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Seed variety diffusion, corporatization, and sustainable agriculture in Bangladesh

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Abstract

Seed is one of the main inputs contribute to variability of agricultural output. The primary objective of the study is to exhibit whether diffusion of seed varieties accrues negative impacts on sustainable agriculture. This study has proceeded using household level data as primary source, has been surveyed on 30 agro-ecological zones of Bangladesh based on situation of seeds. Besides, these other relevant secondary sources have also been used to add the study more appealing. All relevant collected data have been analyzed using some statistical tools and demonstrate that conventional seed is more economic in case of benefit-cost ratio and other factors of sustainable agriculture. In the meantime, diffusion of Hybrid and other seed varieties have come out as blessing only for corporate business as supplier of inputs which incurred huge of production share as cost of production, so it demonstrates less economic in case of benefit-cost ratio and others factors of sustainable agriculture. It is manifested from field survey that there has been a dramatic change in seed sources dynamism. Nowadays, large parts of important crop's seed are mostly supplied by multinational companies in a dominating manner. Study also examines that in the name of green revolution, there has been appeared of many high yielding seed varieties over the decades which posed downbeat effect on sustainable agriculture in Bangladesh. Now it is high time to back to the pavilion of indigenous agricultural practice to uphold the sustainable agriculture and putting control over seeds with up to date the indigenous know-how and method of cultivation.

Keywords: Seed Diffusion; Sustainable Agriculture; Benefit Cost Ratio

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1. Introduction

Bangladesh is a small agrarian based and densely populated country in Southeast Asia. The agro-based economy of this country contributes generously to national food production, employment generation, ensuring food security, and overall socio-economic development. In Bangladesh, 76% of its total population is living in the rural areas, and 90% of the rural population is directly involved with agriculture (GOB, 2009), and around 43.6% of the total labor force is engaged with agricultural activities (GOB, 2011). The contribution of agriculture in the economy was about 59.4% in 1972–73, while in case of industry and service sector it was only 14% and 36%, respectively. But presently, the contribution of agriculture sector is declined by 18.43% (GOB, 2011), whereas the contribution of industry and service sector has increased by 30% and 50%, respectively (Islam, 2010). This experience is really uneven surprised for Bangladesh agriculture as an agrarian country posing potential threats for future sustainability in agriculture as well as for the economy as a whole. Although still, it contributes tremendously to macro-economic variables as a competent donor to national economy knowing this potential needs for alive the nation.

Rapid technological change in agriculture leads to agricultural productivity which has clearly occurred in most developing countries, primarily over the past half century. This was particularly evident during the Green Revolution – a term originally applied to the spread of short-straw, fertilizer-efficient new varieties of rice and wheat, primarily, though not exclusively, in Asia (DFID, 2010). Consequently, this revolution was on track to practice in Bangladesh agriculture in 1960s just a decade after the abolition of Land Lord practice. Later, the agriculture sector started to depart from farmer's hand to commercial market through the introduction of new technological breakthrough in agricultural inputs.

Once Bangladesh was enriched in biological resources specially the plant genetic regarded as human heritage which provide the basic inputs for agricultural technology development with a focus on improved crop varieties. It was evident that once there were 15000 rice varieties cultivated in the country. A survey found that about 12479 local species of rice were present in 1980s which are now in the pole of distinction (Islam, 2010). The main offender of this condition was the introduction of high yielding varieties (HYVs) in late 1960s. Although modern HYV of rice were adopted in 1968, the rate of adoption remained low till 1975–76 and a rapid diffusion of HYVs rice took place after mid 1980s with the freedom of polices regarding the procurement and distribution of agricultural inputs and reduction of import on agricultural equipment. Rice area covered by modern varieties has now reached at nearly 65% of agricultural land whereas traditional varieties are grown only in the unfavorable ecosystems (Husain et al., 2001). Every nation limits the access to genetic resources of its own nation state by another. During the past decades, rapid agricultural development led to the disappearance of many of our landraces and indigenous plant species. Due to the introduction of modern HYVs, crop cultivars have become more uniform, and the genetic diversity of cultivars greatly diminished (BARC and FAO, 2007).

Therefore, this absorption was started first with diffusion of new seed technology - introduced Hybrid, terminated, and genetically modified (GM) seeds which are mostly patented by multinational companies through the right of innovation, marketing, and making guarantee of high yield. By analyzing rice yield data for the years 1971–72–2005–06 (35 years), it is found that rice production rate is continuously increasing over the year. In 1971–72, the average rice yield was 1.05 metric ton per hectare, while in 2005–06, it was 2.52 metric ton, which has been possible by the innovation high yield seeds varieties, modern technology, new management practices such as irrigation, fertilizer, and crop management. If the cost of fertilizers, pesticides, herbicides, and environmental affect and benefit cost ratio (BCR) are considered, the scenario is

reversed. Interestingly, poor farmers and even the policy makers do not worry much about this state. Even, it was evident from a Greenpeace report that an adult would have to take 3.7 kg of hybrid rice to get proposed amount of pro-Vitamin-A, as compared to 300 g of local reddish rice (Baten, 2010).

In the year 2008–09, HYVs covered 72% of total land area in Bangladesh (Basak, 2011). However, it is controversial whether it satisfies sustainable agriculture - means an integrated system of plant and animal production practices having a site-specific application that will, over the long-term satisfy human food and fiber needs; enhance environmental quality and the natural resource base on which the agricultural economy depends; make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole (USDA, 2007). Likewise, sustainable agriculture indicates the agricultural practice which is environmentally viable, economically profitable, socially acceptable, and culturally fit to the contemporary science and technology. Hence, technology diffusion only ensures short-term productivity in some cases, whereas it jeopardizes sustainable agriculture in most cases by depleting soil nutrition value, increasing use of chemical fertilizer, increasing use of pesticides, confining farmers to cultivate only few profitable crops, compelling to loss local crop varieties leading to market oriented agricultural inputs, etc.

It is very regretful that poor farmers are being anticipated to use these technically modified seeds with a view to enjoying high yield which much more than local varieties. But they do not either produce the seeds from the modified seeds or conserve at home because it needs foundation seeds - means the seeds which are produced from the first mother sources. Consequently, thousands of local varieties are in extinct situation. In addition, it is depleting the soil nutrition value, deterring the natural biological environment which is a matter of panic for sustainable agriculture in Bangladesh.

Very limited studies were carried out comprehensively on seed variety diffusion and sustainable agriculture in Bangladesh. In this perspective, the key research question concerns what is the gap between seed diffusion and sustainable agriculture in agro-ecological zones (AEZs) of Bangladesh. To answer this research question, a study was undertaken to demonstrate the scenarios of seed diffusion and its impact on sustainable agriculture in Bangladesh considering the efficiency of different varieties perspective, sources of seeds, trend of agricultural contributions to national production resulting diffusions, and its trend of change over the years. The study proceeds with relevant secondary data and estimates the empirical analysis to suit the research objectives and later communicate some suggestions regarding the findings. It is expected that the findings of the study will be important for the appropriate agriculture policy and planning at the cultivator's level in Bangladesh.

2. Materials and methods

2.1. Description of data sources

The study was carried out at 30[1] AEZs of Bangladesh (Figure 1). These AEZs are sub-divided into 88 agro-ecological sub-regions and further alienated into 535 agro-ecological units. The homogeneity of an

1 Agro ecological Zone-land areas recognized on the basis of hydrology, physiographic, soil types, tidal activity, cropping patterns, and seasons. In fact an agro ecological zone indicates an area characterized by homogeneous agricultural and ecological characteristics. On the basis of four elements such as physiographic, soils, land levels in relation to flooding and agro climatology AEZs are identified. Bangladesh has been tentatively divided into 30 agro ecological zones.

AEZ is more prominent in a sub-region and most prominent in a unit level (banglapedia.org). The AEZs were classified into four types of land level such as highland (land which is above normal flood-level) – suitable for transplanted Aus[2] and/or Aman[3] paddy if bunds are made to retain rainwater on fields; medium highland (land which normally is flooded up to about 90 cm deep during the flood season) – suitable for crops which can tolerate shallow flooding, such as broadcast or transplanted Aus paddy, and transplanted Aman paddy; medium lowland (land which normally is flooded up to between 90 cm and 180 cm deep during the flood season) – suitable for transplanted Aus or transplanted Aman paddy to be grown reliably; lowland (land which normally is flooded up to between 180 cm and 300 cm deep during the flood season) – suitable for broadcast Aus or transplanted Aman; and very lowland (land which normally is flooded deeper than 300 cm during the flood season) – suitable for Boro[4] and Aman paddy. The combined agro-climatic zones could be superimposed on the zones and sub-regions to create unique agro-ecological units (banglapedia.org).

2.2. Methods

The study involves a socio-economic and empirical estimation of seed varieties and its impact on agriculture sustainability at farmers context in AEZs of Bangladesh. The appraisal was accomplished through inter-personal interview with the agriculture farmers by several times over a period of 12 months from March 2014 to February 2015. It was a time-intensive case study in which total time frame planned for the study was flexibly considered. The study covered the three main seasons of agriculture production in each broader area of AEZs located in all over the Bangladesh. On site, locating the samples was completed within 90 days starting from March 2014 and the primary data collection was finished by February 2015. However, in research planning, data collection time was selected purposively considering the easiness of data collection, agriculture seasons, availability of research crews, and available budget. It should be noted that the period of March-August in Bangladesh is usually the season for Aus production. June through December is usually the season for Aman production in Bangladesh. However, November through May is usually the season for Boro production in Bangladesh. Rural agricultural cultivation and production pattern are the function of climatic conditions, so data collection period of this present study intersecting these three major seasons will minimize the seasonal variation, and will increase the likelihood of data reliability.

2.2.1. Assessing efficiency of seed varieties

To measure efficiency of agriculture production in different seed varieties simple regression model was formed. Although this study, we want to find the efficiency of different seed verities – Local, HYV, and Hybrid – the study assumed the efficiency of rice varieties only to focus the efficiency of those varieties. Through following regression model the study has tried to calculate the efficiency of different seed verities. Hence, the simple regression model has been formed as:

$$Y_i = \alpha + \beta \sum X_i + U_i$$

2 The paddy which are sown during the month March-April and harvested in July-August every year

3 The paddy which is harvested in the month of November and December

4 The paddy which is cultivated in the month of March to May

Where Y_i= Output of i^{th} Varieties (i indicate Local, HYV, Hybrid varieties)

X_i = i^{th} inputs cost (Tk/acre) U_i = Error term

$\sum X_i$ Indicates all inputs cost of seed, land, fertilizer, pesticides, and labor hour

2.2.2. Estimation of BCR

To calculate the cost-benefit of different crop varieties, following formula was used to find out the BCR. It is assumed that using the formula the study upshots the output of different varieties, efficiency, and BCR.

$$BCR=\frac{\textbf{Yeild per acre}}{\textbf{Cost per acre}}$$

$$BCR_i=(\sum_i^n BL_i / \sum_i^n CL_i) + (\sum_i^n BHYV_i / \sum_i^n CHYV_i) + (\sum_i^n BHYV_i / \sum_i^n CHYV_i)$$

Where,

BCR_i= BCR ratio of i^{th} it varieties

$\sum_i^n BL_i$, $\sum_i^n BHYV_i$ & $\sum_i^n BHYB_i$ represent gross-returns from local, HYV and hybrid.

$\sum_i^n CL_i$, $\sum_i^n CHYV_i$ & $\sum_i^n CHYB_i$ represent gross costs from local, HYV and hybrid.

{i=1, 2, 3……n}

Now, it is possible to represent the BCR as-

$$BCR=\frac{\textbf{Benifit per acre}}{\textbf{Cost per acre}}=B/C$$

Along with the above empirical estimation, it needs to compare whether these different efficiencies ensure sustainable agriculture.

2.3. Sampling procedure

The study was conducted through the purposive random sampling technique using both closed and open-ended questionnaires. The data were collected from the farmers of 30 AEZs of Bangladesh. At first, a reconnaissance survey was carried out at some AEZs to build a rapport. Then, a total of 180 farmers were sampled, that is, six farmers from each zone. The interview schedule was pre-tested; necessary correction and modification were made before it was applied for final data collection.

2.4. Data processing and analysis

To find real benefit overture, the study was also tried to demonstrate consequences of seed verities diffusion, growth of agriculture production, per capita income, and its growth and compare these with other agricultural beneficiaries. Environmental issues – depleting nutrition value of soil, and besides, other relevant issues – which pose a direct impact on sustainable agriculture were analyzed in similar fashion. To estimate the expected result authors used econometrics tools and tested hypothesis to reach in expected results. First, the study found out the probable influencing variables of agro-production considering the varieties of seeds. The variables that were considered are both continuous variable and dummy. These are seed cost, sources of seed, price of seed, price trend, fertilizer in kilogram, fertilizer cost, irrigation expenditure,

ploughing expenditure, labor, manure, pesticides cost and land type dummy, irrigation type dummy, etc. The corresponding dependent variable was the gross output in respect of different seed varieties. The study, therefore, was formed a number of different flexible functional forms using these variables keeping relevant to specific function. In addition, secondary data were collected from different published sources – statistical yearbook of Bangladesh of different years, year book of agricultural statistics of Bangladesh of different years, population census of different years, agricultural sample survey of Bangladesh, data base of Ministry of Agriculture, etc. The data processing and analysis were carried out by the statistical package, SPSS 16.0, and Office Excel.

3. Results and discussion

3.1. Farmers' socio-economic status

3.1.1. Age and educational status of the respondents in AEZs of Bangladesh

The educational structure of farmer is not as high as other sectors. Farmer's agricultural knowledge is very indigenous though today Bangladesh agriculture is mostly practicing modern technology. The study found that 38% of farmers in AEZs were illiterate, 30% had primary, 25% had secondary, and very few farmers (7%) had more than SSC level of education (Table 1). Although farmers are enjoying and practicing modern agriculture technology with diffusion of seed varieties, their background of poor education and lack of agricultural knowledge are causing more threats for sustainable agriculture in Bangladesh. Agrarian Bangladesh possessed different age structure in the midst of the farmers' community. The study revealed that young (aged 15–30) were 20% of whole farmers community, 30% were under mid age, significant portion 37.5% were old age, and very few (12.5%) farmers whose age were found above 60 years (Table 1).

3.1.2. Variability of income of the farmers in AEZs of Bangladesh

Bangladesh is one of the poor countries in South East Asia with its huge population. Among this huge population large parts are poor farmers whose income is very much lower than other professionals. In addition, there has existence of large misdistribution among the farmers.

The present study indicates that the average monthly income under US$ 64.10 possessed about 20.56% of farmers, 38.89% between US$ 64.11 and 128.20. In addition to this, 38.66% from all farmers possessed income range is less US$ 128.20 month^{-1}. The study also found that 30% of farmers who quite affluent than the previous groups of farmers and income ranges between US$ 128.20 and 192.30. Besides, some farmers (6.67%) income was between US$ 192.31 and 256.41, while very few farmers (3.89%) whose income was higher than US$ 256.42 month^{-1}. The data showed that only 40.56% large income farmers possessed 61.34% of total income. Hence, there exists large inequality among farmers in case of income earnings (Table 2).

3.1.3. Agrarian populations and land ownership variability in AEZs of Bangladesh

Land is considered as one of prime components of agriculture production. According to ministry of land, there exists great inconsistency of land possession among the farmers. In Bangladesh, most of the farmers are

Table 1. Age and educational status of the respondent in agro-ecological zones of Bangladesh

Characteristics	Respondents Group	Status of respondents		
		Respondents	Mean	SD
Age	G1[a]: 15-30	36[b] (20.0)[c]	43.18	12.25
	G2: 31–45	54 (30.0)		
	G3: 46–60	67.5 (37.5)		
	G4: 60+	22.5 (12.5)		
	Total	180 (100)		
Educational Status	G1: Illiterate	68 (38.0)	2.02	0.96
	G2: Primary	54 (30.0)		
	G3: Secondary	45 (25.0)		
	G4: SSC+	13 (7.0)		
	Total	180 (100)		

[a]G indicates the respondents group, [b]Figure in the parenthesis indicates the frequency value, [c]Figure in the parenthesis indicates the percentage value

Table 2. Variability of income of the farmers in agro-ecological zones of Bangladesh

Income group (US$ month^{-1})	Frequency	% of farmers		Percent of ownership possession		Mean
G1*: ≤64.10	37	20.56	59.44	8.29	38.66	135.49
G2: 64.11–128.20	70	38.89		30.37		
G3: 128.21–192.30	54	30.00	40.56	38.44	61.34	
G4: 192.31–256.41	12	6.67		11.75		
G5: >256.42	7	3.89		11.15		
Total	180	100		100		

**G indicates the income group*

land less, marginal, and small farmers but land possession scenario is very poor, whereas very few farmers are possessed huge land property. Hence, surely there exist land ownership and income inequality among the agrarian population in Bangladesh.

It was observed that 68% of land less, marginal, and small farmers possessed only 24% of land property, whereas only 32% of medium and large farmers possessed 76% of agricultural land property. The study showed that 14% of farmers were land less whose land limit was 0–49 decimals possessed only 1.39% of total agricultural land; in figure most of the farmers (39%) were marginal whose land limit was 50–149 decimals possessed only 11.44% of total agricultural land. Among them 15% of farmers were categorized as small whose land limit was 150–249 decimals possessed only 10.97% of total agricultural land. Besides, 27% of farmers were medium class had 250–749 decimals owned 45.03% of total agrarian land, and very few farmers were large (>749 decimals) having 31.18% of agrarian land property. Hence, there exists huge inequality in case of land distribution (Table 3).

Table 3. Variability of land ownership in agro-ecological zones of Bangladesh

Ownership class (decimals)	Frequency	% of farmers		% of land ownership		Mean
Land less: 0–49	26	14	68	1.39	24	237.57
Marginal: 50–149	69	39		11.44		
Small: 150–249	27	15		10.97		
Medium: 250–749	49	27	32	45.03	76	
Large: >749	9	5		31.18		
Total	180	100		100		

3.2. Variability of seeds sources in AEZs of Bangladesh

Seed is the basis of all agricultural practices. There exists many dynamism of using different sources of seed across the country. Once people used to produce and preserve seed or seedlings only at their home through applying their indigenous methods. However, after the green revolution the use of HYVs of seed in the name of high production to mitigate the increasing food demand became popular in agricultural sectors. By the passage of time, it started to use more modified seeds such as hybrid and GM which are more productive than the other sources of seeds and it is not possible to preserve these seeds at farmers home. Hence, at present, seed is no longer at farmers' own hand as mostly it (seed) comes from the corporate sources. Consequently, it is intending to use huge chemical inputs which increasing production cost, chasing farmers laborious income, losing indigenous food culture, harming people's health, depleting soil quality, making environmental at risk, and posing great threats for sustainable agriculture as a whole.

The study found out the variability of seed sources across the country considering the crop variety. It was showed that about 52% of rice seed (*Oryza sativa*) was still come from the farmers own accord, while few decades ago it was totally conserved by farmers themselves or bought from the other farmers. However, now this place was substituted by the companies or Bangladesh Agricultural Development Corporation (BADC) who supply 38.5% and 7% of seed respectively from entire rice seed sources and very less quantity (2.50%) of rice seed come from the other farmers at local level (Table 4).

In case of wheat (*Triticum aestivum*), 24% of seeds come from farmers own source, whereas BADC and Companies provide 43% and 33% of total wheat seeds, respectively. Nobody buy seed from other farmers (Table 4).

In case of maize (*Zea mays*), most part of seeds comes from the company sources, where about 86% of total maize seeds come from the companies, while very few (10% and 4%) of maize seed comes from the farmers own sources and BADC. No farmers collect maize and wheat seed from other farmers (Table 4).

Jute (*Corchorus* spp) is the main cash crop in Bangladesh. Once, Bangladeshi jute fiber was famous in the world for its specialty. Farmers produced and preserved jute seed through indigenous techniques at their homes. The study revealed that most of the jute seed suppliers were some companies who supply 80.65% seeds out of total jute seeds demand, whereas very few (6.85%) of seeds still produced at farmers home. Besides, BADC supplied 12.50% of jute seeds (Table 4).

Potato (*Solanum tuberosum*) is one of the most food supplying agents of Bangladesh. It was observed that most part (54%) of the seeds or seedlings was supplied by the companies. Farmers preserved only 26%

Table 4. Variability of seeds sources in agro-ecological zones of Bangladesh

Crops Name	Sources of seed				Total
	Own	BADC	Company	Other farmers	
Rice	52.0*	7.0	38.5	2.5	100
Wheat	24.0	43.0	33.0	-	100
Maize	10.0	4.0	86.0	-	100
Potato	26.0	3.0	54.0	17.0	100
Jute	6.85	12.5	80.6	-	100
Pulses	71.1	10.4	11.1	7.2	100
Oil seeds	66.0	9.0	17.0	8.0	100
Spices	61.0	1.0	25.0	13.0	100
Vegetables	35.0	1.5	59.0	4.5	100
Tobacco	100.0	-	-	-	100
Sugarcane	96.0	-	1.0	3.0	100
Fruits	12.0	-	62.0	26.0	100

**Figure in the parenthesis indicates the percentage value. BADC: Bangladesh Agricultural Development Corporation*

potato seedling at their home, BADC provided only 4% of seeds. Some part (26%) of potato seedlings were collected from other farmers (Table 4).

The study showed that most part (71.14%) of the pulses seeds (*Cajanus cajan*) were produced and preserved at farmer's houses. BADC and companies supply 10.48% and 11.13% of pulses seed, respectively, whereas farmers collected very few (7.25%) of pulses seed from other farmers (Table 4).

In case of oil seeds – mustard (*Brassica nigra*) and sesame (*Sesamum indicum*) – still farmers collected most part (66%) of the seeds from their own accord. Besides, they collected about 9% from BADC, 17% from Company, and 8% from other farmers' sources.

Likewise, most part (61%) of the spices seed or seedlings were fulfilled by farmers own source, whereas only 1% seeds were provided by BADC. Besides, 25% of spices seeds or seedlings come from company sources, and very few amounts (13%) were collected from other farmers.

Vegetable, very important source of nutrition, is the most important food intake in the country, and is cultivated over all seasons of the year. Once peoples preserved all kind of vegetables seeds at their home but now the scenario has changed over the time. The study revealed that only 35% of vegetables seeds were preserved by farmers, whereas big share (59%) of vegetables sources was the multinational companies providing hybrid seed across the country. Besides, very few (1.50% and 4.50%) of vegetables seed were collected from BADC and other farmers, respectively.

The above dynamism of seeds of different crop varieties, some less noticeable crop varieties such as tobacco (*Nicotiana tabacum*), sugarcane (*Saccharum officinarum*), and fruits seeds had some variation in respect of sources. Tobacco is the most debatable crop in the country which cultivation is motivated by

multinational tobacco companies but these companies do not meet sustainable criteria as tobacco cultivation poses dire impact on environment, health and food security, even though most part of the tobacco (about 100%) seeds were preserved by farmers home. On the other hand, it should be noted that sugarcane is also an important cash crop in Bangladesh and its seedlings were mostly (96%) preserved at farmers home where remaining (4%) seedlings were collected from other farmers. Many fruits such as banana (*Musa* spp), pineapple (*Ananas comosus*), and water lemon (*Citrullus lanatus*) are now cultivated in commercial manner. In the meantime companies have emerged and promoted hybrid seed/seedlings of these fruits species in the farmers' community. As a result, farmers are being motivated for casing more productivity and benefit with significantly low cost. At present, about 62% of fruits seed or seedling were supplied by companies, whereas very less amount (12%) of seed or seedlings were preserved at farmers home, and some part (26%) of seed were still collected from other farmers sources. It can be concluded from the data that seed sources were altered from conventional sources to modern corporate sources by which farmers loses their hundreds of inherited seed varieties. As a result, the country is losing its valuable wealth that may interrupt to achieve sustainable agriculture in Bangladesh.

3.3. Farmers seed rights and some experiences

Seed is the most important inputs in agricultural practice. Once farmers used to produce and preserve seed at their homes and exchanged it among them. Basically, they did not purchase any sorts of seed what they regularly used to cultivate in their fields, even though there were cases where sometimes farmers used to purchase seeds from local hat/bazaar and/or collect those (seed) from fellow farmers during a period of seed scarcity or at the time of cultivating new crops. Hence, they did not take in mind about the price of seed or face any pressure of collecting expected seeds variety. As a result, the local variety were started to become lost and discouraged by the farmers. Now, most of the farmers are intended to cultivate hybrid and HYVs of seed in a view to get more profit and productivity, and companies are taking the advantages of huge demand of these sorts of seed. Sometimes, companies are imposing high price as their wish and running monopoly business to some extent.

Farmers are intending to purchase seeds only to see the quality packaging, companies' advertisement. Most of the farmers cannot recognize the seed by their own expertise rather they believe to traders' words. Sometimes traders provide farmers amalgamated seeds and cheat with poor farmers. Thus, the poor farmers fall into the trap of long terms liabilities since they take credit supports from local NGOs or local lenders by promising to repay loan after the successful collection of into their homes (Box 1 story of afflicted farmers).

3.3.1. Patterns of farmers' seed purchasing location

Usually farmers purchase seed from their annex location. They do not know about feasible location of seed from where they can purchase their required seed at a reasonable price. Table 5 exhibits the patterns of farmer's seed purchasing locations. It is shown that most of the farmers (41%) purchase seed from local seed shops.

Many farmers (39%) purchased seed from Upazila town followed by 13% from district town, 6% from BADC and very negligible farmers who purchase seed from other sources.

Box-1. Picture of afflicted farmers

Md. Rafiqul Islam, a 42 years old tomato grower at Gudagari Rajshahi shared his experience on seed amalgamation story - "I plowed 3 Bigha land of SABAL F-1 Tomato. But after sowing and planting, in early days of cultivation, I observed that types of tomato plants were not homogeneous, instead they were mixed. Instantly I complained about this to local shop, the personnel working at the shop replied nothing bad will occur, just wait and see, it will grow well and you will get good return similar to the previous year. However, as the days passed by those growing tomato plants started to catch virus and became affected by various diseases. Therefore, when it was the time to bloom flower, and when mature tomato plants were pulled together and no tomato was observed in this plant. That was the time I realized that everything had gone. Since then, I was collecting seed with credit from local shop and I promised my creditor that when the tomato will grow I will repay all loans. When I went to local seed shop and stated details of my situation, the shopkeeper replied that he can't help me as he has purchased the seed from dealer. Conversely I was blamed for not cultivating seed "properly" and I was advised to go to the local Syngenta dealer and demand compensation. I was stunned, speechless and shocked by hearing shopkeeper's statement. By this time, through media and word of mouth I came to know that thousands of tomato growers in the country had fall in a similar situation like me. Alongside of other farmers who incurred similar loss, I went to local dealers and demanded compensation after explaining our situation. Local dealer also refused us. Therefore, I was compelled to sell my house shade (Tin) as I was not finding any means to repay my loans. I became mentally stressed for such newfound vulnerability on my livelihood."

3.3.2. Farmer's experience about quality of purchased seed

Bangladeshi farmers mostly have little knowledge about modified or hybrid seed quality. They purchase mostly by an intension of high yield, hearing from others, traders words, and attractive packets. They do not understand what have into the packets actually. Table 6 demonstrates the farmer's experiences about quality of seed when they purchase from traders.

The study showed that about 63% of farmers purchased seed through traders' advice. Many respondents (about 25%) claimed that they purchased seed by their own skills. It was found that 9% of farmers purchased seed by taking advice from other farmers of own locality, whereas some farmers (4%) purchased to see the packets of the seed. Thus, the poor farmers are being cheated by the corporate traders.

3.3.3. Variability of farmer's managing money for purchasing seed

The study revealed that about 47% farmers purchased seed by selling their stored crops, followed by 17.2% by borrowing money from local lenders, 15.6% by selling valuable assets of their family, and 12.2% by taking micro-credit from NGOs. Only 1.1% of the farmers purchased seed by taking loan support from bank, and remaining 6.7% from other sources such as friends, relatives, neighbors, and cooperatives (Table 7).

3.3.4. Farmer's access to seed price

The study showed that most of the farmers (86.7%) were not afford to access ever growing seed price, while few farmers stated that they were afford to access the remaining seed price (Table 8). Hence, this spectrum proved that farmers were very much unsustainable in case of access of seed price and day by day the tendency of preserving seeds by the farmers is reducing.

Table 5. Patterns of farmer's seed purchasing location in agro-ecological zones of Bangladesh

Seed purchase from	No. of farmers	% of the farmers	Mean
Seed shop of local market	74	41	1.87
Seed shop of Upazila town	70	39	
Seed shop of district town	24	13	
Bangladesh Agricultural Development Corporation office	10	6	
Other sources	2	1	
Total	180	100.0	

Table 6. Farmer's experience about quality of purchased seed in agro-ecological zones of Bangladesh

Experience patterns	No. of farmers	% of the farmers	Mean
Depend on won skill	43	24.9	1.94
Depend on trader's advice	113	62.8	
Depend on other farmers' advice	16	9	
To see packet	8	4	
Total	180	100.0	

Table 7. Patterns of farmer's managing money for purchasing seed in agro-ecological zones of Bangladesh

Sources of money	No. of farmers	% of the farmers	Mean
Selling crop	85	47.2	2.24
Selling family valuables	28	15.6	
Borrow money from local lenders	31	17.2	
Borrow from NGO	22	12.2	
Borrow from Bank	2	1.1	
Others	12	6.7	
Total	180	100.0	

Table 8. Farmers access to seed price in agro-ecological zones of Bangladesh

Comments	No. of famers	Percent of the farmers	Mean
Yes	24	13.3	1.87
No	156	86.7	
Total	180	100	

3.3.5. Trend of seed price and farmers perception

The increasing patterns of seed price have added more vulnerability into farmers' net benefit. Sometimes the cost of production becomes higher than the actual yield. In addition, traders' augments seed price showing

artificial crisis and charge high price when peak demand arises among the farmers. The study demonstrates that seed price is increasing very steeper manner over the years. About 38% of farmers' stated that the price of seed was increased at very high trend, whereas 31.7% of farmers opined for very much high price followed by 23.9% high and 6.1% not so high (Table 9).

The study also revealed that the fluctuations trend of seed price when peak seasons arise, and about 39% of farmers argued during peak seasons of sowing, the seed price fluctuated very much high whereas, 32.8% claimed very high, 21.7% high, and 6.7% not so high. The price of seed, thus, is increasing and fluctuating over the years and effect significantly on farmers' industrious income as well as posing threats on sustainable agriculture in Bangladesh.

3.4. Economic viability of seed diffusion

To ensure true economic sustainability agriculture farms must need to be profitable with positive economies of scale in production side. Economic viability in agricultural production can be obtained in various ways. In short term, developing soil management and crop rotation can augment yields, besides in both the medium and long term; improved soil quality and water accessibility as well as considering other environmental factors are also answerable to ensure sustainability in agricultural practice. Economic viability can also be obtained through curving input costs on the specific features of the production process. This study emphasized on calculating the cost actually incurred for per unit production, and how much yield is actually obtaining from per unit of land and finally calculating the cost benefit ratio of yield produced to shows

Table 9. Farmers' perception on price increase and price fluctuations in agro-ecological zones of Bangladesh

Trends	Trend of price increase				Trend of price fluctuations			
	No. of farmers	% of farmers	Mean	S.D	No. of farmers	% of farmers	Mean	S.D
Not so high	11	6.1	2.96	0.89	12	6.7	2.96	0.93
High	43	23.9			39	21.7		
Very high	69	38.3			59	32.8		
Very much high	57	31.7			70	38.9		
Total	180	100.0			180	100.0		

Table 10. Coefficient estimation[8] of gross returns of different rice varieties in agro-ecological zones of Bangladesh

Variety	Coefficient estimations ()	R square
Local	Y_{LOCAL}=15001+0.750X** SE (1.27)	0.65
HYV	Y_{HYV}=29997+0.363X SE (0.213)	-
Hybrid	Y_{HYBRID}=46049−0.045X SE (0.206)	-

*Here, Dependent variables - gross output (yield); Explanatory variables - input costs, **indicates level of significant at 5%; SE indicates the standard error*

8 Coefficients estimated based on following formula

$$Y_i = \alpha + \beta \sum X_i + U_i \quad (6)$$

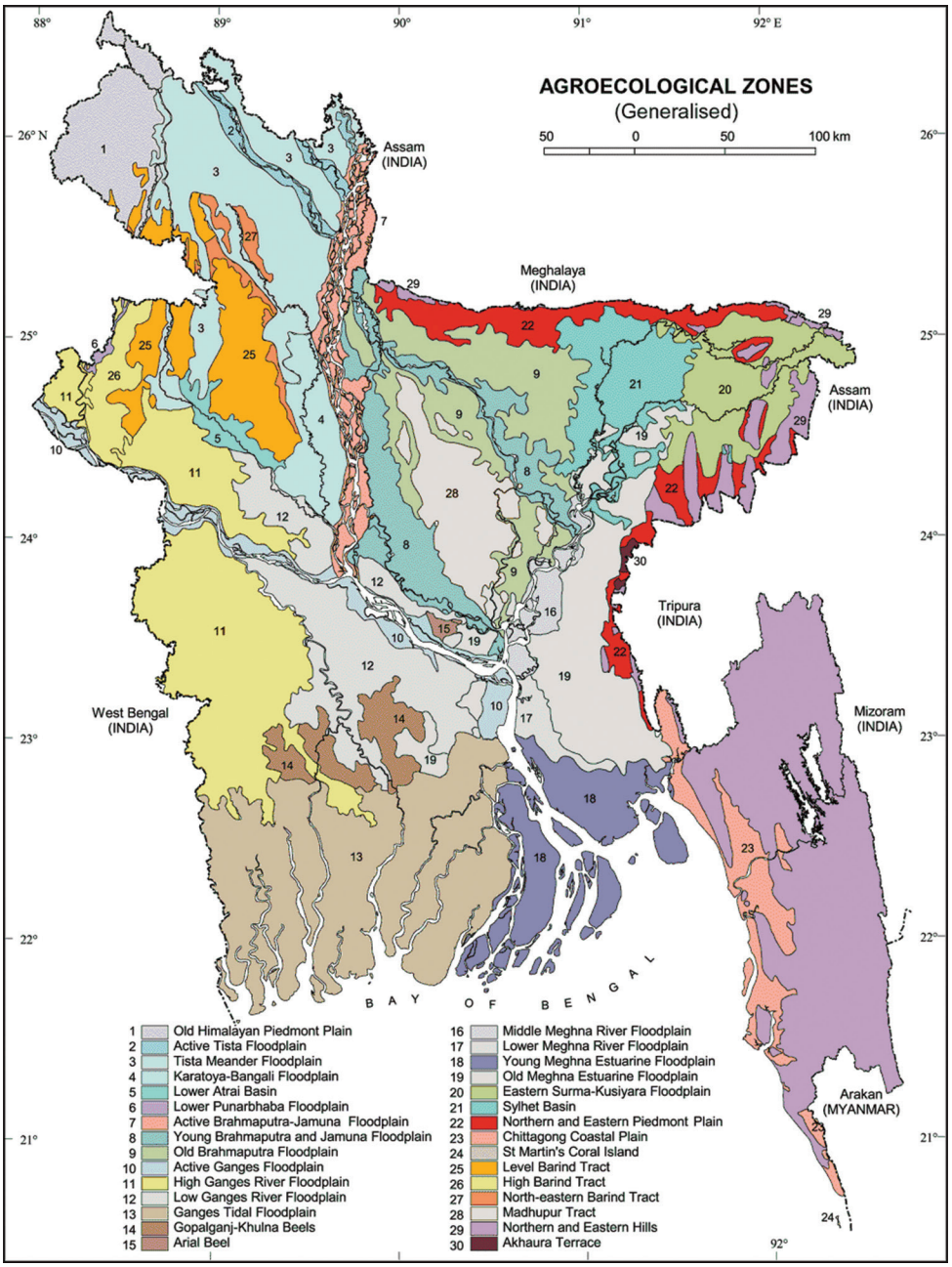

Figure 1. Agro Ecological Zones of Bangladesh

impact of seed variety diffusion on sustainable agriculture. Purposively, this study wants to demonstrate the economic viability in agriculture considering the rice production in different variety of seed used.

3.4.1. Variety wise rice production variability

Rice is the staple food of Bangladesh, which cover 67% of cultivated area, 78% of irrigated area, 52% of agriculture gross domestic product (GDP), and 71% of caloric intake (BBS, 2008). Rice production has increased terrifically after inventing of HYV and Hybrid varieties focusing good volume nationally. Field study

showed that yield per acre of land has increased immensely and mounting radically over the year. The study revealed that hybrid rice production was on average 73.4 mound[5] acre^{-1} of land screening highest figure comparing those of HYV and Local varieties as produced 54.8 and 29.8 mound of rice, respectively (Figure 2).

Although this production varied according to AEZ, and it is tough to measures more accurately the cost and yield by field survey, it was clear that rice production of hybrid and HYV has been screening hand some figure to some extent as compare to that of indigenous varieties.

3.4.2. Variety wise rice price variability

Rice is cultivated about all over the country. Hence, rice price is an issue of concern issue in the context of Bangladesh. If rice price increases, not only that poor people suffers in one hand but also farmers suffer as they have to sale their production at a lower price on the other. Besides, price of rice also depends on the variety and quality of rices. Hence, there exists a complex socio-economic concern on rice price. According to the respondents' perception, Hybrid rice was less qualityful and harvested only for sale comprised of US$ 7.8 mound^{-1} which is less than that of other variety (Figure 3). HYV was introduced by Bangladesh Agricultural

5 Mound- local unit of measurement-one mound equal to 40 KGs

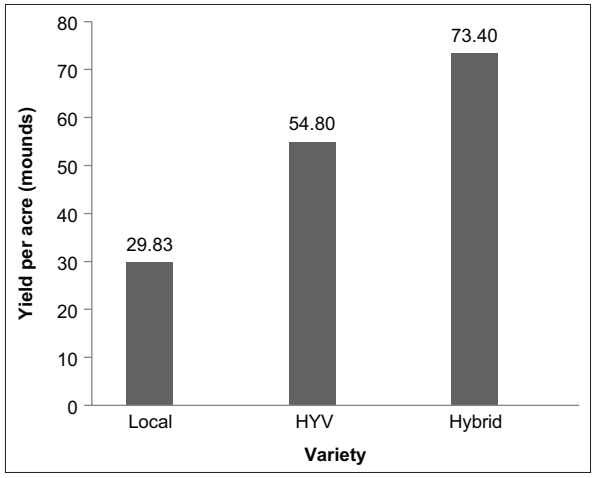

Figure 2. Yield of rice varieties acre^{-1} of land

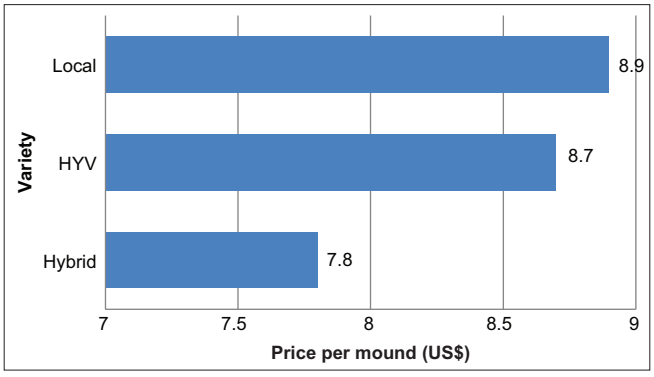

Figure 3. Average price of rice varieties mound^{-1} (US$)

Department, and the quality and price were found better than the hybrid. At present, HYV is much popular among mass people having average price of US$ 8.7 mound^{-1} higher than the hybrid variety of rice.

Besides, local rice now is in scarce situation, but its price is still higher due to food cultural demands, which average current price is US$ 8.9 mound^{-1} higher than both of Hybrid and HYV (Figure 3). This variety also used for making different cakes and delicious food items as significant part of Bengali culture.

3.4.3. Variability of cost-benefit of different rice varieties

Cost and benefit are the prime concern of any production process. Every business aims to minimize its cost and maximizes the benefit. Although agriculture is not a corporate business, farmers go to production mainly to meet their well-being, and to feed themselves. Hence, there was a tradition that farmers did not used to think about what cost actually was incurred during the production period and/or what benefit actually was gained from there. At the age of green revolution, this scenario has been changed. At present, the production cost for cultivating any sorts of crops is not cheap. Every amenity of agricultural inputs has gone to corporate business and everything has to be purchased from corporations. Amount of cost and benefit also depends on the variety of crops. Within this changing business environment, the poor and less literate farmers are now facing huge loss, which they do not take into account yet. The study, here, revealed the comparative scenario of cost and benefit of rice production in terms of different rice variety.

In case of cost of rice production, local variety still incurred less cost than that of HYV and hybrid rice variety. The study showed that Local variety incurred US$[6] 128 for acre^{-1} of rice production cost, whereas it was US$ 261 and US$ 369, respectively, for HYV and Hybrid. Although, gross production (yield) of Hybrid rice (US$ 575) acre^{-1} of land was found higher than those of HYV (US$ 478) and Local (US$ 268) variety. However, after deducting its inputs cost, it showed farmers' net gain for HYV was higher (US$ 218) than that of hybrid (US$ 206) rice variety, while the net profit of local rice was US$ 140 (Figure 4). The study observed that the local variety was more economic than both of HYV and hybrid variety of rice.

3.4.4. BCR of different seed varieties

To observe the real economic viability of seed diffusions, it is important to analyze the economic efficiency by estimating BCR[7] of three varieties of rice. BCR of different seed varieties of rice showed the rate of benefit which was actually drawn from per unit cost invested. The econometric form from data demonstrated that BCR was at higher rate (2.3) for local variety of rice than other varieties, which implies investing BDT^{-1} of local rice production results BDT.2.3 net profit, whereas in case of HYV and hybrid net benefit or return was BDT.2.0 and BDT.1.7, respectively, for BDT^{-1} investment (Figure 5).

Hence, it is proven that local variety was more economically efficient or significant than those of hybrid and high yielding seed varieties.

6 US$= BDT. 78

7 BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. BCR takes into account the amount of monetary gain realized by performing a project versus the amount it costs to execute the project. http://en.wikipedia.org/wiki/Benefit-cost_ratio

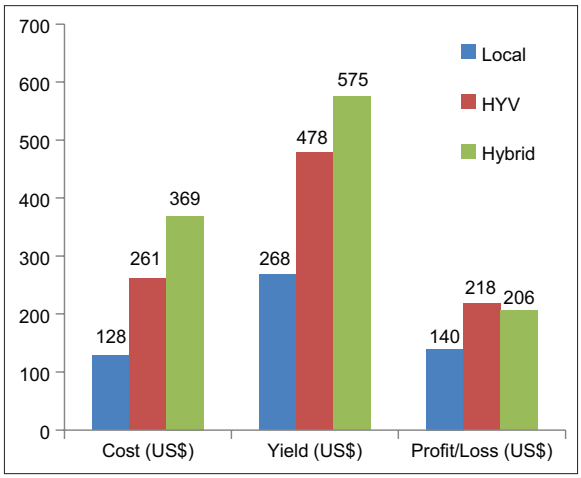

Figure 4. Variability of cost-benefit of different rice varieties

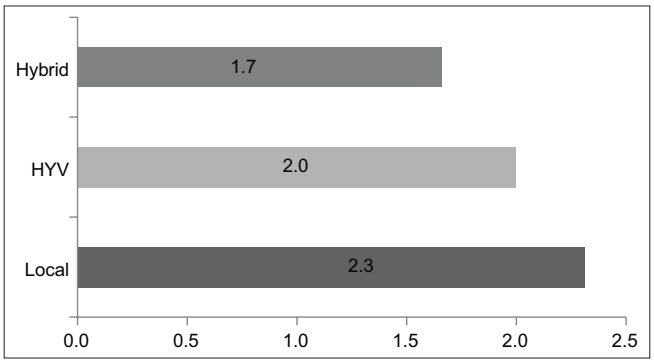

Figure 5. Benefit Cost Ratio (BCR) of different seed varieties

3.4.5. Econometric evaluation of rice production efficiency

The analysis shows the regression coefficient of production functions, where the coefficients of local and HYV rice were 0.75 and 0.36, respectively, representing that one unit change in input, yield (output) increased by 0.75 and 0.36 unit, respectively. In case of hybrid, it was found negative result, as one unit change in input cost, yield (output) decreased by 0.04 units. Among the varieties, only local seed significantly influenced the gross output at 5% level of confidence interval. Hence, it can be concluded that local rice is still much more cost effective and more economically efficient than those of HYV and hybrid rice varieties (Table 10).

3.5. Environmental feasibility of seed diffusion

Diffusion of seed varieties is pretend to make a remarkable effect on environment. Increasing trend of using hybrid, HYVs intends to use more pesticides and fertilizer which are destroying the potential fertility of the land, ruining the other species inhabitant and their numbers, lessening the soil nutrition causing menace for sustainable agriculture in Bangladesh. In the sense of intensive agriculture production Bangladesh started to use chemical fertilizer and toxic pesticides in early 1980s, which is now very widespread posing threat for people health especially for rural farmer, food taker, mass people, and whole human being. In Bangladesh, 70% of pesticide is used for cultivation of rice (BBS, 2011). It is mentionable that it (pesticide) is sprayed

several times a week especially in case of vegetable production. Since vegetables are grown mostly near the house and water pot threatening for health loss especially for women and children.

3.5.1. Soil fertility depletion

With the increasing population, land is decreasing over the years now in Bangladesh. An estimated land area of the country is 14.84 million hectares, of which 8.29 million hectares are used for agriculture. It is the matter of stunned that agricultural land is decreasing rapidly to meet others supporting activities of people. In 1951, the total population was about 47 million with per capita agricultural land was 0.16 ha. At present, it has lowered as much it gone to 0.066 ha, when the total population is about 160 million (Kafiluddin and Islam, 2008). It is really tough to feed the huge population with this limited land. To meet the challenges of food security, Bangladesh admitted the strategy of green revolution for increasing production with limited land area. Consequently, soil started to loss its fertility due to artificial chemical inputs in the process of cultivation. Till the introduction of fertilizer intensive high yielding in 1960's, it was mostly subsistence agriculture with very low yield without any stress on soil fertility. Once farmers only used organic fertilizer which was prepared by household byproducts of different chemical reaction that could harm the soil quality and other species in biodiversity.

Formerly soil of Bangladesh was as much as fertile that it was compared with gold (Sonar Mati). But in the name of green revolution and intention of high agricultural production chemical fertilizers are pushing into this gold posing great threats for widely deficient nutrients in the soils – nitrogen, phosphorus, potassium, and sulfur (Kafiluddin and Islam, 2008). Now, the soil has been depleted seriously as much as this about unable to produce any crops without chemical fertilizer and pesticides. Figure 6 shows the trend of chemical fertilizer used in Bangladesh for the past 45 years.

In the year 1965–66, the total use of chemical fertilizer in Bangladesh was only 1000 metric tons (MT). After that, fertilize use increased steadily till year 1975–76. However, certainly it started to use fertilizer with very steeper shape. In year 1984–85, fertilizer use increased by 3 times than year 1975–76. There had been rapid increased of using chemical fertilizer from the year 1985 (1260 MT) to 1995 (3023 MT). Since then it is increasing rapidly. The study revealed that the use of chemical fertilizers has been augmented about 12 times within the past three decades from 1980 to 2011.

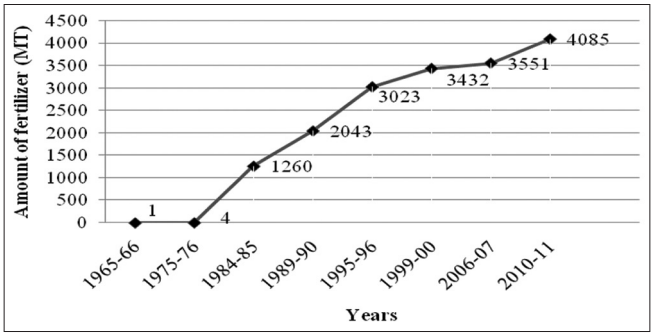

Figure 6. Trend of chemical fertilizer used in Bangladesh (Source: Handbook of agricultural statistics 2007 and Bangladesh economic Review 2011 and Kafiluddin and Islam, 2008)

3.6. Chemical pesticides use and peoples' health hazard

Chemical inputs brought to Bangladesh with a view to ensure ever increasing food demand for growing populations. Although in case of food availability it has seen some positive results, fail to ensure food security which must be nutrient and safe. Modern variety of different modified seed is highly chemical depended, as huge amount of chemicals pesticides/poisonous are being used in different stage of production processing and conservation. Thus, it impacts seriously on human's health. The plant protection wing of the Pakistan government was first imported pesticides in Bangladesh in 1956. At that times, the pesticides were supplied to farmers at free of cost.

The Bangladesh government after the liberation continued to give 100% subsidy to pesticides until 1974, which was reduced by 50% in 1979. The government fully cut off the subsidy and invited private sector to import pesticides in 1980 under the structural adjustment program of WB (Islam, 2011). Despite the removal of subsidy, the use of pesticides became double (Figure 7) during the period of only 5 years from 1985 to 1990, that indicates the dependency of farmers on pesticides created through providing subsidies during the previous years. The data also show that the use of pesticide in 1980–81 was 2274 (MT), which was increased to as high as 48595 MT in 2009–10. Hence, pesticides use increased 21 times over the period of only three decades from 1980–81 to 2009–10, which seems to be increased at a rapid rate in future. This trend also indicates that all efforts of promoting integrated pest management have virtually been failed in the country. In this context, it is a big question how it is possible to ensure food security with the poisonous food produced by modern agriculture. However, it is undoubtedly true that the modern agriculture has tremendously swelled up the pesticide and fertilizer business of the corporations and their profit.

On the other hand, many of the modern varieties are giving higher yield by increasing bulk of the food not the nutrition status. Although the data presented in the Table 9 shows that Bangladesh is a food surplus country since past 1 year, FAO data on nutrition offers different scenarios. The FAO data demonstrate that the rates of malnutrition in Bangladesh are among the highest in the world. More than 54% of pre-school-age children, equivalent to more than 9.5 million children are stunted, 56% are underweight, and more than 17% are wasted (Islam, 2011).

The data further indicate that Bangladeshi children also suffer from high rates of micronutrient deficiencies, particularly Vitamin-A, iron, iodine, and zinc deficiency. Malnutrition among women is also extremely prevalent in Bangladesh. More than 50% of women suffer from chronic energy deficiency.

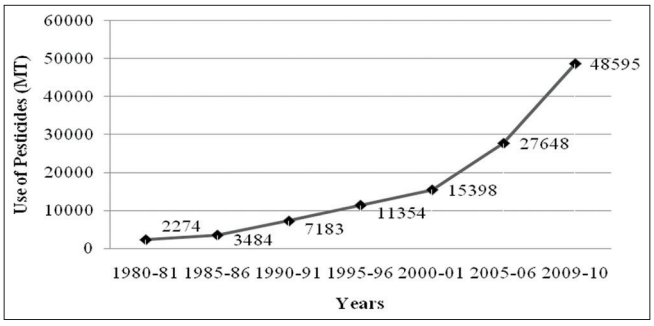

Figure 7. Consumption of Pesticides in Bangladesh Source: Handbook of Agricultural Statistics 2007 and Islam (2011)

It is also well-known to all that due to consumption of poisonous food the health hazards and disease occurrence is increasing in an alarming rate in the country. It is, therefore, crucial to rethink about the production system of the country with an aim to foster safe production practice to grow nutritious food at any cost.

3.7. Trend of agriculture contribution to national economy

A declining trend in the growth of agricultural sector has recently been noticed, which, in turn, contributed to decelerating growth in GDP in the country. Although there was an increasing trend in growth in agriculture from 1990 to 2010, since the FY 2010–11 the rate of growth has been falling. The rate of growth in agriculture was 5.24% in FY 2009–10, whereas in FY 2010–11, FY 2011–12, and FY 2012–13 the rate was 5.13%, 3.11%, and 2.17%, respectively. This falling growth in agriculture has been causing the share of agriculture in GDP to decline over the recent years. For instance, in FY 2009–10, the share of agriculture in GDP was 20.29%, whereas in FY 2010–11, FY 2011–12, and FY 2012–13 the share was 20.01%, 19.42%, and 18.70%, respectively. As a result of this declining contribution of agriculture to national income, the growth of GDP in the country has also been found decelerating. If the current trend persists, the agricultural growth rate might reach as low as 2.09% in FY 2013–14 (Figure 8).

Recent declining trend of growth in agriculture can be attributed to a number of reasons. First, the post-green revolution period has not experienced any breakthrough as regard technological advancement in the country, on the one hand, and the poor and marginal farmers who comprise the majority of total farm population cannot afford the high cost of using high input technologies in agriculture on the other. Second, despite higher cropping intensity, the declining trend in the availability of arable land causes the growth in agricultural sector to fall. Third, though the budget allocation in agriculture is increasing, the large portion of this allocation goes for meeting non-development expenditure every year leaving a meager amount for development spending, thus constraining development in the sector. For instance, 45% of total agriculture related budget was allocated for meeting non-development expenditure in FY 2009–10, 84% in FY 2010–11, and 85% in FY 2011–12. Therefore, to raise productivity and profitability, reduce instability, and increase efficiency in resource use, increase of the allocation on the development side is important (Figure 8).

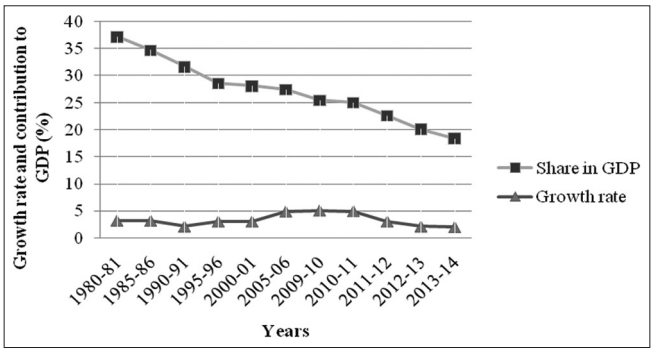

Figure 8. Growth rate and share of agriculture in gross domestic product to national economy Source: Ministry of Finance, 2014

4. Discussion

Seed variety diffusion and sustainable agriculture are becoming a very concerning matter in respects of Bangladesh. The results showed that socio-economic aspects of farmers were vulnerable in terms of education, income, and land possessions. It was found that most of the farmers were illiterate, and very few completed primary and secondary education. Since the farmers work at subsistence level, most of their income comes from agriculture. The increasing trend of commodity price does not mean there is an increase in the income of farmers. Hence, they still enjoy very low income. The study found that above 20% of farmers' income was less than US$ 64. There also exists a big inequality among them. It was found that only 40.5% of farmers with large income possessed 61.34% of total income. Moreover, there was a large inequality in land possession among the farmers. The study found that most of the farmers were landless, marginal, and small who possessed only one-fourth of total agricultural land, whereas it was 32% for medium and 76% for large farmers. Thus, the big portion of landless and marginal farmers was in distress situation regarding the socio-economic status.

On the other hand, in seeds variety diffusion farmers were in very anguish situation due to monopolistic control on the seed right. They conventionally would have been produced and preserved seeds and seedling in the households. Now, multinational companies are the prime sources of seeds, supplying modern variety of different seeds with high costs. In addition, most of the staple (rice and wheat) and cash crop (jute) seeds supplied by company posing great threats to sustainable agriculture in Bangladesh. Poor farmers are suffering tremendously for accessing seed price, managing cash for purchasing seed, and other inputs. It was found that they compelled to purchase these sorts of seeds what company charged. In fact, they did not know what seed was good or what was bad; they mostly depended on the traders' words. The study found that farmers taken loan from local lenders, NGOs, and Bank to meet seed price. The case study (Box 1) depicts that a tomato growers sold his house shed for repay the loans of shopkeepers. Further, price hike and fluctuation bitten them more severely, traders augments the seed price at peak seasons of sowing and planting of seed or seedling, sometimes they creates artificial crisis of seeds. Therefore, the poor farmers are becoming a back and call of these corporate seed suppliers, which intending to loss seed wealth, ecosystems, losing its biodiversity, and indigenous species posing great threats on sustainable agriculture in Bangladesh.

According to the principles of sustainable agriculture, authors tried to show the economic viability of seed diffusion using the econometric model and other relevant tools. It was found that in case of cost local variety rice was more economic than of HYV and hybrid; in case of yield HYV and hybrid results good total than of local variety; and in case of BCR local variety was more economic than of hybrid and HYV.

It was also found that local variety turn out BDT. 2.3 for taka^{-1} investment cost, whereas it was BDT.2 and BDT.1.66 for taka^{-1} investment in case of HYV and hybrid, respectively. Besides, corresponding regression coefficients of local and HYV were 0.75 and 0.36, respectively, representing one unit change in input, yield (output) increases by 0.75 units and 0.36 units, respectively. In case of hybrid, negative result came out as one unit change in input cost, yield (output) decreased by 0.045 units. Among varieties, only local seed significantly influences the gross output at 5% level of confidence interval. Hence, it can conclude that local rice is still much more cost effective and more economically efficient than those of HYV and hybrid rice varieties.

The study observed that environmental viability of seed diffusion posed significant threat on sustainable agriculture and food intakes. Due to modern variety diffusions, it needs huge chemical fertilizers and

pesticides, which depleting the soil fertility. It was found that chemical fertilizer and pesticides use are escalating enormously over the years. The study showed that the use of fertilizers augmented about 12 times within the past three decades.

Besides, chemical pesticides brought in agriculture to ensure ever increasing food demand for growing population, while it showed threats as a killing agent of indigenous species as well as for human being in long terms. Because, modern variety of different crops are mostly chemical depends. Study found that fertilizers use increases in Bangladesh over the past 30 years and its use increased by 24 times by the past 30 years, which also alarming for sustainable agriculture as well for human body. The study also found that the rate of growth in agriculture sector, and share of its in GDP to national economy was declining over the past decades.

5. Conclusion and recommendations

Seed diffusion is posturing adverse impact on every philosophy of sustainable agriculture. First, diffusion seed is intending high inputs costs for cultivating any sorts of crops due to highly chemical inputs dependency, which is not possible to produce and preserved locally. Hence, it is incurring huge share of inputs cost posing economic loss of cultivation which has been gone from poor farmer's industrious income. Thus, it is needed to encourage community seed bank at farmers' level, and government can support them by supplying technology, management knowledge techniques, etc. Alongside, government can also take steps for organic practice systems, and can provide technological subsidy for creating new indigenous knowledge of inputs by which farmers can produce fertilizer and/or pesticides locally. Furthermore, it need to developed and strictly maintain the laws of production, distribution and possessions of seed. Second, it is pretense environmental, socio-cultural and physical hazards due to intension on modern variety of seed. We are losing hundreds and thousands of indigenous variety of seed instead of taking hybrid variety. This also impacts on state, customs and sovereignty. Hence, government can take immediate steps to protect this slaughtering by diffusion of modern variety of seeds.

Acknowledgments

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