

# Crop Diversification in Bangladesh: Constraints and Potentials

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## Abstract

The present study is an effort to analyze the present situation of crop diversification in Bangladesh using secondary data. Required data were collected from various issues of government of the country. Simpson index and Rice Share index of crop diversification have been used to calculate the nature and extent of crop diversity in Bangladesh. The study found that slightly more than half of the gross crop area grows crop twice in a cropping year. Yield and production of different crops, especially cereal crops, except few cash and minor crops, have increased by almost three folds in last four decades due to technological advancement. However, crop sector's contribution to GDP is in a decreasing trend. Cropping intensity has been increasing since independence of the country. Rice share in gross crop area has been decreasing at a snail's pace. Still rice share in gross crop area is more than three fourth of gross crop area. Value of Simpson index of crop diversification has been increasing slowly since 1971. Simpson index value indicates Bangladesh is a mediocre diversified country and Rajshahi division is more diversified region in Bangladesh. Index value also indicates small farmers' practices crop diversification more than that of other types of farmers. The study also found price and yield variability, existing marketing system, present irrigation system and water management system are the few prominent hindrances in the way of crop diversification. By minimizing the reported impediments crop diversification can be enhanced substantially that would lead to increase the potential of employment generation and earnings of the rural people in the country.

## 1. Introduction

Bangladesh is an agriculture dependent country. Agriculture plays a vital role in Bangladesh economy. More than 70% people in the rural areas directly or indirectly are involved with agriculture (BBS, 2011 and MoEF, 2012). It employs nearly 47.5% of labour force and contributes one sixth of gross national product of the country (GoB, 2013). Different types of industries and farms have been developed in the rural areas based on agriculture. Agriculture supplies raw-materials to the industries especially agro-based industries. Rice is dominant among different subsectors of agriculture and accounting for roughly three fourths of gross crop area devoted to rice production (BBS, 2011). Actually, rice based monoculture exists in agriculture of the country. As a result of continual cultivation of rice monoculture gives us self-sufficiency in food production to some extent but it creates many problems. As a result, agriculture sector has been facing a number of problems like reduction of soil fertility, pests and diseases outbreaks in

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the crop fields and decline in water table etc. These problems further create the same problems cyclically. In addition, rice monoculture also reduces production of non-rice crops, erodes biodiversity, creates nutritional imbalance (Hussain et al, 2001; Rahman, 2010). Rice monoculture has also made the farming activities complex and costly. Finally, it reduces farmers' net margin. As a result, farmers are getting reluctant to farming and getting interest to non-farm activities, which is a great concern for Bangladesh in term of food security. Crop diversification is considered as a strategy of reducing the reported problems. It is also considered as an effective approach to utilize scarce land and valuable water resources, and it makes agriculture sustainable and environment friendly (Joshi et al, 2007; Kumari et al, 2010; Singh, 2001). Thus, crop diversification is believed to be a widely prescribed means of agriculture and rural development (Acharya, 2011; Pingali and Rosegrant, 1995; Vyas 1996). It offers comparatively high returns from crops by minimizing price and yield risk created by climatic variability and price volatility of agricultural produce. Again, it also offers higher labor productivity, optimizes use of resources and utilizes the land efficiently (Ashfaq et al. 2008; Mehta, 2009; Mukherjee, 2012). It also creates opportunities for more employment and higher income through higher efficient use of resources. World Bank, (1990), Gunasena (2001) and Singh (2001) believe that crop diversification is a very important instrument for food and nutrition security, income growth, poverty alleviation and employment generation. It also helps to use the land, water and other resources judiciously. Crop diversification as a socially beneficial policy can be complimented by extensive infrastructural facilities, financial and technological support, etc. especially for the localized micro (labor-intensive) enterprises that are engaged in processing, storing, grading and packaging activities (Chakrabarti & Kundu, 2009; De & Bodosa, 2014).

From the above discussion, it can be said that crop diversification is a contemporary issue in the field of agriculture, especially in the context of Bangladesh. Therefore, it claims a comprehensive study for the betterment of the agriculture of the country. From the literature, it is found that there are a good number of studies carried out in different countries regarding this issue. However, a very few studies carried out in Bangladesh. So far the researchers' knowledge goes, no comprehensive and empirical study has been done in this issue. The studies carried out in Bangladesh based on survey and descriptive types which cannot represent the real picture of this issue. In this backdrop, the present study is an attempt to analyze to the present scenario of crop diversification in Bangladesh. Specifically this study concentrates to i) compute the level of crop diversification in Bangladesh ii) explore problems and prospect of crop diversification in Bangladesh.

## **2. Literature Review**

Metzel and Ateng (1993) worked on problems associated with diversified crops by using household level primary data. They used Simpson index and Rice share index to find out the extent of crop diversification. They found low profitability, high input cost, risk in selling non-rice crops and vulnerability to weather variation and pests stand against in the way of crop diversification. In addition they concluded that proximity to towns increased crop diversity while credit decreased it. Mahmud et al (1994) studied agricultural growth and crop diversification in Bangladesh. They identified some problems and offered suggestion to enhance crop diversification in Bangladesh. They found that high price risk, price variability associated to non-rice HVCs and present irrigation system are prominent hindrances on the way of crop diversification. They also believed that real prospects for crop diversification, however, would

still depend on how far technological innovations could make non-cereal crops competitive under conditions of modern irrigation.

Ashfaq et al (2008) worked on the factors affecting crop diversification. They used a multiple regression model in which the values of Entropy index of crop diversification were taken as dependent variable and different factors affecting diversification were taken as independent variables. They found that size of land holding, age of respondent, education level of respondent, farming experience of respondent, off farm income of respondent, distance of farm from main road, distance of farm from main market and farm machinery are the main factor of crop diversification. Malik and Singh (2002) studied extent of crop diversification. In this purpose they used Entropy index of crop diversification. They concluded that availability of market, increased demand of crops, export facilities and proximity to town area facilitate crop diversity whereas absence of proper market, price variability and irrigation facility are the notable hindrances for crop diversification. Haque and Bhattacharya (2010) used Simpson's index of crop diversification by using 2010-11 data and found that the value of Simpson index is the highest in Orissa (0.25) followed by Bihar (0.18), West Bengal (0.16), Uttar Pradesh (0.15), and Jharkhand (0.08).

### 3. Methodology and Data

#### 3.1 Measurement of Crop Diversification Index

This study has computed the level crop diversification in Bangladesh. To measure the level of crop diversification there are different types of measurement index like Simpson index, Entropy index, Herfindahl index, Ogive index etc. Benin et al (2004), Chand (1996), Pandey and Sharma (1996) have used these indices in their studies. Each method has some limitation and/or superiority over the other (Shiyani, 1998). We have used Simpson Index (SI) of crop diversification which has been used extensively in various studies. Other than Simpson index of crop diversification, we have also used Rice share index (RI), rice acreage, to measure the level of crop diversification. Rice share index has been used by Metzler and Ateng (1993).

##### 3.1.1 Simpson Index

Simpson Index (SI) is defined as the difference between one and sum of squares of all the proportion of farm acreage involved in a particular enterprise. The index is represented as:

$$SI = 1 - \sum_{i=1}^n p_i^2 \dots\dots\dots (1)$$

where,  $p = \sum_{i=1}^n \frac{a_i}{A}$ ,  $a_i$  = area devoted to a particular crop in a given year, and A is annual gross cultivated area (equal to the sum of all crop areas in all seasons). The value of the SI ranges between zero to one, denoting zero for perfect specialization, and one for perfect diversification. The value of SI has direct relation to crop diversification.

##### 3.1.2 Rice Share Index

Rice share index refers to the proportion of different rice crop area to gross crop area. The mathematical expression of Rice share index is as follows:

$$RI = \sum_{i=1}^n \frac{r_i}{A} \dots\dots\dots(2)$$

Where, RI = rice share index,  $a_i$  area devoted to  $i^{\text{th}}$  rice and A gross crop area of a year. The value of RI is same as of SI.

### 3.2 Data and Sources of Data

The study has used 40 years time series crops acreage, yield and production data, which were collected from various issues of Yearbook of Agricultural Statistics in Bangladesh, Statistical Yearbook of Bangladesh, Bangladesh Economic Survey, Bangladesh Census of Agriculture and Livestock. In addition, various related published and unpublished issues of the government and non-government organization of Bangladesh, websites were consulted for secondary data and supporting literature. The main purpose of the study is to analyze present state of crop diversification in Bangladesh. Both quantitative and qualitative data were used to justify the research objectives.

## 4. Result and Discussion

### 4.1 Types of Crop Area

Generally there are three crop seasons in Bangladesh. Due to elevation of land and some other problems all the cultivable land is not suitable to use all the three seasons for crop production. Most of the cultivated land (70% of net cultivable land) produce crop more than once in a cropping year is evident from Figure 1. It indicates there are high cropping intensity prevails in the region. Similarly, the more the multiple crop area, the more is the options in practicing crop diversification in the cultivable land.

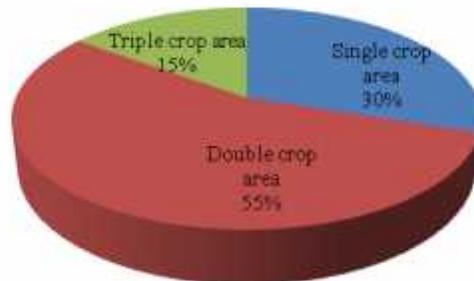


Figure 1: Types of Crops area  
Source: AIS, 2013

## 4.2 Production Performance of Crops

Crop agriculture plays a vital role in Bangladesh economy and gets utmost importance from the government. It is the biggest subsector of agriculture, whose contribution to GDP and labor absorption capacity is the highest among other sectors. Land quality of Bangladesh is deteriorating owing to degradation of soil fertility (e.g. nutrient imbalance), soil erosion and soil salinity. In addition, water resources are also shrinking continuously due to high exploration of ground water for irrigation. In order to produce more food for the ever increasing population of the country and to meet up high demand of raw materials for agro-industries, agricultural productivity needs to be increased. However, increase in the productivity of agriculture is possible by increasing yield rate through intensification and diversification of agriculture. But unfortunately, due to frequent natural calamities like floods, drought, cyclone, etc. Bangladesh economy comes to a halt. However, one of the main objectives of the government of Bangladesh is to fulfill food requirements of the nation.

Major crops in Bangladesh are cereals, sugarcane, fruits, vegetables, oilseeds etc. Major industrial crops are jute, tea, tobacco etc. Long before and imidiate after independence war, agriculture was the dominating sector in Bangladesh economy. Years after independence, agricultural products increased steadily however it could not keep pace with the rapid growth of population. Rice is the main food crop in the country. It acquired the fourth place in the world for the production of huge rice in the middle of the 1980s, which was caused by the use of high yielding varieties of seeds, fertilizer and irrigation (Kamrunnahar, 2006). Yet in the year, 1980s, Bangladesh had to import ‘an average of 2 million tons of food grains each year’ to feed ever increasing people. In the late 1980s, there was a progress in industrialization and from 1990 industrial establishments and foreign investments increased to a great degree, and agriculture was being neglected, because of which its improvement was hampered and fell down sharply.

Table 1: Crop Production and Yield/per hectare in Bangladesh (10 years average)

Crops	1971 – 80		1981 – 90		1991 – 2000		2001 – 10	
	Production (000' tons)	Yield (tons)						
Rice	11620	1.17	14980	1.40	18766	1.84	27199	2.53
Wheat	284	1.34	1098	1.90	1400	1.93	1119	2.05
Maize	2	0.81	2	0.80	40	2.51	542	4.83
Pulse	219	0.63	424	0.70	507	0.75	285	0.83
Oilseed	240	0.78	391	0.90	466	0.85	584	1.29
Vegetables	2277	8.00	2645	8.00	3405	9.00	7417	11.0
Spices	300	1.97	293	2.00	328	2.13	925	3.20
Fruits	1315	11.53	1378	9.70	1395	7.24	1411	6.66
Jute (bale)	5188	7.14	5400	8.20	4790	9.32	4597	10.86
Sugarcane	6234	43.09	6980	42.0	7312	40.13	5898	39.44

Sources: BBS various issues

In the last three decades, major technological changes have occurred in agriculture greatly. As a result, use of fertilizer, irrigation equipment and high yielding varieties (HYVs) of seed has increased simultaneously, rice production has also increased. Though agricultural holdings are small in the country, farmers are increasingly using modern machinery, with the help of cooperatives. But yet rice and wheat are being imported every year to feed the huge number of population. Domestic production of other agricultural products such as pulses, sugar, milk, meat, fish, vegetables and oil never fulfill the requirements of the country, rather remained short.

Table 1 shows the production performance of crop subsector in agriculture. It is evident from the table production and yield of rice in the first decade after independence was 11620 thousand tons and 1.17 tons, respectively, while after 40 years of independence production of rice reached to 27199 thousand tons and yield 2.53 tons. Production of other crops have also increased but comparatively low. Similarly, wheat production was 284 thousand tons in the year 1971– 80 while in 2001–10 it was 1119 thousand tons and per hectare average yield of wheat was 1.34 tons in 1971 – 80 and 2.05 tons in 2001 – 10. Again it is evident from the table that there is a tremendous increased in maize production as well as its yield rate. In 1991 – 2000 its average production was 40 thousand tons while in 2001 – 10 it reached to 542 thousand tons. In that time its' average yield was 2.51 tons and 4.83 tons per hectare respectively.

Average production of pulses was 219 thousand tons in 1971-80 and 285 thousand tons in 2001-210 whereas its average yield was 0.63 tons per hectare and 0.83 tons per hectare, respectively. Productivity of pulses is very low comparing to other crops. Farmers are paying less attention to these crops as its yield rate is very low comparing other crops and farmers grow rice for subsistence. Likewise, average production of oilseeds was 240 thousand tons in 1971 – 80 and 584 thousand tons in 2001 – 10 whereas per hectare average yield was 0.78 tons and 1.29 tons, respectively. Although, edible-oil is an important food-stuff of the people of Bangladesh, oil crops have been neglected equally by farmers, researchers, extension workers and policy planners in Bangladesh.

Average production of vegetables has increased from 2277 thousand tons in 1971 – 80 to 7417 thousand tons in 2001 – 10. Average yield rate has also increased by 8.00 tons to 11.00 tons in the same period. Vegetables of Bangladesh are divided into two categories such as winter vegetables and summer vegetables. A major portion of the vegetables are grown during the winter season. Winter season vegetables are cabbage, broccoli, tomato, brinjal, beans, radish, carrots, cauliflower etc. While among the summer vegetables are sweet gourd, bitter gourd, ribbed gourd etc.

Average spices production has also increased from 300 thousand tons in 1971– 80 to 925 thousand tons in 2001 – 10. The average yield rate has also increased from 1.97 tons per hectare to 3.20 tons during that time. Some spices like ginger and turmeric can easily be grown in the hilly region, which may bring a potential area under successful crop cultivation. Fruits which is produced in a temporary crops areas have considered as crops. These types of fruits are melon, water melon, pineapple, banana and papaya. Average production of these kind of fruits remain almost the same but average yield rate has decreased continuously that is, average yield rate was 11.53 tons per hectare in 1971 – 80 while in 2001 – 10 it was 6.66 tons

In 1971-80, the average production of jute was 5188 thousand bales while in 2001 – 10 it was 4597 thousand bales. During this time its yield has increased by 7.14 bales per hectare to 10.86 bales per hectare. Conversely, average yield rate of sugercane has been decreased continuously but in case of production, it has been increased up to 1990s then decreased in last decades. In 1971 – 80 average production was 6234 thousand tons while in 1991 – 2000 it was 70312 thousand tons but in 2001 – 10 it has been decreased to 5898 thousand tons.

### 4.3 Sector-wise Contribution to GDP

Economy of Bangladesh is divided into three sectors- agriculture, which is called primary sector, industry known as secondary sector and service sector named tertiary sector. Some years back, agriculture was a dominant sector in Bangladesh economy and its contribution to the GDP was more than two thirds. Now-a-days its contribution declined to only 17% to the GDP is evident from Figure 2. Presently contribution of service sector dominant the Bangladesh economy and its contribution is more than half of the total GDP. Similarly Figure 3 shows that among the sub-sectors of agriculture crops' contribution is the highest followed by fisheries, livestock and forestry.

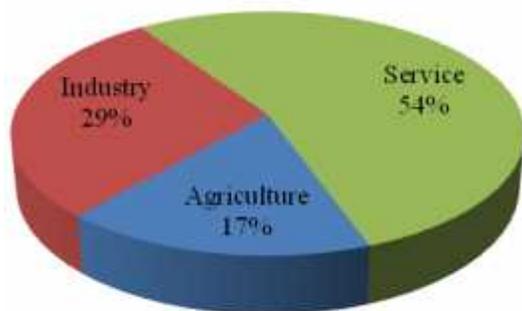


Figure 2: Sector-wise Contribution to GDP  
Source: GoB, 2014

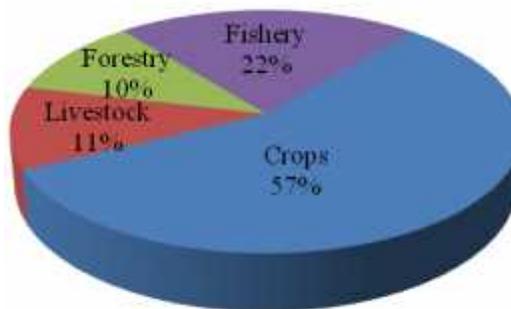


Figure 3: Composition of Agricultural GDP  
Source: GoB, 2014

### 4.4 Contribution of Crops to GDP and Agriculture

Crop subsector is the major contributor to the GDP and in agriculture sector. It also absorb most of the agriculture labor. Similarly, it is a major source of industrial raw materials and is a major contributor of food security in Bangladesh.

Table 2: Contribution of Crops to GDP and Agriculture (%)

Year	Contribution to GDP	Contribution to Agriculture
1995 – 96	14.42	58.52
2000 – 01	14.70	58.73
2005 – 06	12.28	56.23
2010 – 11	11.32	56.32

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Sources: Various issues of BBS, GoB

Table 2 depicts that crop sector contribution to GDP and in agriculture is high but it is decreasing over the years. In agriculture sector, though crop sub-sector's contribution is being declined but yet it is more than 50% of total agriculture.

#### 4.5 Cropping Intensity

Cropping intensity is the ratio of gross cropped area to net cropped area. It shows that how many times a specific piece of land is used for crop production within a cropping year. Although net cultivable land is decreasing steadily, multiple crop area is increasing more than proportionately. Accordingly, cropping intensity is also increasing in Bangladesh. Moreover, cropping intensity has also increased due to technological development of agriculture. Table 3 shows that in 1980 cropping intensity was 153% and in 2010 it rose to 179%.

Table 3: Cropping Intensity in Bangladesh

Year	Cropping intensity %
1980 – 85	153
1985 – 90	162
1990 – 95	174
1995 – 00	175
2000 – 05	177
2005 – 10	179

Source: Various issues of BBS

#### 4.6 Crop Acreage

Crop acreage refers that the area devoted to a particular crop in a cropping pattern. It can be considered as an indicator of the level of crop diversification. Allocation of net cultivable land is another measure of crop diversification, that is, equal distribution of land to all crops is called maximum diversification (Grosskopf et al, 1992). Merely increasing numbers of crops does not indicate higher level of diversification; it also depends on equal distribution. It is evident from Figure 4 that Bangladesh produce a good number of crops but 78% of gross crop area is devoted to rice and other than rice none of the crop acreage is more than 4% of gross crop area. Hence, these finding shows that extent of crop diversification is very low in Bangladesh.

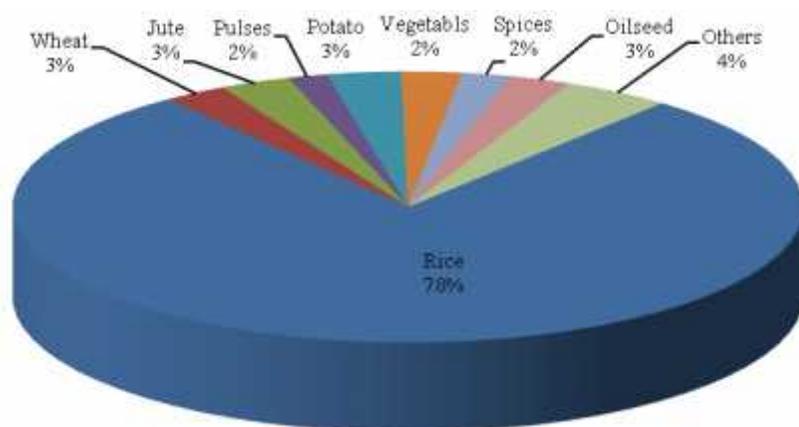


Figure 4: Crops Acreage of Bangladesh  
Source: BBS, 2010

#### 4.7 Share of Rice Crop Area

Bangladesh is basically rice dominated agricultural country. Almost more than three fourths area of gross crop area is devoted to rice. This indicates that practice of crop diversification in Bangladesh is comparatively low. Farmers of Bangladesh are very much poor and in most cases they have to manage their subsistence from agriculture. Moreover, they have to ensure their square meal from agriculture and accordingly they are much more interested in producing rice. 80% of gross crop area was used in growing rice in 1980s and in 2010 it declined to 77%, which is apparent from Table 4. Proportion of rice crop area to gross crop area almost remains the same in last three decades. It is important to note that, area under rice production in Bangladesh has been remained in a consistent level over long time. Due to the availability of improved rice technologies, the harvest area of rice has increased a little bit. However, Bangladesh has made remarkable progress in rice production over the last four decades. If we consider ratio of rice area to gross crop area (Metzel & Ateng, 1993) as a measure of crop diversification index then the magnitude of diversification is very low in Bangladesh.

Table 4: Share of Rice Crop Area

Year	% Rice area of gross crop area (five years average)
1971 – 75	80%
1975 – 80	81%
1980 – 85	79%
1985 – 90	76%
1990 – 95	74%
1995 – 00	74%
2000 – 05	75%
2005 – 10	77%

Source: Various issues of BBS

## 4.8 Extent of Crop Diversification

From the above discussion it is found that Bangladesh agriculture is dominated by rice. More than three fourths of gross crop area is used for rice production that indicated low practice of crop diversification. Besides, there are other approaches in measuring the extent of crop diversification among the approaches Simpson Index (SI) is widely used to measure the extent of crop diversification. Higher value of SI gives higher level of crop diversification and vice-versa.

### 4.8.1 National Level Crop Diversification

Table 5 shows that Simpson index value of crop diversification. In 1971 – 72, it was 0.35 and in 2011-12 it rose to 0.42 that indicate that magnitude of crop diversification have been increasing little by little. It is clear from the values of indices that the growth rate of crop diversification index is very low. Thus, present state of crop diversification of the country is not satisfactory.

Table 5: Value of Crop Diversification Index at National Level

Year	SI
1971 – 72	0.35
1976 – 77	0.34
1981 – 82	0.36
1986 – 87	0.42
1991 – 92	0.43
1996 – 97	0.44
2001 – 02	0.42
2006 – 07	0.42
2011 – 12	0.42

Source: Various issues of BBS, GoB

### 4.8.2 Division-Wise Crop Diversification

Different areas are specialized in producing different crops due to climatic advantages and soil quality. Table 6 shows the magnitude of crop diversification in different divisions in Bangladesh. It is apparent from the table that the highest magnitude of crop diversification (SI = 0.49) is found in Rajshahi division and the lowest value (SI = 0.17) is found in Sylhet division. However Rice share index gives different result, the highest diversified area is Khulna division and the lowest is Sylhet.

Table 6: Value of Crop diversification Index in different Division of Bangladesh

Division	SI	RI
Dhaka	0.48	0.71
Rajshahi	0.49	0.71
Chittagong	0.40	0.77

Sylhet	0.17	0.91
Khulna	0.44	0.67
Barisal	0.47	0.72

Source: BBS, 2010

### 4.8.3 Farmer-wise Crop Diversification

Objectives of farming are different in different farmers. Some farmers produce crop for their subsistence whereas some other produce only for cash needs and some cultivate land for subsistence as well as cash needs. Figure 5 and Figure 6 show the value of Simpson index and Rice share index of crop diversification. It is found from the figures that small farmer practices crop diversification more than that of medium and large farmers.

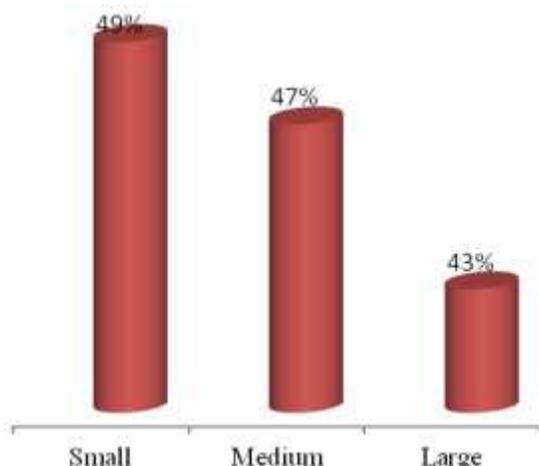


Figure 5: Value of Simpson Index  
Source: BBS, 2010

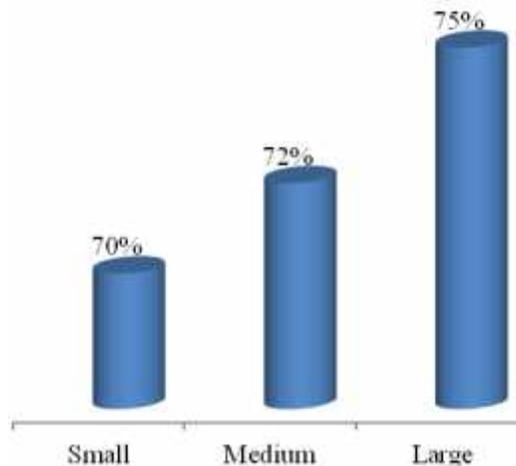


Figure 6: Rice Share Index  
Source: BBS, 2010

### 4.9 Constraints and Potentials of Crop Diversification

It is evident from above discussion that practice of crop diversification is comparatively low. A very few countries of the world depends on a single crop as high as of Bangladesh. From different studies it is found that practicing crop diversification has a numbers of limitations. Rao et al (2006) observed that lack of access to markets; transport facilities and post-harvest infrastructure inflate the transaction costs of marketing, which discourage farmers to diversify towards high value agriculture. Again, Zohir (1993) noted that the constraints on the way of crop diversification are: established soil condition; flood depth levels; lower rainfall; lack of proper training on non- rice crops, inappropriate water management, and inadequate supply of water. Similarly, poor road condition, bad road connectivity and transportation problems stood in the way of crop diversification (Haque & Bhattacharya, 2010).

One important constraint for diversification is the irrigation and water management system. Existing irrigation and water management system in Bangladesh is not conducive to crop diversification. Irrigation system in Bangladesh are planned, designed, constructed and managed primarily to irrigate rice fields and are not suitable for growing non-rice crops (Alam, 2005; Rahman & Talukdar, 2001). Farmers cannot grow non-rice crops especially HVCs due to inflexible existing irrigation system. Under same irrigation scheme most of the farmers produce rice. In addition, perishable nature of many HVCs, lack of cold storage and weak market management system are also notable hindrance on way of crop diversification.

Bangladesh is endowed with favorable climate and soil to produce a variety of crops all the year round. So, there are ample opportunities for diversification in crop agriculture. In Fourth Five Year Plan (1990 – 95), introduction of appropriate cash and commercial crops and policy support for flood and drought resistant crop are considered as the guiding force to promote crop diversification practice in Bangladesh.

As high value crops are more labor intensive, it helps employment generation for the farmers. HVCs especially vegetables need more labor than non-rice crops. Diversification along the line of production of non-rice crops also has implications for labor employment. Some crops like oilseeds and pulses are less labor intensive and hence will have negative impact on employment generation. Since potatoes, vegetables and spices are highly labor-intensive, expansion of area for the production of these crops will have positive impact on labor employment. However, with fluctuation of price and lack of storage, transportation and processing facilities may constrain any large scale expansion of area under these crops. Substantial employment opportunities are generated in seed and seedling production, precision land preparation, and the irrigation, harvesting, cleaning, grading, and packaging of HVCs. It was estimated that a one-hectare of land shifts from cereal to vegetables in one season generated more than one year round full-time employment that is, the difference between cereals and vegetables was more than 220 working days per hectare (Ali & Abedullah, 2002; Rahman & Talukdar, 2001). Joshi et al (2004) also reported similar results. Therefore, cultivation of vegetables, unlike food grains, is labor intensive on the one hand and requires more skilled labor and continuous attention to individual plants at various stages of growth, on the other hand (Bhattacharyya, 2008).

Globalization and market liberalization have opened up the new opportunities to export agricultural crops and crops product from Bangladesh. According to BSS (2013) the country's fresh fruit exports increased twelve times in the past five years, earning Tk. 463.12 crore alone in FY 2011-2012. Saha (2013) noted that the demand for fresh fruits and vegetable has gradually increased globally as many people have switched to a vegetarian diet. He also noted that in peak season Bangladesh exports 450 metric tons of fruits and vegetables a week against the off-season shipments of about 180 metric tons. Braun (1995) quantifies that as a result of diversification to export vegetable production in Guatemala, employment increased by 45% on participants' farms. So, this export potentiality offers a great scope for crop diversification in Bangladesh.

## **5. Conclusion**

Crop diversification is a contemporary issue in the field of agriculture as it is an effective strategy of reducing risk of yield and price volatility of rice monoculture. It augments income and employment opportunities in the rural settings where roughly three fourths of gross crop area

is engaged in producing a single crop. However, farmers grow a great numbers of crops in a little bit more than one fifth of gross crop area. From different indicators of measuring the extent of crop diversification, it can be concluded that magnitude of crop diversification in Bangladesh is mediocre and Rajshahi division is more diversified than that of other divisions in Bangladesh. Present market structure, roads and irrigation systems are some notable constraints on the way of crop diversification. Crop diversification has a great potential of increasing income generating activities and earnings of the rural people. To exploit the potentials of crop diversification Bangladesh government come forward with developed market structures, roads condition and making the irrigation system accessible for non-rice crops.

## Reference

- Alam, J. (2005). Enhancing sustainable development of diverse agriculture in Bangladesh. *ESCAP-CASPA Working Paper, 80*, United Nations.
- Ali, M. & Abedullah (2002). Economic and nutritional benefits from enhanced vegetable production and consumption in developing countries. *Journal of Crop Production, 6* (1(2)), 145-176.
- Ashfaq, M., Hassan. S., Naseer, M. Z., Baig, I. A. & Asma, J. (2008). Factors affecting farm diversification in rice-wheat. *Pakistan Journal of Agricultural Science, 45*(3), 91 – 94.
- BBS (2011). *2011 Yearbook of agricultural statistics of Bangladesh*. Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh.
- Benin, S., Smale, M., Pender, J., Gebremedhin, B. & Ehui, S. (2004). The economic determinants of cereal crop diversity on farms in the Ethiopian highlands. *Agricultural Economics, 3*, 197–208.
- Birthal, P.S., Joshi, P. K., Roy, D. & Thorat, A.(2007). Diversification in Indian agriculture towards high value crops: The role of small holders. *IFPRI Discussion Paper 00727*.
- Braun, J. V. (1995). Agricultural commercialization: Impact on income and nutrition and implications for policy. *Food Policy, 20* (3), 187-202.
- BSS (2013). <http://www1.bssnews.net/newsDetails.php?cat=0&id=331894&date = 2013-05-18>. ( Accessed on 25<sup>th</sup> April, 2014)
- Chakrabarti, S. & Kundu, A. (2009). Rural non-farm economy: A note on the impact of crop-diversification and land-conversion in India. *Economic & Political Weekly, XLIV* (12), 69-75.
- Chand, R. (1996). Diversification through high value crops in western Himalayan region: Evidence from Himachal Pradesh. *Indian Journal of Agricultural Economics, 41*(4), 652 – 63.

- De, U. K. & Bodoso, K. (2014). Crop diversification in Assam and use of essential modern inputs under changing climatic condition: Indication of a retrograded option gal. Available at SSRN: <http://ssrn.com/abstract=2472581>
- GoB (2013). *Bangladesh economic review*. Economic Adviser's Wing, Finance Division, ministry of Finance, Government of the People's Republic of Bangladesh.
- GoB (2014). *Bangladesh economic review*. Economic Adviser's Wing, Finance Division, ministry of Finance, Government of the People's Republic of Bangladesh.
- Gunasena, H. P. M. (2001), Intensification of crop diversification in the Asia Pacific region. In Papademetriou, M. K. & Dent, F. J. (Eds), *Crop Diversification in the Asia-Pacific Region*, Food and Agriculture Organization of the United Nations regional office for Asia and the Pacific, Bangkok, Thailand.
- Haque, T. & Bhattacharya, M. (2010). Constraints and potentials of diversified agricultural development in Eastern India. *Council for Social Development (CSD) Sangha Rachna*, New Delhi, India.
- Husain, A. M. M., Hossain, M. & Janaiah, A. (2001). Hybrid rice adoption in Bangladesh: Socio-economic assessment of farmers' experiences. *BRAC Research Monograph Series* No. 18. BRAC, Dhaka, Bangladesh.
- Joshi, P. K., Gulati, A., Birtal, P. S. & Tewari, L. (2004). Agriculture diversification in South Asia: Patterns, determinants and policy implications. *Economic and Political Weekly*, 39(24), 2457-2467.
- Joshi, P. K., Gulati, A. & Cumming Jr. R. (Eds.). (2007). *Agricultural diversification and smallholders in South Asia*. Academic Foundation, New Delhi.
- Kumari, B. A. P., Thiruchelvam, S. Dissanayake, H.M.H. & Lasantha, T. (2010). Crop diversification and income inequality in irrigation systems: The case of Minipe. *Tropical Agricultural Research*. 21(3), 308 – 320.
- Mahmud, W., Rahman, S. S. & Zohir, S. (1994). Agricultural growth through crop diversification in Bangladesh. Food Policy in Bangladesh Working Paper No. 7, *IFPRI*, Washington DC.
- Malik, D. P. & Singh, I. J.(2002). Crop diversification - An economic analysis. *Indian Journal of Agricultural Research*, 36 (1), 61 – 64.
- Mehta, P. K. (2009). Diversification and horticultural crops: A case of Himachal Pradesh. *Phd thesis*. Department of economics, university of Mysore, Mysore, Mysore, Karnataka, India.
- Metzel, J. & Ateng, B. (1993). Constraints to diversification in Bangladesh: A survey of farmers' views. *The Bangladesh Development Studies*, XXI (3), 39 – 71.

- MoEF. (2012). Rio + 20: National Report on sustainable development. Dhaka: Ministry of Environment and Forest, Government of the Peoples' Republic of Bangladesh
- Mukherjee, S. (2012). *Crop diversification and risk: An empirical analysis of Indian states*. [http://mpr.ub.uni-muenchen.de/35947/1/MPRA\\_paper\\_35947.pdf](http://mpr.ub.uni-muenchen.de/35947/1/MPRA_paper_35947.pdf). html (accessed October 01, 2012).
- Pandey, V. K. & Sharma, K. C. (1996). Crop diversification and self- sufficiency in food grains. *Indian Journal of Agricultural Economics*, 51.(4), 644 – 51.
- Pingali, P. L. & Rosegrant, M. W. (1995). Agricultural commercialization and diversification: Processes and policies. *Food Policy*, 20(3), 171 – 186.
- Rahman, A. (2010). *Promoting financial inclusion for poverty reduction with inclusive growth*. Bazlur Rahman Memorial Lecture, presented at the 17<sup>th</sup> biennial conference on 'The economy at the golden jubilee of war of liberation: what type of Bangladesh we would like to see?' organized by Bangladesh Economic Association held on 8 – 10 April at Osmani Memorial Auditorium and Institution of Engineers, Bangladesh Dhaka.
- Rahman, M. L. & Talukder, R. K. (2001). Inter-linkages of agricultural diversification in Bangladesh. *MAP Focus Study Series*, 9, Dhaka, CIRDAP.
- Shiyani, R. L. & Pandya, H. R. (1998). Diversification of agriculture in Gujarat: A spatio-temporal analysis. *Indian Journal of Agricultural Economics*, 53 (4), 627 – 639.
- Rao, P. P., Birthal, P.S., Joshi, P. K. & Kar, D. (2004). Agricultural diversification in India and role of urbanization. MITD discussion paper no.77, *International Food Policy Research Institute*, Washington, D.C. U.S.A
- Saha, S. (2013). Fruit, vegetable export on the rise. *The Daily Star* Wednesday, June 19, 2013.
- Singh, A. J., Jain, K. K. & Sain, I. (1985). Diversification of Punjab agriculture: An econometric analysis. *Indian Journal of Agricultural Economics* 40(3), 298 – 303.
- Vyas, V. S. (1996). Diversification in agriculture: Concept, rationale and approaches. *Indian Journal of Agricultural Economics* 51(4), 636 – 643.
- World Bank. (1990). Agricultural diversification and policies and issues from East Asian Experiences. *Policy and Research Series*, Agriculture and rural development department, The World Bank, Washington, D.C.
- Zohir, S. (1993). Problems and prospects of crop diversification in Bangladesh. *The Bangladesh Development Studies XXII* (3), 73 – 90.