



## Land Utilization Pattern and Perception on Sustainable Development Concerning on Environmental, Social, Economic and Institutional Impact on Shrimp Farming in Coastal Belt of Bangladesh

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**Abstract:** Shrimp is one of the major export item in Bangladesh. Total shrimp and prawn production including capture fisheries were increased from 1,60,000 MT in 2002-03 to 2,46,000 MT in 2016-17. This study was conducted to find out the relationship between farmers' land utilization pattern and individual product market as well as perception on sustainable development aspect on environmental, social, economic and institutional impact on shrimp farming in coastal belt of Bangladesh. Five hundred Households data were collected from 13th sub-districts in Khulna division of Bangladesh during July 2010 to December 2010, purposively. Farmer's perception and attitude on shrimp farming impacts in these regions were considered as a part of sustainable development. The study revealed that after adopting shrimp farming land utilization patterns and cropping patterns has changed in both ways positively and negatively. Three (RS, RSFV and OS) farming systems were profitable. For shrimp, among the three (RS, RSFV and OS) farming systems, RSFV farming system is more profitable than RS and OS farming system. According to the farmers' perceptions and attitude in different aspect of impacts of shrimp farming, economically shrimp farming has big contribution on food security, employment opportunity, income generating opportunity, creating other linkage industries which is inter-related to social impact.

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### 1. Introduction

Shrimp farming is a sector with a very high degree of diversity, involving a wide range of species, farming systems and production practices, and farming locations. There are significant differences between and within countries regarding the levels of production intensity and yields, farm numbers and their sizes, and the various types of resources utilized. Shrimp farms are often classified into extensive (low input systems characterized by low stocking densities, little or no external nutritional inputs, tidal water exchange and shrimp yields of less than 500 kg/ha/yr.); semi-intensive (use of fertilizers combined with supplemental feeding, intermediate stocking, occasional pumping of water and yields of 1-2 tons/ha/yr.); and intensive systems (high stocking density, formulated complete feeds, aeration and water pumping with yields of more than 2 tons/ha/yr.). Such classification of shrimp farming systems are difficult, and can be rather arbitrary, given that there are additional characteristics, different criteria and terminologies were used. Farms may also use

monoculture or polyculture systems (polyculture systems are usually common with low input systems); they may operate as mixed systems (e.g. shrimp and mangrove farms); or by alternate cropping, involving one crop of shrimp followed by a harvest of another species or crop (e.g., rice-shrimp alternate cropping systems in Bangladesh, India, and Vietnam) (FAO, 1999).

Contribution of fish farming is better in national development in Bangladesh. Many of the environmental and ecological problems associated with shrimp farming have been criticized. A large number of literatures argued that the shrimp farming has many negative environmental impacts including mangrove deforestation, salinization of soil and water, depletion of wild shrimp and fish larvae stocks, coastal water pollution and loss of agricultural lands. Therefore, farmer's land utilization patterns and relation on product profit from each marketing

channel are very important for sustainable agriculture development.

In Bangladesh, the crop rotation of food grains production, especially rice-based production system is apparently popular and this approach has appeared to be harmful in protecting the land productivity. At present, rice covers about 75 percent of the cultivable land in Bangladesh. Area covers by other crops are as follows: pulses (4.64%), wheat (3.92%), oilseeds (3.77%), jute (3.71%), sugarcane (1.23%), potato (1.11%), fruits (0.84%) and vegetables (1.39%). The production system dominated by a single crop (i.e. rice) is neither scientific nor acceptable from the economic point of view. It is therefore, necessary to increase the cultivation and production of other crops. However, it considers the increasing demand for food grains and with a view to ensure food security. In order to increase crop production, supportive programs has been taken to rise per hectare yield through the use of modern technology and improved cultural practices along with the increased use of high yield variety (HYV) seeds. Agriculture is the main source of livelihood of two-third of the rural population; a serious concern has arisen about the sustainability of agriculture in the face of deterioration of land quality, declining yield, and increased population. Being a land-scarce country, emphasis has been given to increase food production by intensifying the use of land, inorganic fertilizers, pesticides and water. Subsidies are provided on inorganic fertilizers, pesticides, and irrigation equipments to enable farmers to adopt these technologies for increasing crop yields. These have caused major changes in cropping patterns, use of agricultural inputs, and management of soil fertility. Likewise, cropping intensity and the area under irrigation and HYV paddy have all increased considerably. Use of inorganic fertilizers increased six times during 1970–90, and the use of pesticides increased about three times in just one decade, during 1982–92 (Bangladesh Economic Review 2008).

Farmer's point of view in Bangladesh, shrimp and other high value of agricultural export products farming are profitable because farmers get better price. But, high value of agricultural product's export quantity is very small. Domestic marketing systems have been a major constraint to Bangladesh agricultural growth and its potential to reduce poverty. Market is localized, price fluctuates frequently, market is control by market intermediaries, and input price is high in commodity markets. Markets are generally restricted by limited market infrastructure, transport and accessibility, better pricing mechanism, ineffective market institutions and systems (channel, linkages and function), and disabling elements in the policy environment which indicate the market

standard. This research project will try to find out a relationship between farmers marketing channel and land utilization pattern. Therefore, hypothesis of the study, shrimp farming is profitable because of good export system for farmers. Hence, shrimp production has increased. On the other hand, profit from existing marketing channel is small. Land use of rice production has decreased. These have negative impact for environment. If rice-marketing system improves, rice farming would be profitable. Therefore, rice production would not be declined with a friendly environment.

The broad objective of the proposed study was to find out the relationship between farmers' land utilization pattern and individual product market as well as perception on sustainable development aspects (environmental, social, economic and institutional impacts) on shrimp farming in the coastal bent of Bangladesh. Cost and return were calculated for analyzing the profitability of different types of shrimp crop farming system.

Most of the literatures have been done on the reproductive behavior, strategies, embryonic development, soil degradation, agricultural technology adoption, impact of shrimp farming, impact of rice prawn farming, shrimp farming in Bangladesh as well as safety issues (Tasnova et al., 2015, Tasnova et al., 2014, Tasnova et al., 2010, Tasnoova and Iwamoto 2009, Swapan and Gavin, 2011; Paul and Vogl, 2011; Ahmed, 2008; Akhand and Hasan, 1992; Ali, 2006; Azad et al., 2005; Azad et al., 2007; Azam et al., 2010; Banks, 2003; Chanda, 1997; Deb, 1998; Hossain, et al., 2007; Hossain and Islam, 2007; Hossain et al., 2000; Giap and Lin CK, 2005; Hossain, 2001; Hossain and Islam, 2006; Islam, 2003; Islam, 2008; Ito, 2002; Ito, 2004; Ito, 2005; Ito, 2007; Ahmed et al., 2008; King, 1989; Nandeesh, 2003). However, in Bangladesh, a few study were done on land utilization pattern, individual product market, profitability and perception on sustainability aspects.

## 2. Methodology

For this study, data and information were collected from both primary and secondary sources. Five hundred Households data were collected from 13 sub-districts (Koyra, Dumuria, Fakirhat, Piakgacha, Mollahat, Satkira, Ashamuni, Dephata, Shamnager, fultola, Chitolmari, kaligong, Dakop) of Khulna, Berghat and Satkira districts in Khulna division of Bangladesh during July 2010 to December 2010 purposively. Farmer's perception and attitude on shrimp farming impacts in these regions were considered as a part of sustainable development.

During the survey, three types of farming system were found in this region. Such as,

- i. Only shrimp farming (OS) (70 households)

- ii. Rice shrimp farming (RS) (169 households)
- iii. Rice shrimp vegetables and fruits farming (RSVF) (261 households)

Semi-structured interviews were also conducted with personal of other stakeholder organizations. Besides, secondary data and information were collected from various organizations as well as from published and unpublished sources of government agencies and trade organizations of Bangladesh (type of documents, reports, handouts, notifications, etc), which were relevant in this study.

After tabulation, necessary adjustments were made such as local unit like land area bhiga were converted in hectare. The converted data were summarized, and tabulated in accordance with the objectives of the study. In Bangladesh, the rural household activities and income are not generally recorded. Therefore, it was difficult to estimate the household income accurately, particularly for unpaid household activities. The hired labors and paid money for machineries (tractors, water pump etc.) were considered as cost items. Most of the rural households have different types of expenditures such as rice, fish, vegetables, fruits, poultry, duck and livestock rearing, fishing nearby swamplands and canal etc., and saving activities for family consumption. Therefore, only the selling quantities were considered as income and buying quantities were included in cost items. The present study was other limitations. In the study areas, especially for rice shrimp farming (RS) and Rice shrimp vegetables and fruits farming (RSVF), farmers produced Bagda and Golda in separate pond or used same pond together. They didn't have any record about any separate cost and return for each pond/gher. Some farmers were scared to give the proper information to the unknown persons. The farmers may have thought that, the researchers came here as the government officials to collect taxes. Therefore, the researchers couldn't collect the information from these types of farmers. Only shrimp farming (OS), Rice shrimp farming (RS) and Rice shrimp vegetables and fruits farming (RSVF) were practiced only in southwest coastal belt of Bangladesh particularly in greater Khulna division. Khulna, Bagerhat and Satkira districts are well-known and farmers are practicing those tree types of farming in these three districts in Khulna division. Each product marketing information were collected.

#### Why farming system were categorized in three types?

In Bangladesh, there are two types of shrimp are cultivated.

- i. Bagda (*Penaeus monodon*) or Brackish water shrimp.
- ii. Golda (*Macrobrachium rosenbergii*) or Freshwater shrimp.

Shrimp culture started in Bangladesh in the coastal district of Satkhira in 1960s. Gradually its culture expanded to the coastal belts of Khulna, Bagerhat, Cox's Bazar and Chittagong and now the area under shrimp culture had increased from 52,000 ha in 1982-83 to 270,000 ha in 2007-08 (Bangladesh Frozen Food Exporters Association, BFFEA, 2009). About 90% shrimp land is located in the Khulna, Bagerhat, Satkhira and Cox's Bazar districts in the south-eastern region of the country which is shown in figure 1.

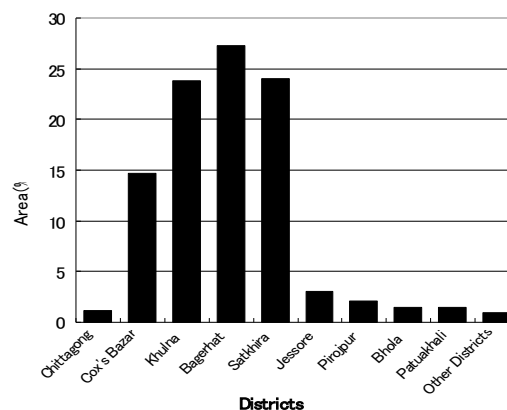


Fig. 1. Percentage of shrimp farming area in Bangladesh 2005-06

Source: Statistical Year Book Bangladesh 2008

The gher which are traditional earthen ponds or fields situated by riversides and impounded by dykes (Islam et al., 2005; Ahmed et al., 2008). For Aman rice, a gher is used to grow rice between the month of August and December/January, and shrimp culture is practiced during the month of February to July/August. For Boro rice, a gher is used to grow rice between the month of January and March/April, and shrimp culture is practiced during the rest of the months. The rapid growth of gher farming has negative environmental impact which was short term and long term impact such as land degradation and salt water intrusion, pollution, loss of capture fishery stock and seed supply, diseases and danger of imported fry and genetic alternation. Other problems were arisen (social, economic and institutional) with environmental problem. Therefore, some parts of coastal belt, farmer could only produce Bagda shrimp and some of them produce Bagda shrimp round the year. But 25 years ago in the same land they could produce different crops such as rice, vegetable, shrimp and fruits and 12 years ago they could produce only rice and Bagda shrimp. At present they can't produce anything but Bagda shrimp. Gher farming in those regions were expanded in late 1980s. Therefore, cropping pattern, landholding size, land tenant and

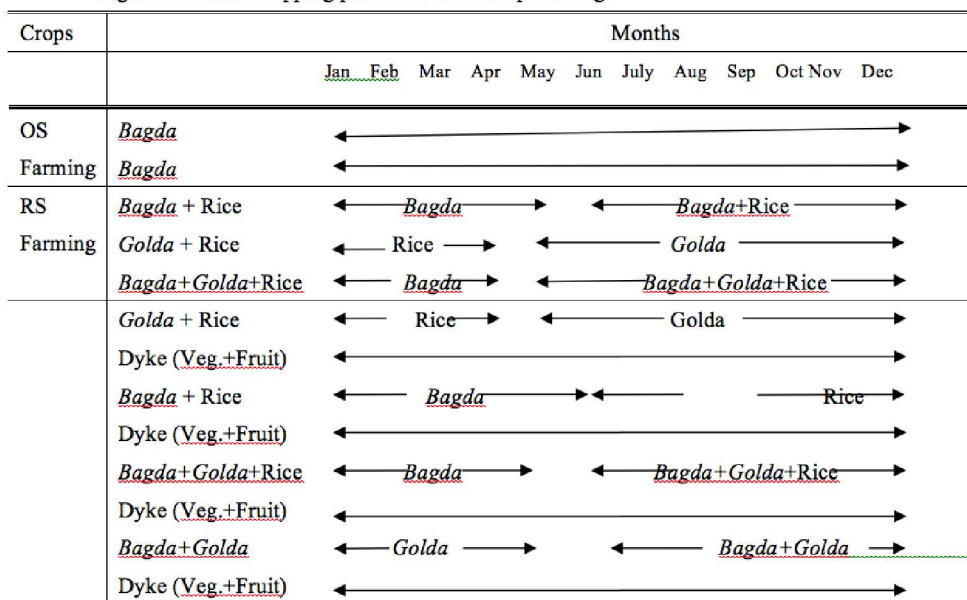
farming system were changed. Before, shrimp (Bagda and Golda) were cultured separately. Recently, some farmers produce nothing except Bagda shrimp. Some of them were produced shrimp (Bagda, Golda) and rice together with the same land which was categorized as rice shrimp farming (RS). They were produced Bagda and rice or Golda and rice or Bagda, Golda and rice. Some of them are using their land more intensive. They were produced rice, shrimp (Bagda, Golda), vegetables and fruits in dyke of the gher or pond which was categorized as rice shrimp vegetables and fruits farming.

**Cropping pattern of the study areas:**

Table 1 shows Cropping pattern of the before and after shrimp farming in the coastal belt in

Bangladesh. Before shrimp farming farmers produced all crops, jute, all vegetables and fruit. Now, farmers changed the producing products items. Firstly, they preferred to produce shrimp because high market value and price and secondly they also produce rice because of staple food in Bangladesh. Some farmers also utilizing their land very intensively and they were produced vegetables and fruits in the ponds/ghers dyke. They also used net to produce vegetables besides shrimp (Bagda and Golda) farming. The following the cropping pattern has been found for rice shrimp farming (RS), Rice shrimp vegetables and fruits farming (RSVF) and OS farming which are shown in Figure 2.

Figure 2: Recent cropping pattern of the shrimp farming



Source: Field survey, 2010

**3. Result and Discussion**

**Land area (ha) for respondents before and after shrimp farming:**

Table 1: Cropping pattern of the before and after shrimp farming

Item	RS Farming		RSVF farming		OSF farming	
	B.S Farming	Presently	B.S Farming	Presently	B.S Farming	Presently
Cultivated product	Rice and other crops, jute vegetables, fruits	shrimp ( <i>Bagda</i> , <i>Golda</i> ), Rice	Rice and other crops, jute vegetables, fruit	shrimp ( <i>Bagda</i> , <i>Golda</i> ), Rice, vegetables, fruit	Rice and other crops vegetables, fruits	Only shrimp Bagda
Selling place	Local market	For shrimp, local market and farm gate. But for rice only local market	Local market	For shrimp, local market and farm. For others only local market	Local market	For shrimp, local market and farm gate

Source: Field survey, 2010

Table 2 shows land area for respondents before and after shrimp farming. Farmers were categorized according to their present cropping patterns and land utilization patterns and location of land. OS farming land is closer to coastal belt and low lying areas. Before and after shrimp farming total land area was higher (3.71 and 10.10 ha) for OS farming. Before shrimp farming their own and lease in land area was 3.81 and 1.32 ha respectively. Rich farmers/land lords started shrimp farming in 1980s in their low lying areas in coastal belts in Bangladesh due to higher market price, demand and higher profit from shrimp farming. Initially, that time farmers were produced all crops besides shrimp (*Bagda*) farming. After observing their profit, other farmers started shrimp farming in these regions. Their own and lease in land area was increased (7.09 and 2.93 ha). Now some part of these coastal belt people can't grow anything except shrimp because of environmental problems (such as water logging, restricted floodplain inundation with associated reductions in soil fertility,

subsidence of land within polders, siltation of rivers and canals and increased saline intrusion) which created by long time culture of shrimp farming and construction of embankments and polders during 1960s. Before, farmers produced shrimp (*Bagda* and *Golda*) separately, now farmers used same pond or separate pond for producing two types of shrimp beside rice.

RS farming and RHFV farming land are not as low as OS farming land. RS farming farmer's farm size was not so big which was 0.88 ha and 1.72 ha before and after shrimp farming respectively. Their own land area was increased (0.84 ha to 1.51 ha) because of good return from shrimp farming.

RSVF farming farmer's farm size was not also so big which was 0.76 ha and 1.57 ha before and after shrimp farming. Their own land area was also increased (0.73 ha to 1.30 ha) and their lease in (0.37 ha to 0.25 ha) and lease out land (0.25 to 0.02 ha) were declined.

**Table 2: Land area (ha) for respondents before and after shrimp farming**

Item	RS Farming (169)		RSVF farming (261)		OS farming (70)	
	B.S Farming	Presently	B.S Farming	Presently	B.S Farming	Presently
Total land	0.88	1.72	0.76	1.57	3.71	10.10
Own	0.84	1.51	0.73	1.30	3.81	7.09
Lease in	0.82	0.25	0.37	0.25	1.32	2.93
Lease out	0.09	0.08	0.25	0.02	1.10	0.00

Source: Field survey, 2010

**Table 3: Net return from different farming systems in Bangladesh ha/yr**

Item	RS Farming (169)	RSVF farming (261)	OS farming (70)
Return for shrimp			
<i>Bagda</i>	122,266	120,360	128,286
<i>Golda</i>	103,454	160,435	0
Others	13,977	9,093	9,065
Vegetables	0	1,036	0
Fruit	0	456	0
Total Return from shrimp (A)	<b>239,717</b>	<b>291,380</b>	<b>137,351</b>
Return from rice (B)	<b>23,098</b>	<b>34,696</b>	<b>0</b>
Total return for rice shrimp C= (A+B)	<b>262,815</b>	<b>326,076</b>	<b>137,351</b>
Total cost for shrimp farming (D)	68,096	73,458	27,587
Total cost for rice farming (E)	9,432	16,529	0
Total cost for rice shrimp farming F=(D+E)	<b>77,528</b>	<b>89,987</b>	<b>0</b>
Net return for rice shrimp farming G= C-F	<b>185,287</b>	<b>236,089</b>	<b>109,764</b>

Source: Field survey, 2010



**Table 4: Cost and Return for rice for rice shrimp farming in Bangladesh ha/yr**

Item	RS Farming (169)	RSVF farming (261)	OS farming (70)
Total Return from rice	<b>23098</b>	<b>34,696</b>	<b>0</b>
Cost items			
Seedling	1,046	2,445	0
Human labor	5,442	6,831	0
Power tiller	385	492	0
Urea	399	2,621	0
TSP	429	650	0
MP	632	2,073	0
Cow dung	92	311	0
Irrigation	697	873	0
Insecticide	310	233	0
<b>Total cost (B)</b>	<b>9,432</b>	<b>16,529</b>	<b>0</b>
<b>Net return= (A-B)</b>	<b>13,667</b>	<b>18,167</b>	<b>0</b>

Source: Field survey, 2010

**Table 5: Cost and Return for shrimp for rice shrimp farming in Bangladesh ha/yr**

Item	RS Farming (169)	RSVF farming (261)	OS farming (70)
Total return from shrimp	<b>239,717</b>	<b>291,380</b>	<b>137,351</b>
Cost items			
Fingerling			
<i>Bagda</i>	4,889	3,767	3,304
<i>Golda</i>	3,679	4,680	0
Others	2,371	1,011	1,119
Human labor	13,792	20,022	8,251
Urea	150	252	104
TSP	127	215	28
MP	65	211	6
Cow dung	153	408	2
Fish meal	8,631	3,774	918
Rice bran	1,694	1,967	3,031
Formulated feed	5,418	6,443	0
Snail	499	212	0
Lime	752	1,144	28
Lease in	25,876	29,120	10,796
Vegetable cost	0	147	0
Fruit	0	85	0
<b>Total cost (B)</b>	<b>68,096</b>	<b>73,458</b>	<b>27,587</b>
<b>Net return= (A-B)</b>	<b>171,621</b>	<b>217,522</b>	<b>109,764</b>

Source: Field survey, 2010

#### Net return for rice shrimp farming in Bangladesh per ha/yr:

Table 3 shows net return from different farming systems in Bangladesh. Net return was the lowest for OS farming farmers (Tk.109,764) per ha/year. For the environmental problems, farmers weren't produced any other agricultural crops except shrimp (*Bagda*). Some of the OS farming farmers were produced *Bagda* shrimp June to December and rest of them tried to produce *Bagda* shrimp around the year.

For RS farming and RSVF farming farmer's net return were Tk.185,287 and Tk. 236,089 respectively

and their net return was two times higher than OS farming farmers. Both farming systems, farmers were cultured Shrimp (*Bagda*, *Golda*) together or separately and they were used the same field for producing rice. But RSVF farming farmers used their land more intensively and they were produced diversify vegetables and fruits in their ponds/*ghers* dykes or using the net for vegetable farming. Though, the net return was very few from vegetables and fruits. Net return was higher for the RSVF farming farmers than RS farming farmers because input cost was higher for RSVF farming farmers. Now, table 4 and

table 5 were shown the cost and return for different farming systems.

Table 4 shows the cost and return for rice for RS and RSVF farming systems.

For both farming systems, the highest cost for rice was human labor cost which was Tk.5,442 for RS farming and Tk.6,831 for RSVF farming farmers. For RS farming farmers, second highest cost was for seedling (Tk.1,046). For RSVF farming farmers, second highest cost was for urea (TK. 2,621) and they were used higher input for rice farming than RS farming farmers. The total cost (TK.16,529) for RSVF farming farmers was about two times higher than RS farming farmers cost (TK. 9,432). Therefore, total (TK.34,696) and net return (TK.18,167) for RSVF farming farmers were higher than RS farming farmers total (TK.23,098) and net return (TK.13,667) respectively.

Table 5 shows the cost and return for shrimp for RS, RSVF OS farming systems. To examine the cost and return for shrimp for RS, RSVF OS farming systems, the total cost was highest for the RSVF farming farmers (TK.73,458) than RS (TK. 68,096) and OS farming farmers (TK. 27,587) per ha per year.

To compare the average cost, RS and RSVF farming farmers cost were more than two times higher than OS farming farmers cost.

The total return was also highest for the RSVF farming farmers (TK.291,380) than RS (TK. 239,717) and OS farming farmers (TK. 137,351) per ha per year. To compare the average total return, RSVF farming farmer's total return was more than two times higher than OS farming farmer's total return and for RS farming farmer's total return was more around two times higher than OS farming farmers total return.

To compare the average net return, the net return was highest for the RSVF farming farmers (TK.217,522) than RS (TK. 171,621) and OS farming farmers (TK. 109,764) per ha per year. RS and RSVF farming farmer's net return were more than two times higher than OS farming farmer's net return.

#### **Farmer's perception and attitude on shrimp farming impacts in these regions:**

According to the perception and attitude on shrimp farming impacts, positive and negative impacts were found in these regions. Four types of impacts were considered for sustainable development in this region which were as follows:

1. Environmental impact
2. Social impact
3. Economic impact and
4. Institutional impact

Those four types of impacts were shown in table 6, Table 7, table 8 and table 9. Table 6 shows different farmer's perception and attitude on shrimp farming impact (environmental impact) in these regions. RS

and RSVF farming is still okay for farmers but 100 percent OS farmers were suffered bad environmental impact which against of sustainable development. Large numbers of RS, RSVF and OS farming farmers weren't known what kind of bad impact occurred for shrimp farming in these regions such as land degradation, water logging, ecological problems etc. For the sustainability of shrimp farming environmental awareness is very important in these regions.

Table 7 shows different farmer's perception and attitude on shrimp farming impact (social impact) in these regions. RS and RSVF farming farmers were faced less social problems for shrimp farming, but 89 percent OS farmers were agreed that shrimp farming created social problems (land conflicts, water sharing problems) in these regions. One hundred percent RS, RSVF and OS farming farmers were also agreed that shrimp farming were improved the livelihood condition, children education, housing status of the respondents and infrastructure development in these regions as well as hundred percent RS and RSVF farming farmers and forty-three percent OS farming farmers agreed that shrimp farming were contributed alleviating poverty in these regions. Therefore, RS and RSVF farming were still more sustainable than OS shrimp farming in these regions.

Table 8 shows different farmer's perception and attitude on shrimp farming impact (economic impact) in these regions. Hundred percent RS, RSVF and OS farming farmers agreed that shrimp farming were changed the land utilization patter and cropping patterns in these regions. One hundred percent RS, RSVF and OS farming farmers also answered yes that shrimp farming were profitable. Hundred percent RS and RSVF farming farmers answered yes that present cropping pattern were profitable than before. But hundred percent OS shrimp farming were answered no because of negative impact of producing others crops (rice, vegetables, fruits) and livelihood (pure drinking water and bad impact of livestock and poultry). Therefore, RS and RSVF farming were still more sustainable than OS shrimp farming in these regions.

Table 9 shows different farmer's perception and attitude on shrimp farming impact (institutional impact) in these regions. Hundred percent RS, RSVF and OS farming farmers answer was yes on institutional need for shrimp farming in these regions. Only twelve percent RS, eleven percent RSVF and twenty-nine percent OS farming farmers answer were yes for getting institutional help (credit, training and support on farming systems and managements from extension officers, rules and regulation etc.) in these regions for shrimp farming.

A better institution can make better rules and regulations and proper implementation of the better rules and regulations improve the efficiency of any aspect and provide sustainability. Hundred percent RS, RSFV and OS farming farmers agreed that shrimp farming has high risks and they also believed that

farm insurance reduces risk of shrimp farming and better work of law enforcement institute can reduce the social and institutional problems for shrimp farming in these regions. Most of them were no idea of shrimp producing zone in these regions.

**Table 6: Different farmer's perception and attitude on shrimp farming impact (environmental impact) in these regions**

Items	RS Farming (169) (%)			RSFV farming (261) (%)			OS farming (70) (%)		
	1	2	3	1	2	3	1	2	3
<b>Environmental impact:</b>									
Is shrimp farming hampering mangrove ecosystem?	59	18	23	76	8	16	86	7	7
Is shrimp farming creating land degradation?	30	18	52	29	4	67	57	14	29
Is shrimp farming has sedimentation?	30	18	50	27	6	67	47	17	36
Is shrimp farming creating pollution	35	15	50	31	19	50	64	7	29
Is shrimp farming creating water logging problems	24	24	52	19	15	66	100	0	0
Is shrimp farming creating natural seed crisis	100	0	0	100	0	0	100	0	0
Loss of capture fishery stock	28	20	52	29	17	54	70	1	29
Is salt water intrusion creating for shrimp farming?	24	18	58	27	23	50	86	3	11
Do the imported fry and genetic alternation danger for environment?	30	18	52	23	17	60	43	43	14
Does shrimp farming has diseases risk?	100	0	0	100	0	0	100	0	0
In <i>gher</i> farming, are applications of agrochemical, antibiotics and disinfect creating environmental problems?	30	18	52	25	16	59	14	14	72
Do you think, shrimp farming zone can protect the future more environmental threat?	30	0	70	17	23	60	50	11	39
Do you think, you should more concern about the environmental impact of shrimp farming?	100	0	0	100	0	0	100	0	0
Are you facing bad impact of shrimp farming?	0	100	0	0	100	0	100	0	0
1= Yes, 2= No and 3= I don't know/sometimes									
Source: Field survey, 2010									

**Table 7: Different farmer's perception and attitude on shrimp farming impact (social impact) in these regions**

Items	RS Farming (169) (%)			RSFV farming (261) (%)			OS farming (70) (%)		
	1	2	3	1	2	3	1	2	3
<b>Social impact:</b>									
Is shrimp farming creating social problems	12	18	70	15	19	66	89	11	0
Is shrimp farming creating land conflicts in these regions?	100	0	0	100	0	0	100	0	0
Is shrimp farming creating water sharing problems?	35	59	6	19	58	23	72	14	14
Is it improving the livelihood condition?	100	0	0	100	0	0	100	0	0
Is it improving children education?	100	0	0	100	0	0	100	0	0
Is it improving housing status?	100	0	0	100	0	0	100	0	0
Is it improving the infrastructure development?	100	0	0	100	0	0	100	0	0
Is it alleviating poverty in these regions?	100	0	0	100	0	0	43	43	14
1= Yes, 2= No and 3= I don't know/sometimes									
Source: Field survey, 2010									



**Table 8: Different farmer's perception and attitude on shrimp farming impact (economic impact) in these regions**

Items	RS Farming (169) (%)			RSVF farming (261) (%)			OS farming (70) (%)		
	1	2	3	1	2	3	1	2	3
<b>Economic impact:</b>									
Does shrimp farming change the land utilization and cropping patterns in these regions?	100	0	0	100	0	0	100	0	0
Are Present cropping pattern profitable than before?	100	0	0	100	0	0	0	100	0
Is shrimp farming profitable?	100	0	0	100	0	0	100	0	0
Is shrimp farming creating employment opportunities?	100	0	0	100	0	0	100	0	0
Is shrimp farming creating income generating opportunities?	100	0	0	100	0	0	100	0	0
Is shrimp farming creating other linkage industries?	100	0	0	100	0	0	100	0	0
Does shrimp farming has negative impact on livestock and poultry?	0	100	0	0	76	24	72	4	24
Does shrimp farming has negative impact on paddy production?	0	100	0	0	100	0	100	0	0
Does shrimp farming has negative impact on vegetables production?	52	30	18	0	100	0	100	0	0
Does shrimp farming has negative impact on fruits production?	52	30	18	0	100	0	100	0	0
Do you think, shrimp farming have sustainability in these regions?	100	0	0	100	0	0	100	0	0
Do you think, shrimp farming can contribute for food security these regions?	100	0	0	100	0	0	50	26	24
1= Yes, 2= No and 3= I don't know/sometimes									
Source: Field survey, 2010									

**Table 9: Different farmer's perception and attitude on shrimp farming impact (institutional impact) in these regions**

Items	RS Farming (169) (%)			RSVF farming (261) (%)			OS farming (70) (%)		
	1	2	3	1	2	3	1	2	3
<b>Institutional impact:</b>									
Do you need institutional help for shrimp farming?	100	0	0	100	0	0	100	0	0
Do you get institutional help for shrimp farming?	12	77	11	11	80	9	29	64	7
Are training is available for shrimp and rice shrimp farming from agriculture and fisheries office?	0	100	0	0	100	0	0	100	0
Is institutional credit available for shrimp and rice shrimp farming?	0	100	0	0	100	0	0	100	0
Do you know the all rules and regulations for shrimp farming?	48	28	24	50	50	0	50	50	0
Do you follow the all rules and regulations for shrimp farming?	12	48	40	50	50	0	50	50	0
Do you think agriculture and fisheries extension officers are available for farmers?	0	100	0	0	100	0	0	100	0
Do you think shrimp farming has high risk?	100	0	0	100	0	0	100	0	0
Major risks for shrimp farming (virus diseases, flood, cyclone and theft)	100	0	0	100	0	0	100	0	0
Do you think, farm insurance is good way to reduce the risk?	50	0	50	50	0	50	100	0	0
Do you think, better work of law enforcement institute can reduce the social and institutional problems for shrimp farming?	100	0	0	100	0	0	100	0	0
Do you know about, the idea of shrimp producing zone?	6	94	0	4	96	0	10	90	0
1= Yes, 2= No and 3= I don't know/sometimes									
Source: Field survey, 2010									

#### 4. Conclusion

From the above discussions the following conclusion were drawn:

1. After, adopting shrimp farming land utilization patterns and cropping patterns has changed in both ways positively and negatively. Among the three (RS, RSFV and OS) farming systems, RS and RSFV farming farmers have positive change. Before shrimp farming RS and RSFV farming farmers have produced all crops in these region and still they can produce all crop. RSFV farming farmers have diversified their farm and utilized their land more intensively. But, OS farming farmers have lost their crop production diversification which is the negative impact of shrimp farming.

2. Before and after shrimp farming, there was no change on crop (rice, vegetables and fruits) marketing system and still they are selling their crops in local markets. But after shrimp farming, only for shrimp (*Bagda* and *Golda*) farmers sells their product at farm gate/ local markets.

3. Among the three (RS, RSFV and OS) farming systems, RS and RSFV farming farmers average farm size was smaller than OS farming farmers land size. After shrimp farming all farming systems farmer's average total and own land area were increased.

4. Three (RS, RSFV and OS) farming systems were profitable. For shrimp, among the three (RS, RSFV and OS) farming systems, RSFV farming system was more profitable than RS farming system because of higher input cost. Here, human labor cost, Urea, TSP, MP, cow dung, formulated feed and lime cost were higher than RS and OS farming which increased the productivity of shrimp. Lease cost was higher for the RSVF farming than RS and OS farming. Though, the profit from vegetables and fruits were very low in RSVF farming, but farmers were tried used their fallow dyke intensively. RSVF and RS farming were considered as improve extensive farming system. The lowest profit was come from OS farming system as well as their input cost was also lowest. They were produced only *Bagda* shrimp and it was considered as extensive farming system.

5. Comparison between RS and RSFV farming systems, rice framing was less capital intensive than shrimp farming. Per hectare total cost for rice and shrimp was higher for RSFV than RS farming farmers. Here, the seedling cost, human labor cost and TSP cost were much higher for RSVF farming than RS farming. RSVF farming farmers used Urea and MP six times higher and more than three times higher than RS farming. Therefore, production was higher as well as net return for rice was higher for RSFV than RS farming farmers.

6. Among the three (RS, RSFV and OS) farming systems, RS and RSFV farming systems are more sustainable than OS farming system.

7. According to the farmers' perceptions and attitude on different aspect of impacts of shrimp farming, economically shrimp farming has big contribution on food security, employment opportunity, income generating opportunity, creating other linkage industries which is interrelated to social impact.

8. Though shrimp farming was created some social problems. It was also provided social advantages such as improvement livelihood, children education, housing status, infrastructure development and contributing alleviating poverty which were very important for sustainable development.

9. Considering institutional impact, all farmers had mixed opinions good and bad. Better institutional policy and proper implementation on these policies could make sustainable shrimp farming systems in coastal belt in Bangladesh.

10. There was no changed and improvement in rice, vegetables and fruits marketing channel. For rice price was very low. The comparison for RS farming, shrimp farming was more than twelve times profitable than rice farming and comparison for RSVF farming, shrimp farming was around twelve times profitable than rice farming. Therefore, if farmers could use their land three times for production of rice, though wouldn't be profitable than shrimp farming. Hence, high value export product shrimp (*Bagda* and *Golda*) were more profitable than rice farming. RS and RSVF farming are still environmentally friendly. OS farming is also profitable though it had some environmental problems.

Though shrimp farming was one of the driving force for foreign currency and had huge economic impact in Bangladesh. For the sustainability of this sector, government and fisheries department in Bangladesh were made and implemented some important policies, rules and regulations. But there was different problems for sustainable development. Therefore, the following recommendation should be considered for the long term sustainability of shrimp farming and exporting related stakeholders.

1. Government, shrimp industry owners, middlemen and farmers should rethink about the ecosystem and long run resource management for getting sustainable return from shrimp farming, processing and exporting.

2. Shrimp industry owners, middlemen and farmers should have more proper knowledge on understanding the conservation and management of the shrimp and fishery resources which could be increased the awareness of shrimp farmers and other

shrimp related entrepreneurs. Knowledge management should be expanded through education, workshop and training. Government should be emphasized on fishers and fish-farmers involvement in the policy formulation and implementation system and considered the threats they were faced.

3. Particular effort should be made to protect from environmental problems such as destruction, degradation, pollution and other significant impacts resulting from human activities that threaten the health and viability of the fishery resources.

4. Farmers should have more responsibility and fulfil the requirement for responsible action in harvesting and post-harvesting practices:

5. Farmers, shrimp industry owners, and middlemen should take more precautions and responsibilities on harvesting, handling, processing, packaging and distribution of shrimp and fishery products for alleviating the existing problems in international market. They should be realized in a manner which will retain the nutritional value, quality and safety of the products, reduce waste and minimize negative impacts on the environment and protect the highest international standards for continues demand in international markets.

6. Government has local and national laws and regulations for shrimp and fisheries resources maintaining and marketing and government should assure that all level of involved people are corroborating those laws and regulations.

7. Government and policy makers, in accordance with apt procedures, should promote and accelerate more consultation and the effective participation of industry, fish-workers, environmental, social, and institutional organization, activist and other interested organizations in making decisions with respect to the development of laws and policies related to shrimp and fisheries management, development, resolving the conflicts, aid and sustainable development aspects.

8. Government has different policies on aquaculture management, including open water and culture-based fisheries, as a meaning of stimulating diversification of income, diet and livelihood development. Government should make sure that resource are utilized responsibly and destructive impacts on the environment and on local communities are reduced.

9. Traceability method could be resolved many exiting international shrimp marketing problems.

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