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Article

Yield gap of major crops in sadar upazila of Mymensingh district

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Abstract: The aim of this study was to ascertain yield and yield gap status of major crops. The study was conducted in two villages of sadar upazila under the Mymensingh district. Ninety farmers were selected as sample size following proportionate random sampling technique. The researcher himself personally collected data during mid-March to mid-May 2014. Collected data were compiled, coded, analyzed and interpreted as per objectives of the study. It was found that majority of the respondents were middle-aged having a primary level of education, medium farm size, small family size with low agricultural knowledge but the favorable attitude towards the current agricultural system. Boro rice, Mustard, Bitter gourd, and Black gram are the major crops of the study area. Yields of Boro rice, Mustard, Bitter gourd and black gram in farmers' field were found 5,295 Kg/ha, 703 Kg/ha, 12,654 Kg/ha and 771 Kg/ha with mean yield gap of 704 Kg/ha, 396 Kg/ha, 9,345 Kg/ha and 628 Kg/ha, respectively. Farmers' characteristics like age, farming experience, agricultural training, knowledge about agriculture and attitude towards agricultural practices found negatively related to their yield gap of the major crops.

Keywords: household; yield gap; major crops

1. Introduction

Mymensingh sadar upzila is one of the densely populated areas of Bangladesh. Total Population in this upazila 674452; male 350372, female 324080. The livelihood of the people of the rural area of this upazila mainly depends on agriculture. Main sources of income agriculture 34.57%, non-agricultural laborer 4.05%, industry 1.01%, commerce 19.18%, transport and communication 6.68%, service 16.54%, construction 4.03%, religious service 0.24%, rent and remittance 0.86% and others 12.84%. A major cultivated crop of the area is rice and farmers are not getting satisfactory yield. Extinct or nearly extinct crops are mustard, linseed, arahar. Main fruits are mango, jackfruit, banana, papaya, litchi, watermelon (Banglapedia, 2018). Bangladesh has practiced a continued annual deficiency of about 1.5 million tons of food grains (Karim, 1999). Islam (2007) argued that reducing the yield gap alone could supply additional 15% of the increased annual grain demand by the year 2025. The term yield gap has been widely used in the literature for at least the past few decades. The yield gap is a concept that rests on the definition and measurement of yield potential. Yield gaps are estimated by the difference between yield potential and average farmers' yields over some specified spatial and temporal scale of interest (Ittersum *et al*., 2013). Yield potential, in turn, can be defined and measured in a variety of ways. It can be defined as the yield of an adapted crop variety or hybrid when grown under favorable conditions where

water, nutrients, pests, or diseases are not limiting (Evans, 1993). For any given site and growing season, yield potential is determined by three factors namely, solar radiation, temperature, and water supply (Lobell *et al*., 2009). All three environmental factors vary throughout the year, and therefore, yield potential may depend not only on location but also on the crop-sowing date and maturity rating. The latter is a genetic trait that determines the length of the growing season when a crop is sown on a given date, with longer maturity cultivars requiring more growing-degree days to reach maturity than shorter maturity varieties. In fact, crop yield potential at a given location can vary considerably due to different planting dates and maturity period (Ortiz-Monasterio *et al*., 1994, Yang *et al*., 2006). Yield potential must, therefore, be defined in relation to a specific planting date and cultivar maturity, with the maximum value considered to be the optimum combination of planting date and maturity for a given location (Lobell *et al*., 2009). In Bangladesh, despite the technologies developed by different National Agricultural Research System (NARS) institutes and extension agencies to disseminate the technologies, yield gaps exist in major crops of Bangladesh that may range from 19% to about 64% of the potential yield (Alam, 2006; OFRD, 2003-2004b, Roy, 1997; Matin *et al*., 1996). It was seen that in Boro rice the yield gaps were 24% to 23% (Alam, 2006). Yield gap of wheat (var. Kanchan) at the Palashbari, Rangpur was observed at 27% (OFRD, 2003-2004a). At Atgharia upazila of Pabna district evaluation of the yield gap in mustard using the variety, BARI Sharisha-13 showed yield gap of 35% (OFRD, 2008-2009). Yield gaps of groundnut and sesame were found 27% and 34%, respectively. In potato and sweet potato, yield gaps were 45% and 64%, respectively, between demo and farmers' average. Yield gaps of 32%, 35%, and 19% were found in potato, lentil, and jute, respectively (Roy, 1997). The yield gaps were found to be 37% and 40% in tomato and radish, respectively (Matin *et al*., 1996; Roy, 1997a). It is thus evident that yield gaps in different crops in Bangladesh varied from 19% to 64% (Mondal, 2011). There is a gap between the achievable yield and farmer's actual yield. It is widely perceived that there is a wide gap between the potential and farm level field and the major part of the gap is due to the yield loss caused by several biotic and abiotic factors (Alam and Hossain, 1998). Yield gaps caused by biological, socio-economic, and institutional constraints can be effectively addressed through an integrated crop management (1CM) practices. Transfer of the practices through extension agents could effectively help farmers to minimize yield gaps. Timely planting, irrigation, weeding, plant protection, and timely harvesting could account for more than 20% yield increase (Siddiq, 2000). However, the factors behind this yield gap are yet to be identified. Yield gaps in different crops are the big challenges. Understanding of yield gaps helps to inform predictions of future crop yields and targeting efforts to increase sustainable crop production. In addition, information on yield gap also helps government/policymakers to develop guidelines or action plans to address the problem of enhancing crop production. Therefore, the study was conducted to determine the socio-demographic profiles of the respondents; to evaluate the yield and yield gap status of major crops in the study area and to find out the relationship between the selected characteristics of the respondents and the yield gaps of major crops.

2. Materials and Methods

2.1. Study area and periods

The field investigation was carried out in two villages, Khagdohor and Charjelkhana of Khagdohor union of Mymensingh sadar upazila, Mymensingh district. Farmers of Khagdohor and Charjelkhana villages were the population of the study. At first two villages, Khagdohor and Charjelkhana were selected randomly from Khagdohor union. A total number of farm families in Khagdohor and Charjelkhana were 343 and 257, respectively. Fifteen percent of farmers were selected as sample following proportionate random sampling. The field data were collected from mid-March to mid-May 2014.

2.2. Field crop disrtibutions

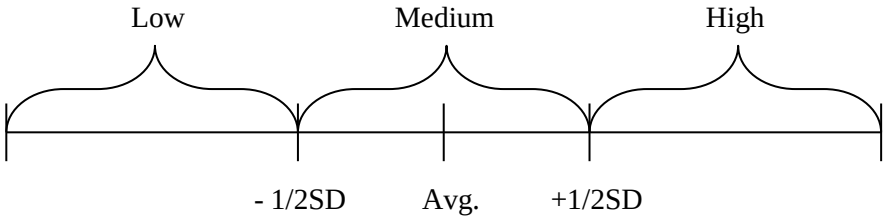
Nine field crops were primarily selected to find out the major crops of the selected area (Table 1). It shows that Boro rice, Mustard, Bitter gourd, and Black gram were cultivated by 100%, 68.8%, 53.3% and 38.8% of the respondents, respectively. Therefore, it can be assumed that Boro Rice, Mustard, Bitter gourd, and Black gram are the major crops of the study area. Here sample size 90 was constant for all the selected crops those yield gaps were measured. Sample size found varied in different crops for measuring yield gap. For Boro rice, it was 90, for Mustard, it was 62, for Bitter gourd it was 48 and for Black gram, it was 35. Because out of 90 respondent 90 farmers were cultivated Boro rice, alongside 62 respondent attached in Mustard production, 48 respondents attached in a Bitter gourd and 35 respondents involved in black gram productions.

Table 1. Distribution of the respondents according to their field crops.

Sl. No.	Field crops	Number	Percent
1.	Aus rice	-	-
	Aman rice	10	11.11
	Boro rice	90	100
2	Wheat	04	4.40
3	Maize	-	-
4	Mustard	62	68.88
5	Lentil	14	15.55
6	Black gram	35	38.9
7	Potato	03	3.30
8	Chili	08	8.90
9	Bitter gourd	48	53.3

2.3. Measurement of dependent variables

Yield gaps of major crops of the selected areas that were cultivated by the respondents are the dependent variables of the study. Yield gaps of the major crops were estimated by the substitution of the actual yields of the crops from the yields of the corresponding crops found in the research station. Relationships between the yield gaps of the major crops of the area and the selected socio-demographic characteristics of the respondents were measured through the coefficient of correlation. Yield gap of major crops was categorized into three different categories such as low yield gap, medium yield gap, and high yield gap. Scores 1, 2 and 3 were assigned for low, medium and high yield gaps, respectively. Based on the mean and frequency, farmers' response scores were categorized into the following three categories considering the formula.



2.4. Measurement of independent variables

The independent variables of this study were farmer’s age, education, family size, farm size, cosmopolitensess, farming experience, training duration, knowledge about agriculture and attitude towards agricultural practice. Conventional procedures were used to measure these characteristics. A brief understanding of the measurement of the variables could be achieved from Table 1.

3. Results and Discussion

3.1. Salient features of the farmers

About 67.8% of the respondents were middle-aged while 2.20% and 30% of the respondents fell in the young and old aged category, respectively with an average of 46.42 years (Table 2). Maximum 29.2% of the respondents got a primary level education, 31.7% had completed secondary level of education, and 10.8 % had above secondary level with 28.35% of ill Average family size of respondents was 4.71 and 51.1% of the respondents had small family size compared to 3.3% of the respondents having large family size. The farm size of the respondents ranged 0.54 ha to 2.27 ha with an average of 1.17 ha and 55.6% of the respondents had medium farm size. cosmopolitensess of the respondents ranged from 0 to 15 with an average 9.9. Maximum (60%) of the respondent had medium cosmopoliteness followed by 25.6 % had low cosmopolitensess. 72.2% of the respondents had low farming experience whether 27.8% of the respondents had medium farming experience. Average agricultural training of the respondents was 16.28 and 13.3% of the respondents had low agricultural training and 30% had high agricultural training. The agricultural knowledge of the respondents ranged from 14 to 24 with an average of 18.50 and 67.8% of the respondents had low agricultural knowledge. An attitude of the respondents towards the prevailed agricultural system of the study area ranged from 26 to 36, with an average of 31.09. 80% of the respondents showed favorable attitude while 10% of the respondents showed both highly favorable and unfavorable attitude.

Table 2. Salient features of the selected characteristics of the farmers.

Characteristics	Category	Percent	Mean	SD
Age	Young aged (up to 35)	2.20	46.42	10.53
	Middle-aged (36-50)	67.8		
	Old aged (50 and above)	30.0		
Education	Illiterate (0)	28.3	4.97	4.36
	Primary (1-5)	29.2		
	Secondary (6-10)	31.7		
	Above secondary (11 and above)	10.8		
Family size	Small Family (up to 5)	51.1	4.71	1.20
	Medium Family (5-7)	45.6		
	Large family (7 and above)	3.30		
Farm Size	Small farm (up to .99)	44.4	1.17	0.42
	Medium farm (1.0-2.99)	55.6		
	Large (above 3)	0.0		
Cosmopoliteness	Low cosmopolitensess (up to 9)	25.6	9.89	2.05
	Medium cosmopolitensess (9 to 12)	60.0		
	High cosmopolitensess (12 and above)	14.4		
Farming Experience	Low experience (up to16)	72.2	13.31	3.996
	Medium experience (16-30)	27.8		
	High experience (30 and above)	0.0		
Agricultural training	No agricultural training (0)	37.8	16.28	28.43
	Low agricultural training (1 to 4)	13.3		
	Medium agricultural training (5 to 9)	18.9		
	High agricultural training (10 and above)	30.0		
Knowledge about agriculture	Low level of knowledge (up to 20)	67.8	18.50	2.23
	Medium level knowledge (21 to 30)	32.2		
	High level of knowledge (31 and above)	0.0		
Attitude towards agricultural practices	Unfavorable attitude (up to 28)	10	31.09	2.41
	Favorable attitude (28 to 33)	80		
	Highly favorable attitude (33 and above)	10		

3.2. Yield gap status of major crops

The yield gap status of the major crops is shown in a way of comparison between the maximum and minimum yield gap between the corresponding crops. Figure 1 shows the minimum, mean and maximum yield gap of Boro rice production of the selected areas. Maximum yield gap of Boro rice was 2609 Kg/ha whereas the minimum was -840 Kg/ha. Average yield gap was 704 Kg/ha. The positive mean value is the evidence that, in general, farmers produce less Boro rice than the recommended production in the study areas.

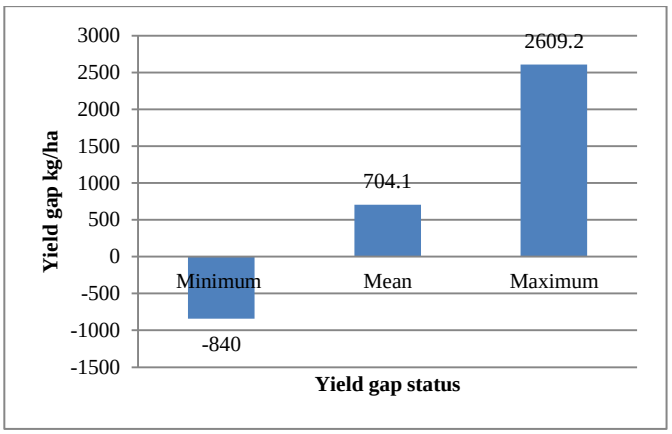


Figure 1. Yield gap status of Boro rice.

Data of table 3 shows the frequency of the respondents according to the yield gap of Boro rice production. The respondents were classified into three categories such as low yield gap, medium yield gap, and high yield gap.

Table 3. Distribution of the respondents according to the yield gap of Boro rice.

Categories	Number	Percent (%)
Low yield gap (<400 Kg/ha)	33	36.7
Medium yield gap (400-1000Kg/ha)	33	36.7
High yield gap (>1000 Kg/ha)	24	26.7
Total	90	100

Most of the farmers (73.3%) had low to medium yield gap. On the other hand, only 26.7% of the respondents had high yield gap (Table 3). High adaptation of modern technology of management practices may lead them to the minimization of yield gap of Boro rice.

The yield gap of mustard showed a minimum and maximum range of -85 Kg/ha to 696 Kg/ha with a mean of 396 Kg/ha (Figure 2). The positive mean reveals that the farmers had fewer yields than that of the recommended yield of mustard.

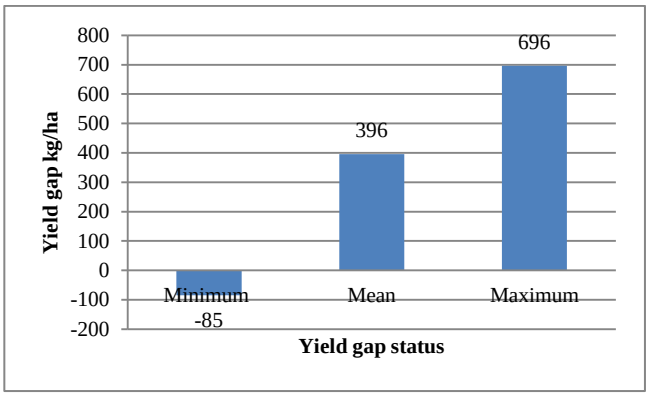


Figure 2. Yield gap status of Mustard.

The highest 35.4% of the respondents who cultivated bitter gourd had high yield gap while 33.3% of the respondents had medium yield gap. Only 31.2% of the bitter gourd cultivars had low yield gap (Table 4).

Table 4. Distribution of the respondents according to the yield gap of Bittergourd.

Categories	Number	Percent (%)
Low yield gap (<500 Kg/ha)	15	31.3
Medium yield gap (500-750Kg/ha)	16	33.3
High yield gap (>750 Kg/ha)	17	35.4
Total	48	100

The maximum, minimum and mean yield gap of a black gram is 1065, -67 and 628 Kg/ha, respectively (Figure 3). The mean of the yield gap is positive which is the evidence that the farmers produce less black gram than the recommended level of a yield of the Black gram.

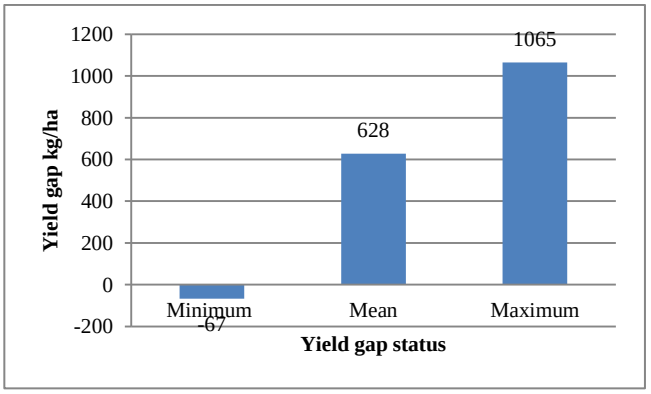


Figure 3. Yield gap status of Black gram.

The distribution of the respondents according to the yield gap of a Black gram. It is assumed that highest 42.9% of the black gram cultivars had medium yield gap. 31.45 of them belong to the low yield gap category followed by high yield gap of 25.7% of the cultivators (Table 5). The above Figures indicate a huge gap between the minimum and maximum yield gap among the major crops. The maximum yield gaps in the crops are greater than the minimum yield gaps. So, there are opportunities to minimize the gaps by undertaking intensive agricultural management practices.

Table 5. Distribution of the respondents according to the yield gap of black gram.

Categories	Number	Percent (%)
Low yield gap (<7000 Kg/ha)	11	31.4
Medium yield gap (7000-12000Kg/ha)	15	42.9
High yield gap (>12000 Kg/ha)	09	25.7
Total	35	100

3.3. Relationships between the selected characteristics of the respondents and the yield gaps

To assess the relationship between the selected characteristics of the respondents and the yield gap of major crops, coefficient of correlation analysis was used. The null hypothesis developed by the researcher was, "There is no significant relationship between the selected characteristics of the respondents and the yield gap of major crops". The results of correlation (r) between the selected characteristics of the respondents and the yield gap of major crops are shown in Table 6.

Table 6. Relationship between selected characteristics of the respondents and their yield gaps of major crops.

Variables	Boro rice	Mustard	Bitter gourd	Black gram
Age	-0.345**	-0.372**	-0.192	-0.297
Education	-0.064	-0.104	-0.232	0.023
Family size	-0.141	-0.021	0.026	0.029
Farm size	-0.020	-0.074	-0.161	0.092
Cosmopoliteness	0.129	-0.088	0.010	0.166
Farming Experience	-0.838**	-0.650**	-0.554**	-0.058
Agricultural Training	-0.244*	-0.207	-0.312*	0.165
Knowledge	-0.234*	-0.522**	-0.100	-0.117
Attitude	-0.549**	-0.443**	-0.259	-0.010

***** Significant at 0.05 level of probability, ** Significant at 0.01 level of probability

3.4. Yield gap of Boro rice and selected characteristics

Age, farming experience, agricultural training, knowledge about agriculture and attitude towards the current agricultural system of the respondents had negative significant relationship (at 0.01 level and 0.05 level) with the yield gap of Boro rice being the 'r' value was -0.345**, -0.838**, -0.244*, -0.234 *and -0.549**, respectively. So the null hypothesis was rejected. In other words, age, farming experience, agricultural training, knowledge about agriculture and attitude towards the current agricultural system influenced the yield gap of Boro rice negatively i.e. with the increase of age, farming experience, agricultural training, knowledge about agriculture and attitude towards the current agricultural system yield gap of Boro rice was decreased.

3.5. The yield gap between Mustard and selected characteristics

Ages, farming experience, knowledge about agriculture and attitude towards the current agricultural system of the respondents had a negatively significant relationship (at 0.01 level) with the yield gap of mustard being the 'r' value was -0.372**, -0.650**, -0.522** and -0.443**, respectively. So the null hypothesis was rejected. In other words, age, farming experience, knowledge about agriculture and attitude towards the current agricultural system influenced the yield gap of mustard negatively i.e. with the increase of age, farming experience, knowledge about agriculture and attitude towards the current agricultural system yield gap of mustard was decreased.

3.6. Yield gap of Bittergourd and selected characteristics

Farming experience and agricultural training of the respondents had a negatively significant relationship (at 0.01 level and 0.05 level) with the yield gap of bitter gourd being the 'r' value was -0.554** and -0.312*,

respectively. So the null hypothesis was rejected. In other words farming experience and agricultural training influenced the yield gap of bitter gourd negatively i.e. with the increase of farming experience and agricultural training yield gap of bitter gourd was decreased.

3.7. Yield gap of a Black gram and selected characteristics

Yield gap of Black gram did not show any significant relationship with the selected socio-demographic characteristics of the respondents. Average farmers' yield over the specified spatial scale of interests varies significantly with the change in the spatial scale of interests. As a result, the influences of the respondents' socio-demographic characteristics on the yield gap of a Black gram may not be significant.

4. Conclusions

Major crops of the study area are Boro rice, mustard, bittergourd, and black gram. The difference between the minimum and maximum yield of the crops confirms that through intensive agricultural practices the yield can be increased. Yield gap varies from crop to crop, time to time and even location to location. Yield gap of the crops showed a similar result, which provides the opportunity to improvise the cultural practices. It was found that farmers' characteristics like farming experience, agricultural training, agricultural knowledge and attitude towards modern practices showed a negative significant relationship with the yield gap of major crops. Therefore, it may be concluded that farmers with higher farming experience, higher agricultural training, higher agricultural knowledge and favorable attitude towards modern practices had lower yield gap as compared to others.

Conflict of interest

None to declare.

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