but regular sale. Although they usually sell regular shrimp but sometimes, they also sell mother shrimp which they buy from nearby hatcheries. They generally buy shrimp from various sources

including farmer, shrimp *faria*, shrimp *aratdar*, and processor. Retailers at coastal areas usually buy shrimp from sea fishermen but in this case, they can only buy a few varieties. The variety they buy from sea fishermen is called *Chaka* and the other varieties include *Harina*, Black Tiger, *Laila* and *Chali*. While retailers sell both fresh and processed shrimps, they do not do any processing. They do cash only sales and generally do not offer credit sale. They enjoy power position in fixing sales price which they decide based on size of the shrimp. Domestic buyers comprise their clientele who have very limited bargaining power.

3.1.14. Foreign buyer

Foreign buyers include institutional buyers from more than 50 countries and the major buyers come from USA, EU, UK, Japan, Middle East, and Southeast Asia (GoB 2017). Although foreign buyers buy a range of different varieties of shrimp but the most preferred one is *Bagda*. Generally foreign buyers buy processed shrimp. Packaging play a pivotal role while exporting shrimp and that needs to match with specific demand from the foreign buyers. In most cases smaller packet sizes are on high demand among foreign buyers but it needs special technical arrangements for the processors-cum-exporters to ensure expected quality in packaging.

While all the value chain actors discussed above represent overall configuration of shrimp value chain in Bangladesh, but the difficult realities encountered by sea fishermen demand attention when value addition perspective is in consideration.

3.2. The Marine Shrimp Value Chain Perspective

The specialties about marine shrimp value chain in Bangladesh, in comparison with shrimp value chain based on mainland shrimp production, include absence of a group of actors (fry catcher, fry *faria,* fry *aratdar*, and fry commission agent) who deal with shrimp fry, and the crucial challenges encountered by the sea fishermen. Marine shrimp grows naturally in the sea from fry to the marketable sizes at which sea fishermen catch those. In most cases sea fishermen get different other sea fishes along with shrimp and they retain all the marketable varieties of fishes for sale. As sea fishermen get the shrimp grown naturally at their marketable sizes, intermediary value chain actors mentioned above are redundant in this case.

While the sea is open to all sea fishermen to catch sea fishes, but their capability to catch sea fishes depends on the type of water vehicle they can afford to use and the degree they are ready to take risks associated with deep-sea fishing. Sea fishermen use either motor driven or manual boat to go for fishing in the sea. Quality of fishing net and on boat temporary fish storage facilities also depend on the type of boat. Generally motor driven boats have better fishing net and cold storage provision. Following two diagrams (Figure 2 and Figure 3) present the configurations of marine shrimp value chain actors based on the type of boat sea fishermen use for fishing.

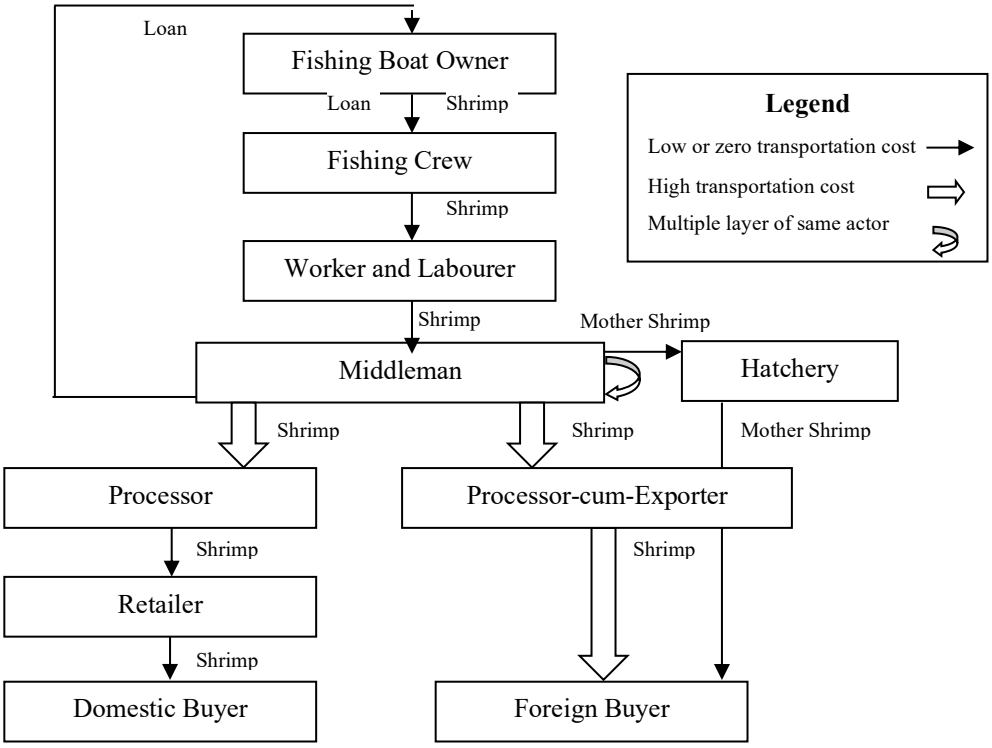

Figure 2: Marine Shrimp Value Chain using Mechanised Boat
Source: Authors' construct

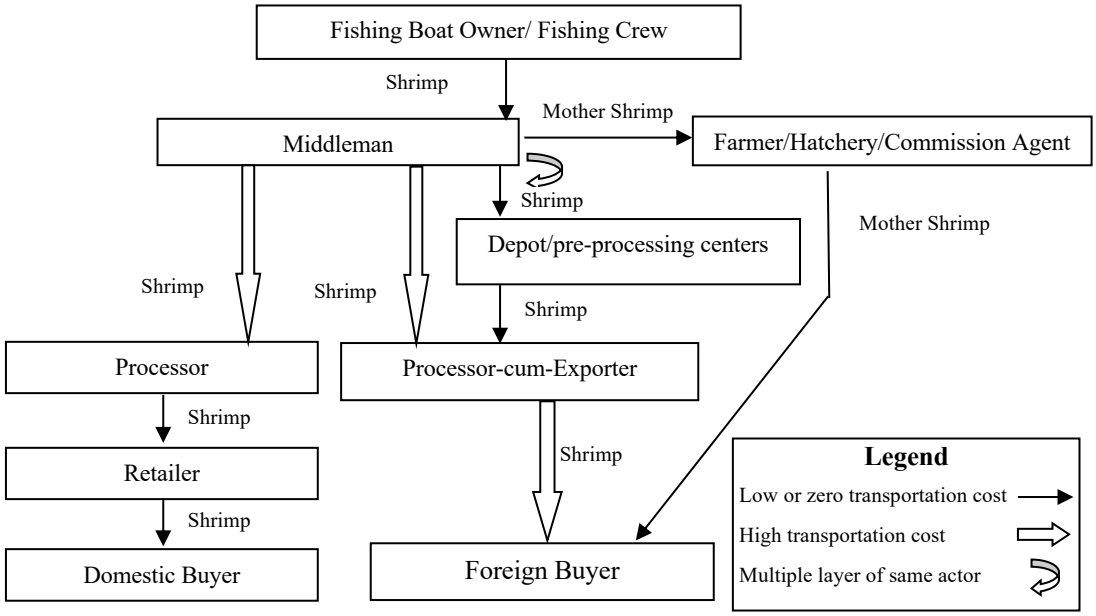

Figure 3: Marine Shrimp Value Chain using Manual Boat
Source: Authors' construct

The above two diagrams show that while there are shared patterns in the way value chain actors are linked, a few differences also exist in this respect. For instance, while in case of marine shrimp value chain where mechanised boats are used, workers or labourers are involved managing several processing activities including sorting, deshelling, de-heading, deveining, and preliminary packaging. These workers are not found in the marine value chain where manual boat is used. Although mechanised boat assisted sea fishing is a well-equipped approach but operating and maintaining it is an expensive task. Generally, the middlemen offer loans to the boat owners to meet these expenses but with the condition of selling shrimp to them. While the fishing crew have ownership of shrimp, they catch from the sea but because of a few unavoidable hard realities they cannot sell those at available market price. The reasons for this constraint include exploitative relationship with the fishing boat owner, and conditional loans offered by respective boat owners conforming shrimp sale to them.

The other considerable difference in the way value chain actors are linked in a marine shrimp value chain is involvement of depot/pre-processing centers when non-mechanised boats are used for fishing. Middlemen who take services from depot/pre-processing centers usually sell their shrimp to processor-cum-exporter. Fishing with the non-mechanised boat is not a well-equipped approach and the total amount of shrimp caught is also less than the amount caught by the mechanised boat approach. Though non-mechanised boats are environmentally friendly but these are usually smaller and slower compared to mechanised boats and therefore fishing crews can only explore a limited area in the sea by these. However, non-mechanised boats do not involve the curse of lending and borrowing of money along with shrimp selling constraints at lesser price because fishing crews own the boats. Alike the mechanised boat approach this approach also involves only male participants as women are discouraged to participate due to the high risk involved in fishing in the deep sea. Another aspect of this approach is that, shrimp catchers can enjoy market price in selling shrimp as it is free from the influence of contract selling imposed by the lenders. Nevertheless, in both approaches, middlemen sell semi-processed or un-processed shrimp either to the processor-cum-exporters for further processing and packaging for export purposes, or to the processors for reselling shrimp ultimately to domestic buyers through retailers. In a similar manner, sometimes one middleman sell shrimp to another middleman.

The sections above demonstrate mostly the ways different actors are linked in shrimp value chain but do not explicitly show the flow of activities along the chain and the variations which exist in the approach towards shrimp production. The following section offers an action-based perspective of shrimp value chain in Bangladesh.

3.3. The Action-based Perspective

This section focuses on the flow of activities carried out by the value chain actors which takes place throughout the shrimp value chain in Bangladesh. It also elucidates how the production process varies in different approaches. Each approach to production leaves considerable influence over the quantity and quality of the shrimp produced which variation imprints varying degrees of value addition.

Shrimp farming can broadly be classified into two categories: i) open system farming, and ii) closed system farming. Open system farming implicates production of shrimp in nature without any human assistance and control. In this system, shrimp grow naturally in sea or river consuming naturally grown feeds. Generally, shrimp grown in open system are healthier and tastier compared to those grown in closed system. There exist little human influence over their production apart from human made impacts on biodiversity usually through climatic changes which eventually affects the production negatively.

Closed system farming indicates shrimp farming under human control where nourishment of shrimp takes place with care offered by human. In closed system farming, three approaches – i) traditional, ii) modified traditional, and iii) semi-intensive - are common which vary mostly in terms of production quantity and required supports. Traditional production process developed along the coastal regions of Cox's Bazar, Khulna, Satkhira, Bagerhat, and Chittagong in early 1950s, due to favourable production environment (consistent source of saline water required for *Bagda* production, stable water temperature, and abundant shrimp fry along the shores) and available cheap labour (Gammage *et.al*. 2006b). In this system shrimp is grown in a large polder connected to nearby sea through canals or estuaries. Sluice gates are used to control the flow of sea or brackish water get into polders utilizing tidal cycles and this water is the only source of naturally available shrimp fry and their feeds. As a result, while there is no cost for feed and technology, and no need for borrowing money, but yield remains low although most of the shrimp in Bangladesh is produced in this way.

Modified traditional farming approach is in between traditional and semi intensive approaches in terms of complexity of the process and yield. In a physical setup similar to that of traditional farming approach nursery nourished shrimp fry is grown in a polder to marketable sizes. A combination of several technical innovations ensures higher yield and/or increased income in this approach. For instance, i) electric pump is used to minimise dependency on tidal cycles, ii) polder bed is pre-prepared with lime to enhance sustained growth of shrimp, and iii) mixed production approaches are adopted. Mixed production approaches can take several forms such as producing *Bagda* and *Galda* together, producing shrimp and carp fishes together, and growing paddy and shrimp in a mixed crop production style. Sometimes shrimp fry is served in the polder at several days interval to ensure continuous production of shrimp at marketable sizes. Some farmers also produce sea salt at commercial level during off-season for shrimp production. While this approach facilitates increased income, feed cost remains considerably high to compensate for the negative impacts on quality and quantity of shrimp created by mixed production. Generally, farmers do not struggle with the required skills essential to pursue this approach.

Semi-intensive approach is highly technical, requires expertise and skills, needs considerably high input and operating costs, the least common approach adopted by farmers, but offers the highest yields. In this approach polder is prepared using saline water from the sea using an electric motor. Before serving fry in the polder brackish water is checked for specific pH level and density of dissolved oxygen. Monitoring and maintaining these technical configurations are key to high yield and these need technical expertise and skills, which are provided through training. Abundant high quality feed is essential to nourish the high density of 25 fry per square meter. A mixture of wild and hatchery produced fry facilitates ensuring a synergistic impact over the fry sustainability rate. It is a capital-intensive farming approach, which also leaves adverse environmental impacts due to use of chemicals and its waste discharge.

The above discussions elucidate activities along the shrimp value chain but only from beginning to production of shrimp at marketable sizes. The overall shrimp value chain configured through actions' perspective, focusing value additions at every level, is presented in the following Figure 4. Here sequential flow of the value adding actions is presented with their order and the varying nature of arrows indicates major transportation cost variations.

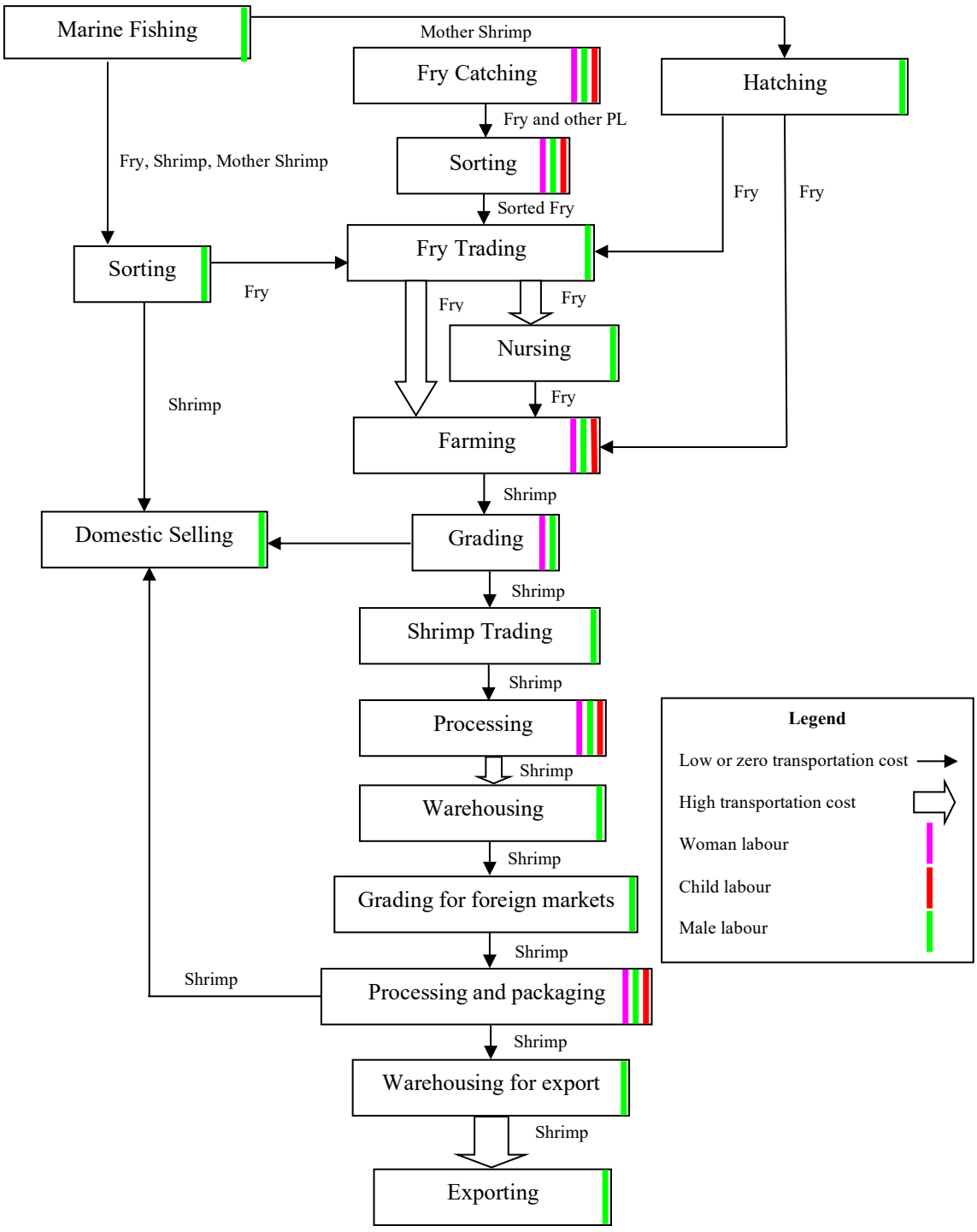

Figure 4: Action-based Shrimp Value Chain in Bangladesh

Source: Authors' construct

Value adding activities involve fry catching, hatching, sorting fry from other PL, fry trading, fry transporting, fry nursing, farming, shrimp grading, shrimp trading, shrimp processing, shrimp transporting, shrimp warehousing, shrimp grading for foreign markets, shrimp processing and packaging, shrimp warehousing for export, and shrimp exporting. While all these activities engage predominantly male labour, however, female and child labour are also widely used for fry catching, fry sorting, farming, processing and packaging. In case of shrimp sorting men and women work together but child labour is usually not involved.

In order to facilitate a better comprehension, while the above sections present discussions on value additions in terms of involvement of particular actors and respective actions, a value addition is usually perceived with a blurred division between actor and action. This usual underlying sense is adopted in the following section to discuss challenges facing and scopes of further value addition along the shrimp value chain.

4. Major Vulnerabilities and Scopes of Value Addition

Several sources of vulnerabilities and value addition scopes were identified where vulnerabilities were mostly related to broader environmental and scopes of value addition were mostly embedded within the value chain itself.

4.1. Environmental Impacts as a Toll versus Underlying Economic Gain

Several authors have claimed negative impacts of shrimp farming on environment done through distorting biodiversity (Folke & Kautsky 1992, Paul & Vogl 2011, Primavera 1997) and decreasing soil fertility affecting agricultural crop production caused by saline water (Islam 2003, Ito 2002 & 2004, Paul & Vogl 2011). While these impacts are explicit and empirically evidenced, but these consequences also triggered innovations such as introducing salinity tolerant high yield rice varieties by agricultural research institutions in Bangladesh (Chowdhury, Shivakoti & Salequzzaman 2006, Islam & Gregorio 2013). While this disaster led innovation is an achievement and positive contribution to economic gains, but this can hardly be considered as an absolute compensation to the damage made to the soil properties because that does not get back to its previous efficacy in terms of fertility.

Lower yield of crop due to shrimp production led soil salinity stimulated innovation to diversify or minimise economic risks further by adopting mixed crop production of paddy and sweet water shrimp (*Galda*). Although Deb (1998) claimed that extensive shrimp farming replaced this mixed crop production, but empirical data refute this claim because a considerable proportion of farmers still use mixed crop production. Some farmers also magnify their economic gains through mixed crop production by producing shrimp and carp fishes together as discussed in section 2.3 above. Therefore, these economic gains through innovations can help farmers minimise the tolls due to adverse environmental impacts, but these innovations can hardly heal the damage made to the environment.

4.2. Political Economy of Shrimp Sector

In the spirit of maintaining biodiversity and environmentally friendly management of shrimp value chain, GoB enforced legal injunction in 2002 banning collection of wild fry (Aftabuddin, Zafar & Kader 2009, DoF 2006, Robbins & Coulter 2012). However, GoB also acknowledges that this ban is not widely enforced which leaves a question about where this ban is enforced and based on which criteria the enforcement areas are selected (DoF 2006). Involvement of fisheries experts might add value in this area selection process. Expertise is also required to identify a method to catch shrimp fry without destroying PL phases of other fish species (Islam, Islam & Ahmed 1999), or to find commercial means of utilizing those PL phases of other fish species by distributing those to farmers who produce those fishes. The later could add superior values horizontally, beyond the shrimp value chain. While enforcing this ban aids managing biodiversity particularly along the coastal region, but this tradeoff is associated with a pivotal factor regarding production of better-quality shrimp. Farmers claim that wild fry is a better choice compared to fry coming from hatchery, particularly because of their better survival rate and better taste. In favour of involving wild fry in shrimp value chain, farmers also argue that the mother shrimp grown in *gher* from hatchery-produced fry are weaker mother shrimp compared to the ones grown from wild fry. They also argue that choice of mother shrimp, with direct implication of choice of fry, has unavoidable consequences realised through breeding and producing generations of fry resulting poorer mother shrimp down the line. For instance, M. rosenbergii (one variant of *Galda*) available in Bangladesh is the most popular shrimp among the foreigners due to its unparallel taste, but some farmers and commission agents claim that due to the cross breeding with lower quality shrimp from India and Thailand, M. rosenbergii is losing its originality in taste and overall quality. Therefore, choice of fry has considerable influence over shrimp production quantity and quality of the shrimp in terms of taste that is an imperative element in value addition.

Fish feed can be considered as another aspect of the political economy of shrimp production where fish feed industry offers efficient production and distribution of fish feed contributing to higher production but at the same time influences the effectiveness by means of the manner feed is manufactured and thus influencing quality of the shrimp.

Empirical data inform allegations of presence of antibiotic in fish feed which eventually contributes to the quality of shrimp. Similar contamination caused by use of poultry excreta is evidenced which sometimes is resulted by the integrated farming campaign from GoB entitled ‘One House One Farm’ initiative that fosters homestead poultry farming (Islam, Hoque, Miah & Sheheli 2013). Farmers use lime but do not know about the ph status of soil or water. They sometimes use poultry feed which contains antibiotic causing health distortion for shrimps. At a wide scale, the farmers either do not provide any feed or provide inadequate feed to their *gher*. This fact is adversely affecting the growth rate of shrimp in relation to time and is hampering the quality and taste of shrimp at the same time. Greater value is possible to add with appropriate feeding which can facilitate higher grade of shrimp production eventually benefiting the farmers economically. Nonetheless, farmers use feed at a limited scale and use either locally produced unrefined feed or the imported feed that is usually expensive for them.

According to farmers, these feed options suffer from either inappropriate content ratio or possibilities of containing ingredients (including antibiotic) that sometimes result virus infections or adverse consequences. However, there also exits an opportunity to produce feed locally in formal factory setup and market throughout the country that might open up a new business avenue and aid sustainable growth of the shrimp sector.

Virus has been a consistent threat to shrimp production in Bangladesh. Farmers claim that the resulting consequences of virus attack has remained mostly the same throughout decades – a disaster accompanied by financial shocks. They also claim that no considerable innovation or measurement was available to them to encounter this threat. This implies scopes for research and development (R&D) to contribute to enabling the farmers encounter virus caused epidemics with minimised impacts. The following Box 1 presents the persisting scenario around virus in the shrimp sector of Bangladesh.

Box 1: Virus, the Unprotected Threat

Viruses often bring on disasters to the shrimp production. The historical origin of viruses to the shrimp industry is not clearly known. It is generally thought that virus first came to Bangladesh from Thailand. In 1994-95, about 50 crores of Tiger shrimp fry were imported from Thailand (DoF, 1995) to Bangladesh. That import has been linked to the outbreak of a disease referred to as "China Virus". That import is alleged to cause "China Virus" and spread the defected gene through several generations.

There are no known and effective treatments for the prevention of virus infection or its treatment. There are variety of local medicines that are sold in the market, which are claimed to be effective in treating virus infection. Their true effectiveness is not known. Unfortunately, the government offices of the Department of Fisheries are not very helpful yet in this regard.

There is a lack of adequate information about shrimp diseases and their remedies. Due to the lack of R&D in this issue, most of the farmers identify any of the diseases of shrimp as a virus attack. So, it is not yet confirmed whether shrimps are affected by viruses only or some other diseases are also there. Farmers know that Taiwan was one of the major shrimp producing countries earlier but extreme use of drug in preventing virus has changed Taiwan into a major shrimp importing country. This information facilitated the farmers in staying obscure about the virus effect. No significant advisory services from the government, been provided concerning shrimp diseases. No foreign investment been made in any R&D project to find out the health issues of shrimp. Existing foreign investigations about shrimp were concerning only shrimp export related issues but there was none concerning virus.

Shrimp has consistently been one of the top five export items from Bangladesh representing proven prospects of this sector (Bangladesh Bank 2018). However, capitalizing this prospect by potential market entrants has become a systematic challenge due to fragmentation induced by involvements of too many institutions (Afroz & Alam 2013). Shrimp production, processing and marketing need to conform to a multitude of regulations and requirements controlled by as many as 17 ministries and a total of 28 government departments and agencies (Paul & Vogl 2011, Maniruzzaman 2006). Intermediaries, particularly processors and exporters, shared their concerns regarding the existing complex regulatory framework that not only demotivates and discourages

involvements of new intermediaries, but also negatively affects capitalizing global market opportunities and cost minimization through full capacity utilization[9] of the institutional processing initiatives. Processor-cum-exporters specifically share the challenges they encounter caused by this multitude of regulatory directions that sometimes appear conflicting.

In response to this multitude of rules and regulations and the post 1997 ban by the EU (Alam & Pokrant 2009), most of the value chain actors particularly shrimp processor-cum-exporters invested their efforts further with the help of government funding to rectify the problem areas. Several positive changes took place regarding value addition through better and effective management of the shrimp value chain actions. Significant improvements include i) use of temperature controlled storage system for shrimp throughout the supply chain; ii) use of appropriate containers to hold and transport shrimp; iii) maintenance of better cleanliness, hygiene and sanitation at farming area and sorting and grading depot; iv) reduced unethical practices and improved marking of product; v) generation and dissemination of traceability information; vi) incorporation of HACCP compliance requirement in obtaining government license to function as a depot; vii) introduction of waste treatment and disposal management arrangements; viii) well-equipped laboratory facility; ix) more qualified people are employed and appropriate channels are established; and x) improved working condition throughout the chain. While these improvements have been investment intensive, but one of the major aftereffects is that the growth rate of shrimp export in years, other than 1998 and 1999, remained consistently increasing except in 2002 and 2003 because of 9/11 incident in the USA (Yunus 2009). Despite these improvements, a constant monitoring is imperative to ensure continuation of underlying modified practices and this can be legitimised by the evidences reported by global watchdog who claimed breach of some of the commitments (Tran 2014).

4.3. Sociocultural Realities

Persisting sociocultural realities particularly around the contested social justice and power inequality make it difficult for the bottom of the pyramid to enjoy fair economic gains from shrimp production despite their invaluable contributions to shrimp sector. This scenario puts forward Prahalad's assumptions and propositions about business prospects at the bottom of the pyramid a contested one in this perspective (Prahalad 2006).

In most cases, it is the farmers who face unexpected challenges from within their respective localities and generally they struggle to overcome those. This can be considered as one of the scopes to facilitate value addition in a sustainable manner. For instance, some farmers reported malicious deeds such as poisoning the *gher* causing a total loss for the respective farmers. It is reported that in most cases this type of occurrence takes place due to rivalry among *gher* owners. Some farmers have formed cooperative society or farmers association to arrange and enforce active guarding measures following a rota. While this approach helps farmers to ensure security of their

[9] Empirical data evidences that most of these processing plants operate at 20%-25% of their capacity due to the shortage of shrimp supply.

ghers particularly during nighttime which is the most vulnerable period, but in most cases this approach is pursued in an informal manner and in limited scale. Involving suitable technology means as well as the local administration might support capacity building of this type of association which remains as one of the prominent scopes for value addition. These can also address issues around imbalanced power relationship of the farmers with other actors of the value chain in forward linkage, and thus can minimise instances of oppressions and power abuse. Generally, this type of cooperative society is also found among fry *aratdars,* hatchery owners, nursery owners, processor, and processor-cum-exporters, but in most cases, these are not fully functional or well capacitated. However, no such cooperative society or association of fry catchers exists that are rather crucial to enhance their bargaining power and protect their interests to ensure fare practices in business which can add value by facilitating enhancement of their quality of life as a trickledown effect. For instance, persisting conflicts between wild fry sellers and hatchery fry sellers can be resolved.

Persisting norm of pursuing informal means of doing business at rural level is another point of vulnerability along the shrimp value chain in Bangladesh. Usually only informal verbal contracts for business among different value chain actors can be traced. This type of verbal contracts, mostly among shrimp commission agents and other value chain actors along the backward linkage, may result in high chance of sufferings of the poor and socially weak ones. This situation demands for institutionalizing the record keeping of contracts among respective shrimp value chain actors in the form of written book keeping and formal record keeping.

Overall working environment for the workforce in shrimp industry has improved compared to the pre-HACCP situation. However, there exists ample scopes for further improvements in the workplace environment. For instance, in the processing plants the workers need to work tolerating obnoxious smell during the whole day causing considerable mental irritation, unpleasant state of mind and related health consequences. Although this vulnerability can be perceived as an unavoidable hygiene factor, but it demands appropriate measures and it is possible through appropriate ergonomically reengineered servicescape design.

5. Conclusions

Shrimp value chain in Bangladesh started to evolve in the late 50s and since then value additions have mostly been driven by the demands put forward by the buyers in western countries (Hussain 1994). In about 70 years' time, the situation has now got improved but still there exist scopes for further improvements. One of the critical scopes of improvement remains figuring out a sustainable and environmentally friendly shrimp production process with maximised economic return. The other factors that have considerable impacts over shrimp value chain include increased salinity of soil; effective implementations of government-led and foreign buyer-led regulations (such as HACCP); production of environment friendly feed; virus infection and its consequences; effective and maximised utilization of institutional capacity; ensuring fare economic gains for those value chain actors who are economically deprived and belong to the bottom of the pyramid; imbalanced power relationships among value chain actors; formal

institutionalised record keeping system in lieu of informal verbal contracts; and context sensitive ergonomically reengineered servicescape design. Impacts of loan specially in case of marine shrimp value chain need to be understood and institutional arrangements should be taken to address the resulting issues of oppression and exploitation. One silver lining is how shrimp value chain has been incorporating women workforce due to its superior quality of labour though fairness of benefit spread among women workforce remains questionable. Shrimp industry in Bangladesh should also effectively embed nursery services in the value chain as it can facilitate higher yields and can create more employments contributing to a better life particularly for those in the bottom of the pyramid.

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