Photo credit: Front cover, Nazneen Khan/WorldFish

Identifying suitable carp and prawn nursing practices under changing environmental cycles and developing their business model by linking with market and farmers

UKaid from the British people

United Purpose Out of poverty

CGIAR RESEARCH PROGRAM ON Fish

WorldFish

Identifying suitable carp and prawn nursing practices under changing environmental cycles and developing their business model by linking with market and farmers

Authors

Shikder Saiful Islam,[1] Nazneen Khan,[2] Qazi Azad uz zaman[2] and Malcolm Dickson[2]

Authors' Affiliations

[1] Khulna University, Bangladesh

[2] WorldFish, Bangladesh

Citation

The publication should be cited as: Islam SS, Khan N, Azad uz zaman Q and Dickson M. 2018. Identifying suitable carp and prawn nursing practices under changing environmental cycles and developing their business model by linking with market and farmers. Khulna, Bangladesh: WorldFish. Special Study Report.

Acknowledgments

This work was undertaken as part of the CGIAR Research Program on Fish. This publication was made possible by the support of the British people through the Improving Food Security and Livelihoods Project of the United Kingdom Agency for International Development (UKAid).

Contents

List of figures 4
List of tables 5
List of abbreviations 6
Executive summary 7
Introduction 9
Methodology of the study 13
Results 16
Discussion 24
Conclusions and recommendations 25
Notes 26
References 27

List of figures

Figure 1. Ecological effects and impact on coastal aquaculture by climatic variables (Ahmed and Diana, 2015) 11
Figure 2. Existing trade channel of fry and fingerlings in the southwestern districts of Bangladesh 12
Figure 3. Map of study areas 13
Figure 4. KII with Dr. Dilip Kumar Datta, Environmental Disipline, KU 14
Figure 5. Discussion with an LSP on cutting-edge technologies 15
Figure 6. An wish pond for nursing carp and prawn seed 16
Figure 7. Carp nursery management, Alypur, Rupsha 19
Figure 8. Overwintening carp nursing trials, Alaypur 19
Figure 9. Carp fattening mixed with Prawn, Alypur, Rupsha 20
Figure 10. Nursing carp and prawn in nice field, Alypur, Rupsha 20
Figure 11. Existing business model of Prawn seeds in Khulna and Bagerhat districts (based on this study) 23
Figure 12. Existing business model of prawn and carp fry in Khulna and Bagerhat district (based on this study) 24
Figure 13. Business model for advanced carp-prawn nursing practices 25

List of tables

Table 1. Production of carp hatchlings in 2014 to 2016 9

Table 2. Production of fish fry from both Government and private nurseries in 2013 to 2016 (DoF, 2016b) 10

Table 3. Production of shrimp and prawn PL in 2012 to 2016 10

Table 4. Scenario of prawn seeds used by the farmers and their nursing status in the study area 18

Table 5. Scenario of carp seed used by the farmers and their nursing status in the study area 18

Table 6. A qualitative ranking of identified practices against the challenges 18

List of abbreviations

BSc	Bachelor of Science
CBO	Community Based Organization
DoF	Department of Fisheries
EFSL	Improving Food Security & Livelihoods Project
EMS	Early Mortality Syndrome
FFD	Farmers' Field Day
FGD	Focus Group Discussion
FRSS	Fisheries Resources Survey System
FSMFs	Fish Seed Multiplication Farms
KII	Key Informants Interviews
LSP	Local Service Provider
MRP	Manufacturer Recommended Price
PL	Post Larvae
SPA	Service Provider Association

Executive summary

The coastal zone of southwest Bangladesh plays an important role in ensuring the sustainable livelihoods and food security of its people. However, it is prone to adverse weather and climate change which impacts its agricultural production systems, including fish and shrimp farming and associated inputs such as fish seed. This makes it is important for smallholder farmers to adapt to the changes and adjust their farming practices.

This study was conducted to characterize fish and prawn nursery practices and examine how these are being impacted by changing environmental conditions. The study also assessed a series of advanced nursery practices introduced by the WorldFish component of the IFSL project and an improved business model to extend the technologies through existing market actors. The study was carried out by selecting a group of experts in fish and prawn seed nursing. Data was collected through 12 focus group discussions with advanced farmers and local service providers (LSPs) in 6 Upazillas along with interviewing key informants. Data was cross-checked by sector experts.

The results of the study revealed that fish farmers in Khulna and Bagerhat Districts generally practice prawn and carp polyculture. Carp species include rohu, catla, mrigal, silver carp, mirror carp and grass carp. Farmers need fish seed ranging from hatchlings to fingerlings depending on their farming strategies. A few farmers have their own nurseries while most depend on external sources. Eighty per cent of the carp seed come from Jashore, 5% come from Fultala and the remaining 15% come from government hatcheries either in Khulna or other districts. Some of the more advanced farmers over-winter their fish. Farmers frequently face natural shocks including flooding, drought and waterlogging which can result in severe economic losses. Few farmers have the knowledge and technical support to adapt to these challenges.

Usually, there are at least 3 intermediaries in the distribution chain from fish nurseries to grow-out farmers which results in higher prices for fish seed, decreased quality and poor alignment between supply and demand for fish seed. The IFSL project introduced a business model focused on extending the use of advanced nursing practices and using Local service Providers (LSPs) to shorten the distribution chain, thereby reducing seed costs and improving the quality of seed supplied to grow-out farmers. The aims at on creating direct linkages between fish farmers, LSPs, hatchery owners and nursery operators. Producer group members are organized into Upazila-based clusters involving advanced farmers in carp and prawn seed nursing and LSPs as community organizers communicating directly between the nursery operators and grow-out farmers. Each LSP organizes inputs for around 10 groups of 20-25 farming households.

This provides an opportunity for LSPs to supply sufficient amounts of high quality fish seed from local nurseries with the option of engaging in fry trading. Farmers benefit as they get higher quality seed at lower cost as well as after sales services from the LSPs. Through the IFSL project, the model was successfully introduced and integrated into these communities and is expanding throughout southwestern Bangladesh.

Photo credit: <Habibul Haque> <Worldfish>

Fry being counted. Allahar dan hatchery, Jessore, Bangladesh.

Introduction

Overview of aquaculture in South West Bangladesh

With extensive wetlands and high levels of aquatic biodiversity, fish has always been an important component of diets in Bangladesh (Ghose, 2014). The fisheries sector of Bangladesh comprises 3 categories: aquaculture (freshwater and marine), inland capture fisheries and marine fisheries. Total fish production in Bangladesh in 2016-2017 was estimated at 4.1 million tons of which, 1.1 million tons (28 %) were from inland capture fisheries, 2.3 million tons (56 %) were from aquaculture and 0.6 million tons (15.42%) from marine fisheries (DoF, 2017b). This represents annual growth rates of overall fish production between 6.6 and 7.20 per cent since 2000-2001 (FRSS 2016; FRSS 2017).

Southwestern Bangladesh has both freshwater and marine or brackish water aquaculture systems, including the integration of carps (various species), tilapia (*Oreochromis niloticus*) and marine shrimp (*Penaeus monodon*) or prawn (*Macrobrachium rosenbergii*) (Shamsuzzaman et al., 2017). Aquaculture production systems in the country have been classified as extensive, improved extensive, semi-intensive, and intensive (Hossain, 2014). About 80% of aquaculture production comes from pond aquaculture which is presently dominated by indigenous and exotic carps, pangasius and tilapia (Shamsuzzaman et al., 2017). Bangladesh is one of the most suitable countries in the world for freshwater prawn farming due to its biophysical resources (Ahmed and Diana, 2015). The total area under prawn culture is 65,221 ha, about 75% of which is located in the southwest region of Bangladesh. Total prawn production in Bangladesh was 48,574 tons in 2016-2017 with an average annual productivity of 478 kg ha-1 (DoF, 2017b). The fisheries sector plays an important role in the national economy of the country being the second largest export industry after ready-made garments.

Carp and prawn seed production scenario in Bangladesh

The success of inland aquaculture depends largely on the availability of high quality fish seed. During the 1960s and early 1970s, the government established Fish Seed Multiplication Farms (FSMFs) to supply fish seed to fish farmers (FRSS, 2017). During that time, wild fish seed was collected from rivers and supplied to the fish farmer as fingerlings through the FSMFs. In the mid 1970s, due to reduced availability of wild carp fish seed in the rivers, the DoF initiated research and developed technologies for artificial carp seed production. These technologies were adopted, adapted and scaled up by private sector hatcheries in recent decades. Recent production statistics for carp hatchlings, nurseries and prawn post larvae (PL) from both government and private hatcheries reflect these developments (Table 1, Table 2 and Table 3).

Source of production	Year 2014		Year 2015		Year 2016	
	No of hatcheries	Production (Kg)	No of hatcheries	Production (Kg)	No of hatcheries	Production (Kg)
Government fish farms	92	10338	79	10566	89	14775
Private hatcheries	790	478993	800	536983	813	594839
Total	882	489331	879	547549	902	6096143

Source: Yearbook of Fisheries Statistics of Bangladesh 2014-16. Fisheries Resources Survey System (FRSS), DoF.

Table 1. Production of carp hatchlings in 2014 to 2016.

Source of production	Year 2013		Year 2014		Year 2015		Year 2016	
	No of nurseries	Production (in millions)	No of nurseries	Production (in millions)	No of nurseries	Production (in millions)	No of nurseries	Production (in millions)
Government fish farm	124	22.2	136	20.7	136	427.86	137	278
Private hatchery	10,450	9,965.3	10,814	9,976.9	13,475	7,973.1	13600	8,284.7
Total	10,574	9,987.5	10,950	9,997.6	13,611	8,015.9	13737	8,312.5

Source: Annual Report 2016 of Department of Fisheries Bangaldesh.

Table 2. Production of fish fry from both Government and private nurseries in 2013 to 2016 (DoF, 2016b).

Name	Year 2012		Year 2013		Year 2014		Year 2015		Year 2016	
	No of hatcheries	Production (Core PL)	No of hatcheries	Production (Core PL)	No of hatcheries	Production (Core PL)	No of hatcheries	Production (Core PL)	No of hatcheries	Production (Core PL)
Prawn	70	125.03	21	3.31	27	2.70	36	4.30	36	4.65
Shrimp	61	820.00	60	923.92	55	1158.80	49	1244.05	49	1314.20
Total	131	945.03	81	927.23	82	1161.50	85	1248.35	85	1318.85

Source: Yearbook of Fisheries Statistics of Bangladesh 2012-16. Fisheries Resources Survey System (FRSS), DoF.

Table 3. Production of shrimp and prawn PL in 2012 to 2016.

Challenges in carp and prawn farming in south west Bangladesh

Lack of quality seed

In 2016, the Bangladesh planning commission reported that the main constraints to development of inland aquaculture are seed, feed and extension services. To address the lack of quality seed, the purity of indigenous aquaculture species broodstock needs to be maintained and the natural habitats (breeding, spawning, nursery and grow-out areas) conserved to complete the natural life cycle (Shamsuzzaman et al., 2017). Ahmed et al. (2008) reported that low supplies of wild fry and poor technical knowledge of farmers are the major constraints in fish and prawn culture. In addition, the stock of natural seed has declined over the years due to the use of destructive gears, overfishing, and a wide variety of diseases (black spot, white spot, gill disease) (Ahmed et al., 2008; MacRae et al., 2002). Therefore, it is evident that the major bottleneck for further expansion of aquaculture is the lack of adequate supplies of quality seed (Ahmed et al., 2008). Other challenges for fish farmers include a lack of quality broodstock, prawn diseases, the misuse of chemicals and drugs, low production rates, ignorance of ethical aquaculture practices, lack of information sharing and coordination, insufficient credit facilities, marketing constraints, rejection of prawn consignments, and vulnerability to climate change (Ahmed et al., 2008; Ahmed and Garnett, 2010).

Environmental constraints

Bangladesh is a low-lying land that makes it extremely vulnerable to sea-level rise, and was ranked first among countries in terms of vulnerability in 2012. In 2015, this ranking went down to number 6, a very high number nonetheless. (Ahmed and Diana, 2015; Harmeling and Eckstein, 2012; Kreft et al., 2014). Hence, environmental issues have been identified as a threat to fish and freshwater prawn culture in southwestern Bangladesh (Ahmed

et al., 2013). The coastal region of Bangladesh is subject to drastic seasonal changes over the course of the year. A combination of climatic variables including coastal flooding, cyclone, drought, salinity, rainfall, drainage, changes in monsoonal rain patterns, extreme climatic events, sealevel rise, water stress, and high temperatures increase the risks of loss in aquaculture systems (Ahmed et al., 2013; Ahmed et al., 2008; Ahmed and Garnett, 2010).

The World Bank (2012) reported that coastal flooding in Bangladesh is influenced by environmental fluctuations as well as human interventions. For instance, cyclonic surges, high river discharges and low drainage capacity contribute to this phenomenon. In addition, this region is affected by violent storms and tropical cyclones with a severe cyclone hitting the country once every three years on average (GoB, 2009). In the last few decades, (in 1970, 1991, 2007 (Sidr), 2008 (Nargis), 2009 (Bijli and Aila), 2013 (Mahasen) Bangladesh has been hit by several cyclones causing the death of hundred thousands of people (Ahmed and Diana, 2015; Dasgupta et al., 2011; GoB, 2008; Nasreen, 2017; World Bank, 2000). Clearly, climate change has a significant impact on coastal ecology and aquaculture (Figure 1).

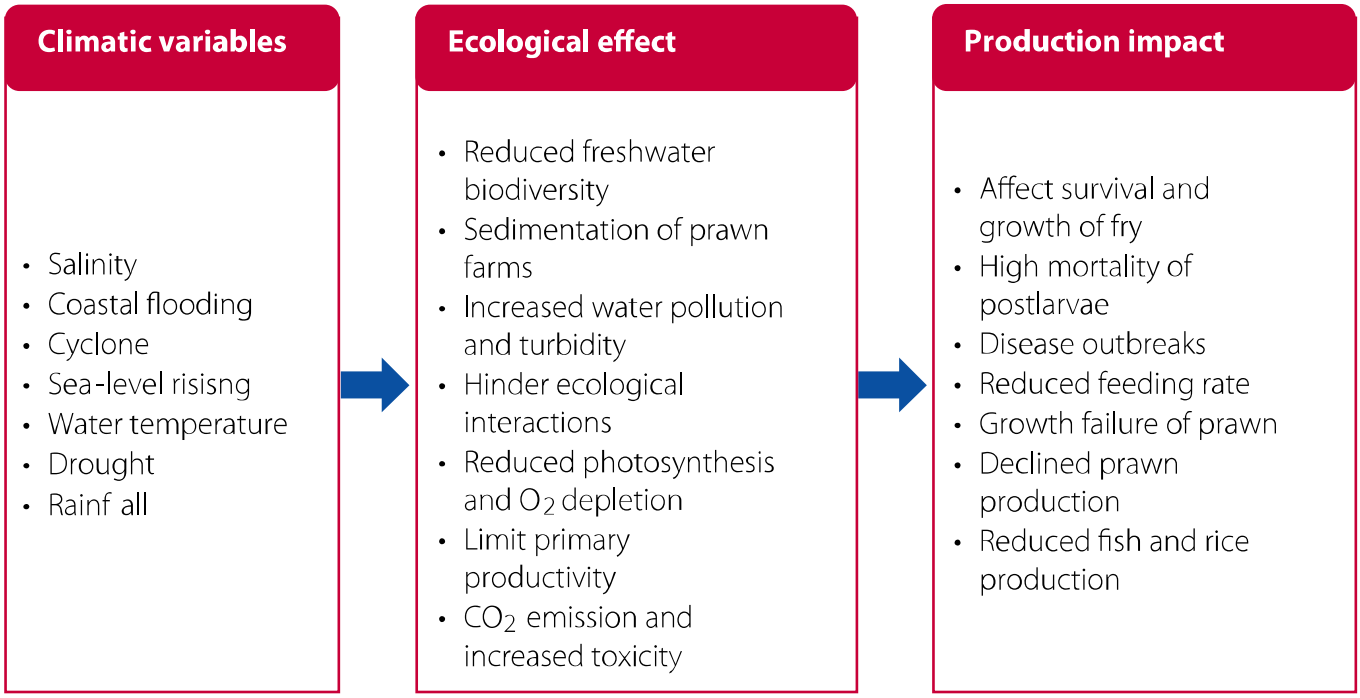

Figure 1. Ecological effects and impact on coastal aquaculture by climatic variables (Ahmed and Diana, 2015).

Marketing interventions and business schemes

A good marketing system is very important to ensure the timely supply of fish seed to fish farmers. Until 1970, the country depended only on fish seed collected from nature. However, since then the collection of fish seed from rivers has decreased and at present, the supply of fish seed from this source is very limited. The market participants who are involved in fish seed marketing and distribution include hatchery operators, nursery operators, fry traders, and fish farmers (Asif et al., 2014; Sharif and Abdulla-Al-Asif, 2015). Sharif and Abdullah-Al-Asif (2015) reported that the marketing channel starts with brood fish farming, followed by hatching eggs and producing spawn, nursing spawn and producing fingerlings or yearlings, and ends with selling fingerlings/yearlings to farmers through wholesalers or retailers (Islam, 1989). The main customer of nursery operators are aratdars who sell fry to the middlemen or the retailers/patilwalas. Finally, the retailers/patilwalas deliver seed to the pond owners.

The retailers commonly sell to pond owners in cash or credit and make a profit of 100-200%. There are problems associated with fry trading created by the involvement of intermediaries as the nursery owners generally do not get the actual price of fry paid by the pond owner.

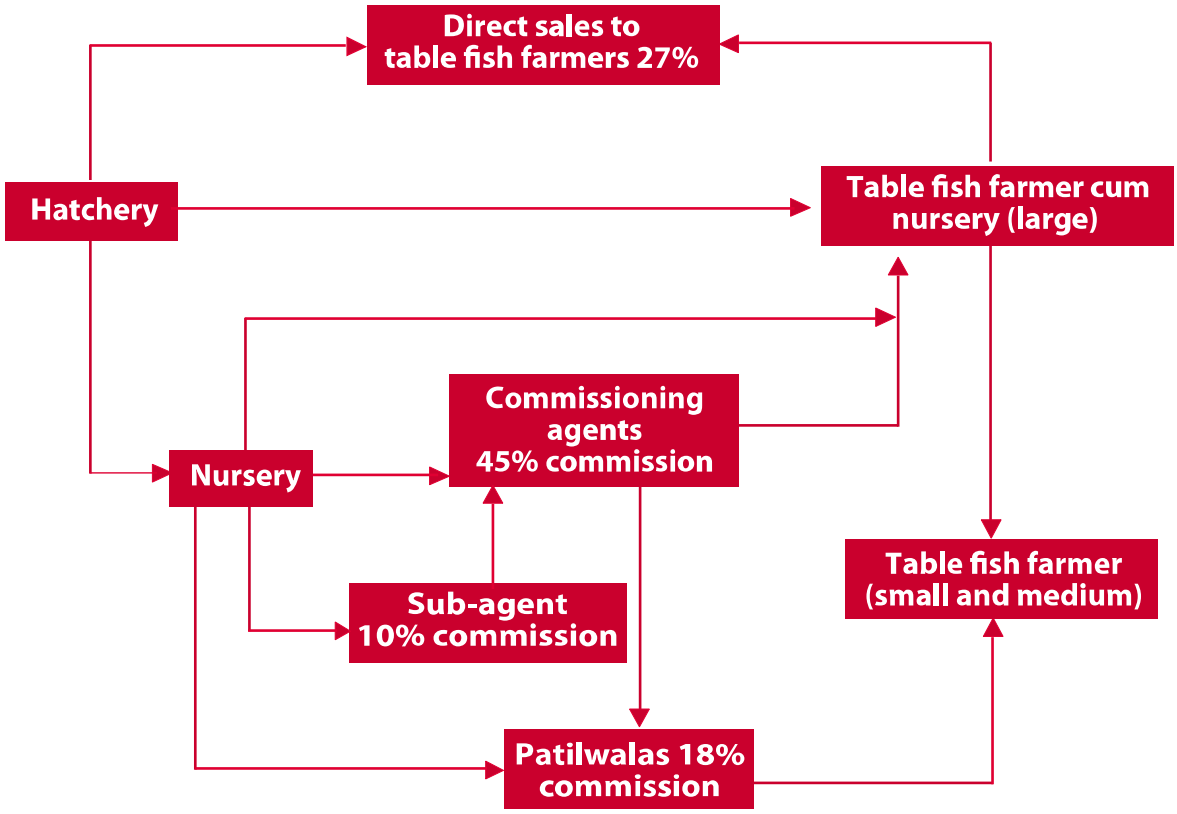

Figure 2. Existing trade channels for fry and fingerlings in the southwestern districts of Bangladesh.

A suitable coping strategy is necessary considering the demand for different sizes of fish seed in different seasons, the extreme vulnerability of carp and prawn farming to climate change, and the big challenge of complex, competitive markets. Several authors have suggested carp and prawn adaptation techniques such as community based strategies (Ahmed et al., 2014), translocation of prawn farming from coastal to inland areas (Ahmed and Diana, 2015), and mixed culture of prawn and shrimp in coastal Bangladesh because of increased water salinity (Ahmed et al., 2013). However, adapting carp and prawn nursing to the biological, environmental, and business challenges requires a combination of advanced nursing and farming techniques. Therefore, considering the present situation of fish/ prawn seed supply, environmental uncertainties and market unstability, this study was conducted to characterize the nursing practices, document the environmental adaptations of farmers, and establish a business model based on advanced nursing practices.

The specific objectives of the study were to:

- Characterize different carp and prawn nursing practices
- Assess their adaptability to the changing environment/weather cycles
- Recommend steps/strategies to increase adaptability and resilience under changing fish cultural seasons
- Document a business model for advanced nursing practices introduced by IFSL
- Make suggestions on how farmers can be linked to the market to minimize the existing demand and supply gap in seed markets.

Methodology of the study

Study area and period

The study was conducted in Batiaghata and Rupsha upazilas of Khulna; and Fakirhat, Chitalmari, Mollahat and Bagerhat Sadar upazilas of Bagerhat districts in the southwestern coastal area of Bangladesh (Figure 3). The IFSL project areas were selected as the study area where remarkable development of fish and prawn farming has already taken place through the project. A significant number of farmers have converted their rice fields to fish and prawn farms, locally known as "gher" (Ahmed and Diana, 2015; Hasanuzzaman et al., 2011). Field research was conducted for a period of three months from November 26, 2017 to January 31, 2018.

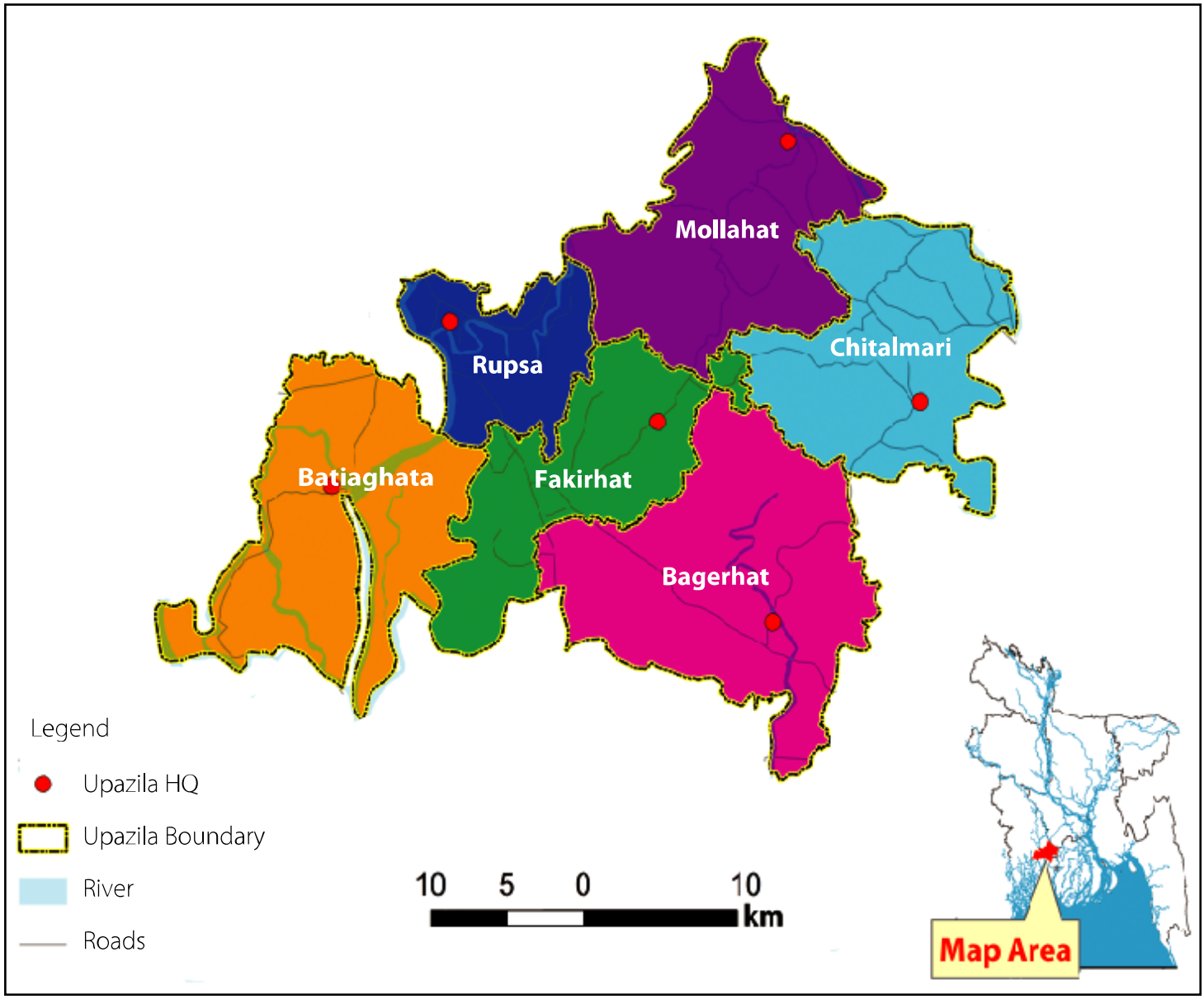

Figure 3. Map of study areas.

Study population

The target population for this study were advanced fish farmers, Local Service Providers (LSP), fish seed suppliers, arotdars, school teachers, local government representatives, and social workers. A total of 95 farmers actively participated in 12 focus group discussion from six different upazilas. In addition, key information was also collected from university teachers and upazila Fisheries Officers.

Data collection

Focus group discussion (FGD)

Prior to conducting the FGD, guidelines were prepared and training was prodivided to enumerators (three BSc students of Fisheries and Marine Resource Technology Discipline, Khulna University) through pilot testing of the FGD. FGD were then conducted with the targeted participants in six different Upazillas of Khulna and Bagerhat districts to obtain information regarding carp and prawn nursing practices, environmental fluctuations in coastal areas, adaptation mechanisms to climate change, marketing of carp and prawn seeds, and the scope of using different advanced nursing practices to overcome their problems (related to seed availability, environmental adaptations and business challenges). A total 81 farmers and 14 LSPs participated in 12 FGD sessions (two FGD conducted in each upazila), where each group consisted of 6-12 people. The FGD sessions lasted about two hours, and were held on schools premises, in farmers' houses, and in community meeting areas.

Key informants interview

Guidelines for key informant's interviews were prepared to collect information from key informants of Khulna University and the Department of Fisheries (DoF). A total of 6 key informants participated in the KII, who have expert knowledge on aquaculture and the impact of climate change on carp and prawn farming (Figure 4).

Figure 4. KII with Dr. Dilip Kumar Datta, Environmental Disipline, KU.

Information collection on advanced nursing technologies through special consultation

Information on advanced fish producing technologies was collected by consulting with the LSP and advanced farmers of Alypur village in Rupsha Upazilla who had adopted advanced technologies from IFSL recommended technologies beforehand (Figure 5). Some of them had been practicing community based adaptation (Ahmed et al., 2014), mixed culture of prawn and shrimp in coastal Bangladesh (Ahmed et al., 2013), and translocation of prawn farm from coastal to inland areas (Ahmed and Diana, 2015). Most of the advanced technologies in the study area were introduced by WorldFish Bangladesh through the IFSL project. These include overwintering carp and prawn seed nursing (due to cheaper prices late in the season, fry or fingerlings in the pond/gher are densely stocked with less feed in a stressed condition in winter. This is done to meet the demands of the following season that often sees a surge in price), carp fattening mixed with prawn (comparatively bigger sized overwintered carp and prawn are stocked in larger size pond/ghers at a very low density and are cultured for 12-14 months), nursing in rice fields, carp and prawn nursing management, and nursing in WISH ponds (Figure 6).

Figure 5. Discussion with an LSP on cutting-edge technologies

Figure 6. A WISH pond for nursing carp and prawn seed

Data analysis

The information from FGD and KII interview was scored, recorded, processed, formulated and analyzed using Microsoft Excel-2010.

Results

Farmers in southwest Bangladesh use various types of carp seed (hatchlings, fry, fingerlings, 5-6 pieces per kg, 1-2 pieces per kg) and prawn (post-larvae, juvenile, adolescent, etc.) in their farms. Most of the seed is supplied in this area are supplied by a number of intermediaries who collect them from other parts of the country. In addition, the coastal region is affected by many environmental fluctuations, including sudden flooding, heavy rain, drought, water logging etc. Sudden flooding was claimed to be the cause of the highest losses to this industry. In addition, a huge gap in prices has been identified between the nursery owners and the grow-out farmers as several intermediaries are also involved in the market. The following sections describe the present scenario of carp and prawn nursing in Khulna and Bagerhat, the effect of environmental uncertainties on nursing and culture of carp and prawn, and the complexity in the marketing and distribution of seed. Finally, upon finding the gaps, the sections also discuss adaptation strategies of farmers using advanced nursing practices.

Carp and prawn nursing practices in southwest Bangladesh

Ninety-nine percent of the farmers that participated in FGD reported that they practice prawn and carp polyculture in *ghers*. Some advanced fish farmers in Chitalmari and Fakirhat upazila in Bagerhat district are integrating tiger shrimp (*P. monodon*) with *Macrobrachium* and carp in their *ghers*. In these coastal districts, most of the fish farmers culture prawns as the main crop integrated with different indigenous and exotic carps. The major carp species include *Labeo rohita, Catla catla, Cirhinus cirhosus, Labeo calbasu, Hypophthalmichthys molitrix, Ctenopharyngodonidella*, etc. Around 5-7% of advanced fish farmers in the study area have adopted technologies to ensure the better supply of seed. At present, 85% of seed come from Jessore and Fultala region in the southwestern part of Bangladesh. About 95% of the farmers claimed that they often do not get an adequate number of quality seed in time. They suggested that the presence of multiple intermediaries and poor management might responsible for the problems in the seed supply chain. Moreover, poor farmers often need to pay in advance to get the seed in a timely manner as the suppliers are worried about not being paid. Intermediaries share more than 50% of the market benefits and farmers pay almost double the first sale price of seed. To overcome a market crisis on quality and quantity of different sized seed, WorldFish, through IFSL project, worked with 25 % of the LSPs and some advanced farmers to nurse their own carp instead of depending on external suppliers. In this process, the fingerlings are overwintered (stocked at high density with with less food that prevents them from growing too big) during the winter season. Later during the following summer, these fingerlings are stocked in the ponds at regular densities in a suitable environment to allow them to grow faster than usual.

About 25-30 % farmers nurse prawn PL up to the juvenile stage at the beginning of summer in a part of a canal of a gher. However, 98% do not maintain standard nursing practices such as stocking density, feed and feeding rate, controlling environmental parameters, fertilizing, and health and growth checking. Among the farmers who practice nursing, many do not prepare their ponds before they start the nursing process. Forty to fifty percent of them do not have a designated nursery pond and create a partition using nets in the ghers for nursing. Ten to twenty percent of farmers encounter diseases in the fish during nursing. The main problem, however is the scarcity of PL from hatcheries due to huge mortalities during the early stages (Early Mortality Syndrome, EMS). This leads to most of the farmers depending on naturally caught PL from coastal rivers. There is scope to improve the supply of prawn from the hatcheries and reducing the pressure on wild caught PL through proper nursing practices. The present scenario of prawn and carp nursing is given below (Table 4 and 5).

Species	Size of nursing	Stocking period	Stocking time in grow-out
Prawn	PL to Juvenile	May - June, year round	June-July
Prawn	Juvenile to adolescent	June-July	July -Sept
Pra wn	Juvenile to adolescent	Nov -Feb (Overwinter)	March -April

Table 4. Scenario of prawn seeds used by the farmers and their nursing status in the study area.

Species	Nursing categories	Stocking period in nursery	Stocking time in grow-out
Rohu, Catla, Mrigal etc.	Hatchlings to fingerlings (100 -150 pieces per kg)	March -May	June -July
	Fingerlings to 5 - 6 inches (10 -12 pieces per kg)	May -July	July -August
	4-6 pieces per kg	Oct-March (Overwinter)	April -June
	1-2 pieces per kg	Oct-March (Overwinter) Some of the advanced farmers produce this size fish seed through overwinter nursing practice, especially this seed is used for carp fattening mixed with prawn a IFSL introduced technology	April -June

***A few advanced farmers are nursing in the study area, most of them depend on other sources for the seeds.

Table 5. Scenario of carp seed used by the farmers and their nursing staus in the study area.

The study found that farmers are unable to get the amount of prawn seed they need because of under production of the seed. Two similar gaps were found in the carp seed supply. Firstly, due to miscommunication or unethical business practices of many intermediaries, there is an information gap between the farmer and the nursery operators. Secondly, because the farmers start to culture their fish at different times of the year, the present nursing system fails to supply enough seed at the right time. In order to address the situation, advanced nursing technology for carp and prawn has been introduced by the WorldFish-IFSL project, including carp fattening mixed with prawn, overwintering carp and prawn nursing, and nursing of carp and prawn in WISH ponds, which have proven to be effective. Farmers said they benefited from the advanced nursing system in terms of fulfilling their demands.

Practice	Priority	Respondant	In practice
Overwintering carp	1	5	5
Nursing carp and prawn in rice field	2	3	3
Wish pond nursing	3	3	3

Table 6. A qualitative ranking of identified practices against the challnges.

Figure 7. Carp nursery management, Alypur, Rupsha

Figure 8. Overwintering carp nursing trials, Alaypur

Figure 9. Carp fattening mixed with prawn, Alypur, Rupsha

Figure 10. Nursing carp and prawn in rice field, Alypur, Rupsha

Adaptability of nursing practices to the changing environment

In the study, representative farmers from the coastal districts claimed that they face various natural calamities and environmental changes during nursing and grow-out. Prominent climate change events include sudden floods, excessive rainfall, drought, water logging, late rain, high temperatures, etc. In some years, different environmental events may even happen several times a year. Farmers also face problems created by human intervention including poor drainage, mismanagement of sluice gates and forceful acquisition of natural water bodies and canals by local political elites. They reported sudden floods as the most devastating calamity for their nursing and culture activities destroying anywhere from 20% to 100% of produc. The highest loss was due to a recent flash flood that occurred because of the torrential rain on August 20, 2016 affecting farmers in Fakirhat region, followed by farmers in Rupsha. About 70-75% losses were recorded in Mollahat, Bagerhat, and Chitalmari. However, it was the lowest in Batiaghata due to functioning drainage systems linked to the Pashur and Rupsha rivers. The FGD participants reported that in the majority of cases, the floods occurred due to a poor drainage systems leading to overflowing of rivers during monsoon storm surges. Along with flooding, this stretch of coastal region is severely affected by cyclones such as Sidr in 2007 and Aila in 2009 making them even more vulnerable. Recently, farmers in Khulna and Bagerhat districts have also faced two other impending disasters; drought and salinity intrusion.

About 5-7 % farmers try to protect their ponds or ghers by enclosing them with nets, which are expensive. More than 90% of farmers said they did not get enough time to prepare their nets because of the sudden onset of floods. Thirty to forty percent farmers get involved in other income generating activities such as services, businesses, day laboring, and agricultural farming to cope with environmental change. However, for the majority of people, the compensation is not enough to combat having lost everything to floods. Participants in this study also reported that after the flood and heavy rain, the natural productivity of the farms falls drastically due to deteriorating water quality. In addition, when ghers are restocked with carp and prawn seed after the flood, farmers face disease outbreaks due to polluted flood water. Ninety eight percent of the partcipants of Fakirhat, Mollahat, Chitalmari, Rupsha and Bagerhat Sadar claimed that the poor drainage system is responsible for sudden floods in these six upazillas. At Batiaghata this percentage was reported to be 40-50%. Recently, farmers have started to feel that the weather cycle is also changing in the coastal regions. They said they are suffering from high temperatures, drought, late rain, irregular prolonged and short winters, extremely low temperatures in winter and even water logging in some areas. The changes in weather cycle are affecting the nursing and culturing of fish. Farmers are trying to adapt to the environmental and weather cycles through modifying crop patterns, alternate livelihoods, (small scale agriculture, grocery, tailoring, day labouring, small businesses/jobs) and other means, without much success. Unfortunately, 90% farmers do not have any training on advanced aquaculture techniques of aquaculture and thus, most of them do not know how to protect their nursery and grow-out crops in order to meet the demand of grow-out farmers.

Recommendations for increasing climate change adaptability and resilience

Most of the participants have realized that their adaptability to environmental changes might be enhanced through improving drainage systems updating fish nursing and farming technology, training farmers on scientific culture techniques and supporting disease identification and response. In this study about 44% of farmers claimed that improving drainage facilities through sluice gate management and canal excavation could possibly help to increase their resilence. A significant proportion of farmers (24%) said they generated lower revenues from their prawn farming in local and export

markets in last two years due to inconsistent demand and supply. They think that a higher price for their products might help them cope with the situation. Some motivated (12%) farmers think that advanced fish nursing and culture technologies might be good options for enhancing adaptation to climate change. A few farmers think that financial assistance (8%), disease preventive techniques in nursing and culture (4%) and good water sources (4%) might also be good options to enhance their adaptative capacity to climate change. The government and NGOs should assist the farmers with microcredit facilities or easy loan opportunities to increase their resilence. Farmers should be trained in eco-friendly and integrated aquaculture approaches to reduce the risk of disease outbreaks. Moreover, they should be encouraged to start probiotics, prebiotic and biofloc based aquaculture for better microbial community and environmental management.

One of the key informants said, "Crab fattening might be a good option to enhance the adaptability of environmental changes. I think that the catastrophic chain in sediment distribution might be the main cause of water logging in the study area, and citizen awareness and government effort is needed to overcome these problems. In addition, the farmers should develop hatcheries and nurseries, and stop collecting natural fish seed and prawn PL".

Another key informant suggested, *"Nursing of PL and carp should be done as a community of farmers (near by cultured ponds); thereby, enhance the supply and distribution of quality seeds and I am happy that WorldFish through IFSL already took such initiatives. New techniques should be adopted to develop healthy and disease free seeds, and to ensure sufficient supply of them. Alternative livelihood options should be created for the farmers during their shocks/crises and balancing gender distribution in family income. Government should take initiatives to find out the inbreeding problems in carp hatchery and develop brood bank for prawn. As WorldFish has already developed brood banks for carp, they can start prawn brood bank development in collaboration with Department of Fisheries of Bangladesh. There should also be some mechanisms to trace out the transboundary movement of seeds from other countires. In addition, there should be development of temperature adapted, salinity tolerant, or other improved genetic strain of prawn and carps on the basis of molecular markers".*

During periods of environmental uncertainty, the farmers face difficulties in nursing of carp and prawn seed such as prolong dry period, extremely high temperature during summers, long winter, extremely low temperature during winter, and increased salinity. These lead to seed shortages during the early summer when farmers most need them to stock their grow-out ponds. Advanced nursing practices such as the use of wish ponds techniques (Figure 6) can be used for carp and prawn nursing during prolonged dry season. Nursing in rice fields (Figure 10) might be a good technique to overcome the problem of high temperatures. Overwintered nursing (Figure 5) can be practiced at low temperatures and during long winters. Finally, integration of *Paeneus monodon* with prawn and carp nursing may be an alternative way to overcome the salinity intrusion problem.

Business models of carp and prawn nursing practices

During this study we observed a complex supply-demand-marketing system for the distribution of prawn and carp seed from hatcheries to grow-out farmers. The Senior Upazila Fisheries Officer (SUFO) from Fakirhat upazilla, and advanced farmers and LSPs from Mollahat upazila reported that about 80% of carp seed comes from Jessore that is 60-80 km away from farming area, 5% come from the neighbouring upazila Fultala and the remaining 15% come from different government hatcheries located in nearby farming areas (Khulna, Dumuria, and Gopalgonj). They also reported that in the Bagerhat and Khulna region, about 20-30% of prawn PLs are supplied by local hatcheries. However, recent EMS problems have had a negative affect on the supply from hatcheries. Most (70-80%) of Prawn PL

are collected naturally from coastal rivers in Patuakhali, Barisal, Bagerhat, Noakhali, and Khulna districts.

The long and complex chain of intermediaries includes wholesalers (arotdar, paiker or bepari) and local fry traders (Faria), patilwala. Hence, the hatchery owner/nurserer gets a lower price by selling their seed to the intermediaries. Occasionally, the seed marketing chain depends on the supply, if the supply is high then they sell it to wholesalers, but when the supply is low then the nurserer sells to local fry traders. Through this complex marketing system, the grow-out farmers get their seed at an inflated price from different levels of intermediaries. In most of the cases, the grow-out farmers do not know the origin of the seed. Thus, they are supplied with low quality seed. In addition, small fry are stressed (through transportation, counting, water adjustment, etc.) before being released in the farms which reduces their quality and results in high mortality. As a result, farmers get low production of fish. Although farmers reported being able to get their seed at short notice, it is only possible through advance payment by booking with the middleman or commission agents and at a premium price. The prime concern of the farmers is the quality of seed. The existing business model of prawn and carp seed from the nursery to the grow-out farmers is given below (Figure 11 and Figure 12).

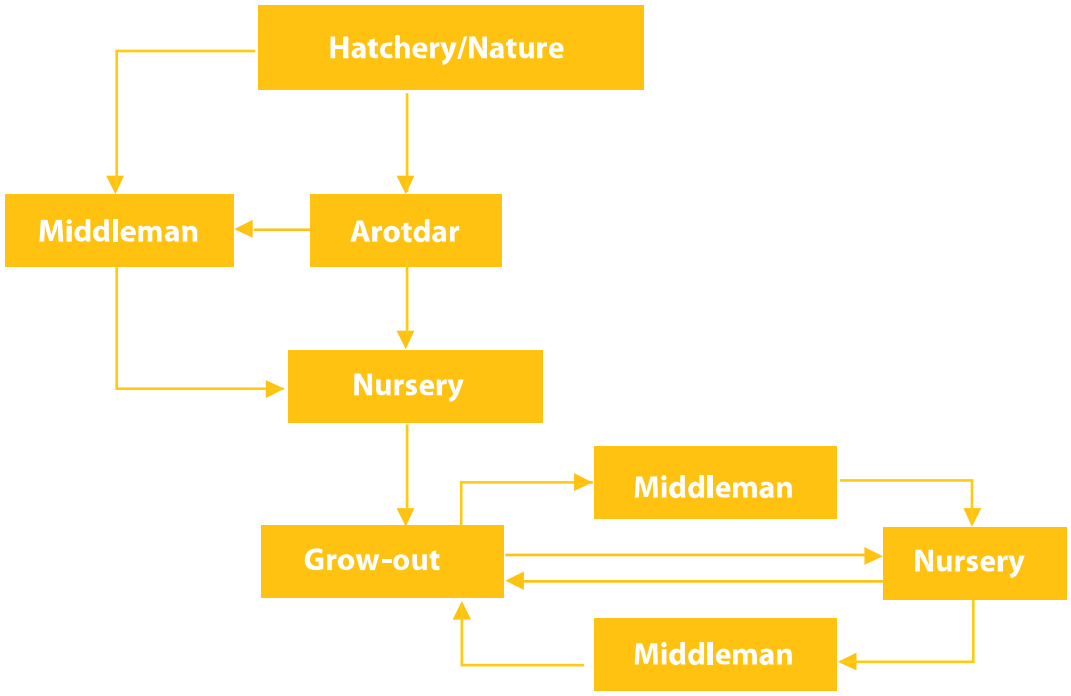

Figure 11. Existing business model of Prawn seed in Khulna and Bagerhat districts (based on this study)

This study found there are several gaps in current present carp and prawn nursing practices. The grow-out farmers do not have direct connections with hatchery owners. Hence, most of the farmers do not have information on the genetic and other biological characters of the seed. In addition, many intermediaries end up taking the maximum share of profits. Furthermore, handling (carrying at high density, counting in different markets, using water from different sources of young seeds) by multiple, often untrained, middlemen causes deterioration of seed quality. It is recommended that the seed supplier inform farmers about the source and quality of seed during sales.

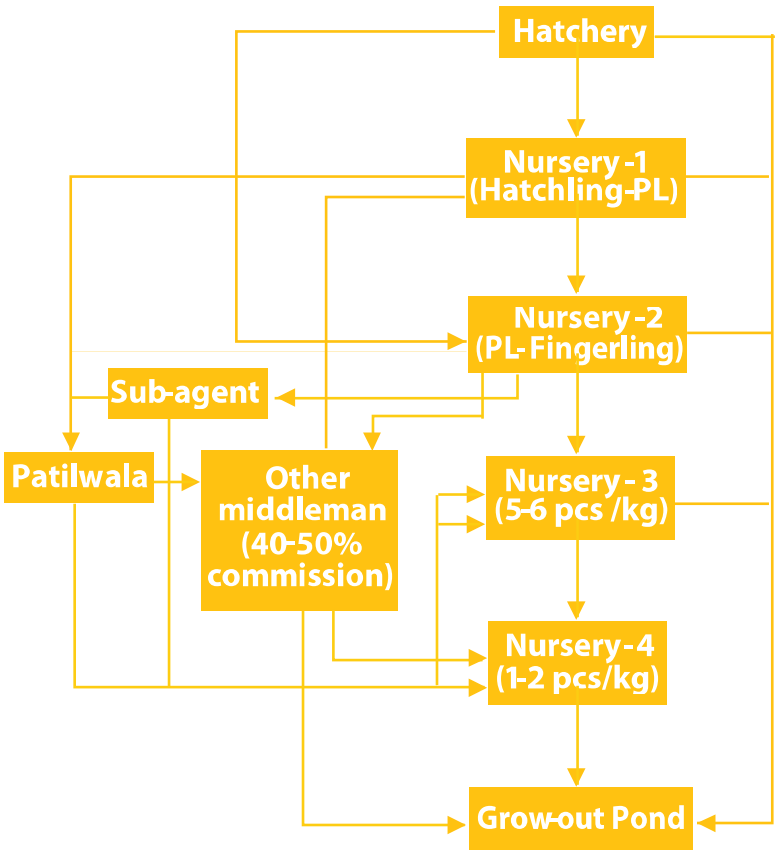

Figure 12. Existing business model of prawn and carp fry in Khulna and Bagerhat district (based on this study).

After surveying different advanced farmers who are already practicing the improved technologies (e.g. over wintering nursing, nursing in WISH ponds nursing fry and PL in rice field) for carp and prawn seed nursing, this business model has been introduced by IFSL (Figure 13). In this model, LSPs, who provide embedded services to the farmers, have the information on the quality of seed and PL. LSPs deliver seed to the ponds and farmers get the seed at the maximum retail price (MRP). LSPs directly purchase seed from the hatchery/nursery according to farmers need that is identified through surveys well ahead in the season. LSPs get a service commission from hatchery/nursery owners due to bulk purchase under agreement clauses determined by the business owners and the LSPs. Sometimes the LSPs themselves practice nursing in their own facility to provide better service to the producer group members. This system develops an efficient farmer community with the involvement of nursery owners, grow-out farmers, LSPs, and SPAs. Similar community based fisheries management systems have been proven to be successful in Galicia (around Ria De Arousa), Spain, where a community of 203 people manage a natural stock of clams by themselves. They have their own hatchery to restock the Ria with clam seed. A representative team is responsible for clam collection, a team is responsible for clam processing, and another team is responsible for marketing. Evidently, verification of seed is more accessible to the grow-out farmers and they can easily get the seed from local expert farmers according to their need at any time of the year. It is forecasted that using this model, the price of the seed in the study areas can be reduced by at least 15-25% by discarding or improving most of intermediaries. In addition, advanced nursing techniques, including overwintering nursing, nursing at WISH pond , nursing in rice field etc. will ensure year round carp and prawn seed supply in response to the demand of farmers.

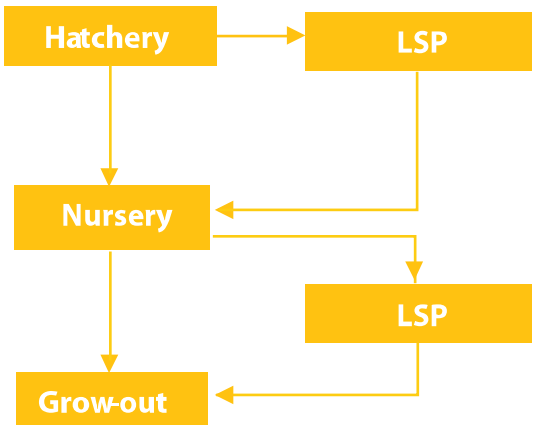

Figure 13. Business model for advanced carp-prawn nursing practices.

Advanced technology extension through market system approach through involving LSP

The IFSL producer group members in the study area that participated in FFD of IFSL on advanced nurseries, adopted advanced nursing practices. In addition, the fish farmers got quality seed with additional support through LSPs. LSPs are unique market actors who can mitigate the supply-demand gap for quality fish seed through their collaborative capability and business goodwill. LSPs are the only intermediary in this recommended business system with the advanced nursing practices. LSPs are often advanced farmers who have had proper training on fish farming and nursing. They maintain linkages with different hatcheries (WorldFish-IFSL supported, DoF regulated, and hatcheries/ nurseries controlled by Fisheries Research Institutes) through which they can supply quality seed to local nurserers in the community. IFSL trained the LSPs, who are now motivating the nursurers to follow advanced nursing practices, giving them technical and logistical support, and helping them to harvest and market their products. In addition the grow-out farmers are reporting their seed requirements to the LSPs including the type, quality, amount, and time, and place. With this information, LSPs are communicating with the nurserers, managing the seed and supplying it to grow-out farmers. In this new marketing system, LSPs are providing required seed/PL to farmers with MRP price along with other embedded services, effectively dropping several middlemen. Under the IFSL project, there is an agreement among the SPAs and hatchery owners to supply quality seed to the producer groups while the SPAs regulate their operations. In this setting, the LSPs now get a set percentage of the business value through a fair business transaction. Furthermore, the producers, intermediaries, and final seed users are well informed about the quality and actual price of the seeds as there are fewer intermediaries. Farmers and nursery operators giving a set percentage of business profits to the LSPs is a sustainable business model as the LSPs have an incentive to continue performing. Evidently, the gaps in communication, quality of fish, quantity of fish, and the financial chain have been minimized significantly through this business model.

Discussion

The existing seasonal cycle of aquaculture is changing due to global warming that hampers proper planning of aquaculture. Farmers try to adopt different methods to collect sufficient seed supplies throughout the year. However, these efforts often fail due to a lack of proper technologies and irregular supply of seed. Moreover, seed quality deteriorates due to long transportation periods and poor handling by different intermediaries meaning most farmers do not get sufficient high quality seed at the right time of year. Most of the farmers often do not get high quality seed in the required quantities in a timely fashion. Poor farmers often need to pay in advance as the suppliers do not want to risk not getting paid. WorldFish, through the IFSL project, worked with a few LSPs and advanced farmers on nursing carp for producer group members. The technologies introduced by IFSL (overwintering carp and prawn nursing, nursing in rice fields, carp fattening mixed with prawn, and utilizing WISH ponds for nursing purposes) help farmers meet their own demand of seed to some extent. LSPs play a key role in the whole process and help smallholder farmers by shortening the distribution channels. Joffre et al., (2017) suggested engaging the private sector in aquaculture innovation. The community level private sector would be a suitable source of support for small scale aquaculture farmers. The Bangladesh government has also promoted various seed improvement programs. (World Bank, 2007)

Farmers also face problems in getting sufficient high quality prawn PL supplies by poor nursing techniques, poor pond management, disease incidence during nursing, and scarcity of PLs from hatchery due to huge mortality. It is expected that the survival of prawn PLs from hatchery might increase through proper nursing practices. Evidently, nursing might be one of the options that can reduce the pressure on the capture of wild PLs. The most common improved management strategy includes nursing prawn PLs as has been shown in Thailand (Schwantes, V.S., 2007). WorldFish is currently in the process of developing a carp brood bank in collaboration with DoF. Similar arrangements should be made for prawn.

Adaptability to environmental changes can be enhanced through developing improved drainage systems. In some cases, financial assistance, disease protection, and accessible water sources might be effective to enhance adaptive capacity. Increasing water salinity was noted and could be addressed by developing crab fattening.

Conclusions and recommendations

Nursing through advanced techniques can fulfill the gaps in present carp and prawn nursing in southwest Bangladesh. These techniques can help to adjust or minimize the effects of environmental changes in the aquaculture industry as well. Nursing techniques can also lessen the shortfalls and complexity of the current business model, thereby making the industry more efficient.

Recommendations from this study are as follows:

- Introduction of prawn PL and carp nursing systems at community level would help farmers to get quality seed on time and at reasonable prices.
- LSPs should dessiminate information on advanced nursing practices introduced by IFSL (carp fattening mixed with golda, overwintering carp nursing, wish pond technique, and nursing under pressure) to address local gaps in seed supply, which will ultimately increase business opportunities.
- There is scope for government or other organizations to work with aquaculture farmers in this area to help them explore alternative livelihood options to build their resilience to natural shocks and environmental changes.

Notes

1 WorldFish has designed a portable small pond which can be used for both grow out and nursing purpose. It is made of polythene, 50 kg size plastic bag (empty fish feed bag) is full with soil and sand mixture, rope, etc. Experimentally this WISH (water and fish) pond were tested for integrated aquaculture and horticulture among the rural pondless and peri-urban landless households. This produced fish and vegetable for regular household consumption and demonstrated resilience against medium scale flooding and salinity intrusion. Later on farmers use this WISH pond for nursing carp, prawn and other fishes. It shows remarkable results for nursing.

2 Farmers practicing integrated culture of prawn or shrimp with carps with training from government and non-government organizations on adopting new technologies in nursery and growout culture.

References

Ahmed N., Brown J.H. and Muir J.F. (2008). Freshwater prawn farming in gher systems in southwest Bangladesh. Aquaculture Economics & Management, 12 (3), 207-223. DOI: 10.1080/13657300802306111.

Ahmed N., Bunting S.W., Rahman S. and Garforth C.J. (2014). Community-based climate change adaptation strategies for integrated prawn–fish–rice farming in Bangladesh to promote social-ecological resilience. Rev. Aquacult. 6, 20–35.

Ahmed N. and Diana J.S. (2015). Coastal to inland: expansion of prawn farming for adaptation to climate change in Bangladesh. Aquaculture Reports, 2, 67-76.

Ahmed N. and Garnett S.T. (2010). Sustainability of Freshwater Prawn Farming in Rice Fields in Southwest Bangladesh. Journal of Sustainable Agriculture, 34(6), 659-679. DOI: 10.1080/10440046.2010.493397.

Ahmed N., Occhipinti-Ambrogi A. and Muir J.F. (2013). The impact of climate change on prawn post-larvae fishing in coastal Bangladesh: socioeconomic and ecological perspectives. Mar. Policy, 39, 224–233.

Asif A.A., Samad M.A., Rahman B.M.S., Rahman M.A., Rahman M.H., Yeasmin S.M. and Nima A. (2014). Study on management of fish fry and fingerling marketing of Jessore in Bangladesh. International Journal of Business, Social and Scientific Research, 2(2), 127-135.

Dasgupta S., Huq M., Khan Z.H., Ahmed M.M.Z., Mukherjee N., Khan M.F. and Pandey K. (2011). Cyclones in a Changing Climate: the Case of Bangladesh. Department for Environment, Food and Rural Affairs, London.

DoF (2016). National fish week, compendium (In Bengali). Dhaka: Department of Fisheries, Ministry of Fisheries and Livestock, Government of Bangladesh.

FRSS, 2013. Fisheries Statistical Yearbook of Bangladesh. Fisheries Resources Survey System (FRSS), Department of Fisheries, Bangladesh. Volume 29:44 p.

FRSS, 2014. Fisheries Statistical Yearbook of Bangladesh. Fisheries Resources Survey System (FRSS), Department of Fisheries, Bangladesh. Volume 30:52 p.

FRSS, 2015. Fisheries Statistical Report of Bangladesh. Fisheries Resources Survey System (FRSS), Department of Fisheries, Bangladesh. Volume 31:57 p

FRSS, 2016. Fisheries Statistical Report of Bangladesh. Fisheries Resources Survey System (FRSS), Department of Fisheries, Bangladesh. Volume 32:57 p.

FRSS, 2017. Yearbook of Fisheries Statistics of Bangladesh. Fisheries Resources Survey System (FRSS), Department of Fisheries, Bangladesh. Volume 33:124 p.

Ghose, B. (2014). Fisheries and aquaculture in Bangladesh: Challenges and opportunities. Annals of Aquaculture and Research 1(1), 1e5.

GoB (2008). Cyclone Sidr in Bangladesh: Damage, Loss, and Needs Assessment for Disaster Recovery and Reconstruction. Government of Bangladesh, Dhaka.

GoB (2009). Bangladesh Climate Change Strategy and Action Plan 2009. Government of Bangladesh, Dhaka.

Harmeling S. and Eckstein D. (2012). Global climate risk index 2013. In: Who Suffers Most from Extreme Weather Events? Weather-related Loss Events in 2011 and 1992–2011. Germanwatch, Bonn.

Hasanuzzaman A.F.M., Rahman M.A. and Islam S.S. (2011). Practice and Economics of Freshwater Prawn Farming in Seasonally Saline Rice Field in Bangladesh. Mesopot. J. Mar. Sci., 26(1), 69-78.

Hossain M.A.R. (2014). An overview of fisheries sector of Bangladesh. Res. Agric. Livest. Fish, 1(1), 109-126. http://dx.doi.org/10.3329/ralf.v1i1.22375.

Islam M.A. (1989). Fish Seed production in Bangladesh. Proceeding of the SAARC Workshop on Fish seed Production, 11-12 June, Dhaka, Bangladesh. pp. 1-12.

Joffre, O.M., Klerkx, L., Malcolm Dickson, Malcolm D. and Marc Verdegem, M. 2017. How is innovation in aquaculture conceptualized and managed? A systematic literature review and reflection framework to inform analysis and action, Aquaculture, Aquaculture 470 (2017) 129–148 (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Kreft S., Eckstein D., Junghans L., Kerestan C. and Hagen U. (2014). Global climate risk index 2015. In: Who Suffers Most from Extreme Weather Events? Weather-related Loss Events in 2013 and 1994–2013. Germanwatch, Bonn.

MacRae I.H., Chapman G., Nabi S.M.N. and Dhar G.C. (2002). A survey of health issues in carp/ Macrobrachium culture in rice fields in Bangladesh. In: Primary Aquatic Animal Health Care in Rural, Small-Scale, Aquaculture Development, FAO Fisheries Technical Paper 406 (ed. by J.R. Arthur, M.J. Phillips, R.P. Subasinghe, M.B. Reantaso, I.H. MacRae), pp. 95–112. FAO, Rome, Italy.

Nasreen M. (2017). Environment and climate action: Challenges for disaster risk reduction. The Daily Star News, February 26, 2017.

Shamsuzzaman M.M., Islam M.M., Tania N.J., Al-Mamun M.A., Barman P.P. and Xu X. (2017). Fisheries resources of Bangladesh: Present status and future direction. Aquaculture and Fisheries, 2, 145-156.

Sharif B.M.N. and Abdulla-Al-Asif (2015). Present status of fish hatchlings and fry production management in greater Jessore, Bangladesh. International Journal of Fisheries and Aquatic Studies, 2(5), 123-127.

Vicki S. Schwantes, V.S. 2007. Social, Economic, and Production Characteristics of Freshwater Prawn Macrobrachiumrosenbergii Culture in Thailand, A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science, School of Natural Resources and Environment, The University of Michigan, May 2007.

World Bank (2000). Bangladesh: Climate Change and Sustainable Development. Report No. 21,104-BD. The World Bank, Dhaka.

World Bank 2007. Changing the Face of the Waters, THE PROMISE AND CHALLENGE OF SUSTAINABLE AQUACULTURE, Edited in Agriculture and Rural Development, The WorldBank (41694).

World Bank (2012). Bangladesh and Maldives Respond to Climate Change Impacts. The World Bank, Washington DC, Press Release.

Photo credit: Back cover, Nazneen Kiran/WorldFish

The publication should be cited as: Islam SS, Khan N, Qazi A and Dickson M. 2018. Identifying suitable carp and prawn nursing practices under changing environmental cycles and developing their business model by linking with market and farmers. Khulna, Bangladesh: WorldFish. Special Study Report.

www.worldfishcenter.org

UKaid from the British people

United Purpose Out of poverty

CGIAR RESEARCH PROGRAM ON Fish

WorldFish