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Adoption Level of Wheat Technology and the Grower's Knowledge Gap in Bangladesh

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Abstract: This paper examines the extent of adoption of modern technology in Bangladesh and knowledge gap of the farmers about the technology. It was found that 100% of wheat acreage in the country were planted to modern varieties. Wheat area, production and yield in the country increased by 10, 14 and 3.5% per annum during 1971-92. The farmers found to have moderate knowledge gap in most of the practices of modern wheat technology. However, high knowledge gap was observed for recommended fertilizer dose. There were significant difference between the practices recommended and the existing knowledge of the farmers for different production practices. The demonstration farmers of farming system research sites and multi-location testing sites had less knowledge gap than the other farmers. Wheat planting before November is not recommended, late planting is one of the main causes of lower yield of wheat in Bangladesh. Wheat planting after November reduces the yield at the rate of 1.3% per day of delay. The overall data showed a significant difference between the practices recommended and existing technological knowledge of the farmers.

Key words: Wheat technology, wheat varieties, Bangladesh

Introduction

Wheat is the second most important cereal crop in Bangladesh. The annual growth rate of wheat was 4.2% during 1991-92 to 1995-96. The area and production of wheat increased dramatically during 1975-76 to 1984-85 (BBS, 1991). Within this period, the average growth rate for wheat production was about 11% per annum. Wheat area and production started decline after 1984-85. This decline was probably associated with some production constraints (Bhuiyan *et al*., 1993). Moreover, this decrease in wheat area might have a correlation with the increase in Boro area due to increased irrigation facilities in the country. Therefore, Wheat Research Center (WRC) of Bangladesh Agricultural Research Institute (BARI, 1990, 1993) developed some technologies to eliminate those constraints, so that the present level of yield could be increased or sustained. Wheat could be made a sustainable crop in the farmer's field by increasing its yield per unit area.

Agriculture has been still the most important activity of human life in many countries of the world. Improved agricultural practices are the products of modern science and technology. Development of new technology is generally not the major problem now a days as most of the countries including Bangladesh already have their own set of bright and enterprising scientists who are capable of providing techniques suitable for the local condition. The main problem that exists today is dissemination of these techniques among the farmers. Adoption of location specific modern technology could increase the productivity of wheat. Several on-farm trials/demonstrations had been prepared by the WRC and conducted by the Department of Agricultural Extension (DAE) and On-Farm Research Division, BARI, to popularize the modern wheat technologies in the farmer's fields in different locations. These on farm trials/demonstrations showed that the yield performance of wheat is quite high as compared to the farmer's yield. In general, farmer's wheat yield was less mainly due to their non-practice of the full-recommended technological packages. Farmers usually adopted modern wheat technology at varying degree based on their infra structural facilities and socio-economic conditions that ultimately resulted variations in yields. Thus their exists a yield gap between full adopter and partial adopter of different technological packages in various regions of Bangladesh. The impact of those on-farm trials/demonstrations had not been studied yet systematically. The objectives of the present study are to determine the extent of adoption of wheat production technology and knowledge gap of the farmers.

Materials and Methods

Sources of data: The main source of data for the present study was secondary data. The secondary data were collected from various issues. Annual Reports and unpublished data base of Bangladesh Agricultural Research Institute, Bangladesh Rice Research Institute, Central Extension Resource Development Institute and Bangladesh Agricultural Research Council.

Analytical Techniques: Measurement of knowledge gap refers to the difference in knowledge between the practices recommended by the WRC and the knowledge of the farmers about different aspects of improved practices of wheat cultivation. The Knowledge Gap Index (KGI) was calculated following the formula used by Singh *et al*. (1991).

$$KGI = \{(P-K)/P\}100$$

Where:

K = Knowledge score obtained by a respondent over all the practices

P = Possible maximum scores for all the respondents/ practices

Results and Discussion

Available wheat varieties: There are 16 released modern wheat varieties in Bangladesh (Table 1). The wheat scientists of BARI developed and released 9 modern wheat varieties: Balaka, Doel, Ananda, Kanchan, Akbar, Barkat, Aghrani, Sawgat and Protiva. Balaka and Doel were released for general cultivation in 1979. Balaka seed was multiplied by Bangladesh Agricultural Development Corporation (BADC) and was distributed among the growers. Yet the variety did not become popular because of its poor visual grain quality and short straw which were unaccepted to the farmers. Within a few years of its release the BADC stopped multiplication of Balaka and the variety naturally went out of production. Doel was not multiplied for seed increase though in some respects the variety was better than Balaka. Doel was withdrawn because the variety becomes susceptible to leaf rust within a year of its release.

Ananda, Kanchan, Akbar and Barkat were released in 1983. All four of these varieties are high yielding and moderately resistant to leaf rust. Seed production of these four varieties was undertaken by the BADC, but none except Kanchan could gain the confidence of the farmers. Kanchan expanded rapidly due to its high yield, bold and amber grain (very much liked by the wheat growers of Bangladesh) and adaptability to different production environments. Kanchan has now become moderately susceptible to leaf rust and Helminthosporium leaf blotch disease, but the variety is still maintaining its popularity with the growers.

Aghrani was released in 1987 with the expectation that when Sonalika would be withdrawn, it would fill the gap of a short-duration variety for the cropping system. Research results indicate that under late planting conditions Aghrani give higher yields than Sonalika. So far Aghrani has not become a popular variety with the BADC and the farmers.

Table 1: Varieties released by Wheat research Center, BARI and used by the farmers

Variety	Source of germplasm	Year of release
Sonora -64	CIMMYT	1968
Kalyansona/Mexipak-65	INDIA/PAKISTAN	1968
f nia 66	CIMMYT	1972
Sonalika	INDIA	1973
Jupateco	CIMMYT	1974
Pa von-76	CIMMYT	1979
Seri- 82	CIMMYT	1987
Balaka	INDIA	1979
Doel	CIMMYT	1979
Kanchan	INDIA	1983
Barkat	CIMMYT	1983
Akbar	CIMMYT	1983
Anada	CIMMYT	1983
Agrhrni	PAKISTAN	1987
Sawgat	CIMMYT	1993
Protiva	THAILAND	1993

Source: BARI

Recently two more varieties, Sawgat and Protiva, selected from CIMMYT lines, have been released by the WRC. These two varieties do not give consistently higher yields than Kanchan, though they have exhibited higher yield potential at a number of locations and have better resistance to leaf rust and Helminthosporium leaf blotch diseases. Both these varieties are in the process of multiplication for seed increase and are also put in on-farm demonstrations.

Wheat Technology and Extent of Adoption

Modern wheat technology: In the past, wheat was not considered as an important cereal crop in Bangladesh. Up to the mid sixties, wheat cultivation did not receive proper attention by the farmers; in reality, it was considered to be a poor mans' crop and was mostly grown by marginal and subsistence farmers. The use of irrigation water and fertilizer was rare and yields were very low. The introduction of Mexican HYV's of wheat in Bangladesh in 1965, however, changed the overall picture considerably. During early '70 and particularly after the war of liberation, prospects of wheat cultivation in Bangladesh agriculture peeped up through pilot research undertaking. By the mid 70's wheat was established as the second major cereal crop after rice and large scale wheat production was made possible with the introduction of Sonalika, a short duration variety. Wheat area and production has increased substantially since 1975.

The importance of wheat as a cereal crop has increased and popularized in the country during the last three decades as its consumption in the country significantly increased. After 1974 famine, farmers sharply increased area of wheat cultivation (Chowdhury *et al.*, 1994). Wheat promotion efforts initiated during the mid 1970s led to further rapid expansion in wheat area by 1980s and 1990s, much of it concentrated in the northern and central parts of the country.

The adoption of wheat Mvs found to be extensive (Table 2). Nearly 100% of the wheat area was covered by MVs. Proportionally the greatest area planted in 1992/93 were Kanchan and Akbar, relatively new MVs released during the past 10 years. Also a significant portion of total wheat area was covered by an old MV-Sonalika. Adoption of MVs has occurred across all farm size categories, with large-scale farmers replaced MVs more rapidly.

After releasing HYV's like Kanchan, Akbar, Barkat etc wheat cultivation became more popular during 1980's. In 1975-76, 59% of the total wheat acreage was under modern varieties. In 1980-81, this rose to 97%. There was a rising trend in wheat area from 1974-75 to 1980-81(BBS, 1991). However, the initial increases were reversed by a decline of 10% in 1981-82. This trend continued in 198283 and 1983-84. But there was an abrupt increase of wheat hectarage in 1984-85. Under the agricultural rehabilitation program wheat seed was distributed free of cost of the farmers in 1983-84. Planting of this seed resulted in the area increase, which did not continue in 1985-86. In 1985-86 area fell to pre-1984-85 levels, where it remained in subsequent years, exhibiting some year to year fluctuation. Therefore, considerable fluctuation in acreage and production of wheat observed from year to year, because of weather intervention and farmer's independent choice of crops. Such fluctuation must be accepted as inevitable in Bangladesh's climatically variable and economically volatile environment.

Table 2: Adoption of wheat modern varieties by farm size, 1992-93

Farm size (ha)	Share of wheat area (%)	Share of newer Mvs area[1] (%)	Share of older Mvs area[1] (%)	Total MVs area (%)
< 0.2	28	65.4	34.0	99.4
0.2-0.5	40	67.0	32.2	99.2
0.5-1.0	19	74.6	25.4	100.0
> 1.0	13	86.7	13.3	100.0
All farms	100	70.6	29.0	99.6

Source: CIMMYT-IFPRI Wheat producer survey, 1993. = [1]Kanchan and Akbar released in 1983 = [2]Sonalika released in 1973.

Wheat as less than 5% of net cropped area covers the districts of Sylhet, Habiganj, Moulabibazar, Sunamganj, Netrokona, Kishoreganj, Feni, Rangamati, Noakhali,

Table 3: Compound growth rate ICGRI of area, production and yield of wheat at different districts in Bangladesh during 1971-72 to 1991-92

Districts	Area		Production		Yield	
	CGR(%)	R^2	CGR(%)	R^2	CORI%)	R^2
Dinajpur	0.2046***	0.744	0.2514***	0.725	0.0388* * *	0.484
Rangpur	0.1682***	0.670	0.2155***	0.668	0.0405***	0.588
Bogra	0.1152***	0.613	0.1402***	0.589	0.0224***	0.378
Rajshahi	0.0651***	0.733	0.1199***	0.712	0.0515***	0.621
Pabna	0.0674***	0.799	0.0952***	0.773	0.0260* *	0.240
Kushtia	0,0649***	0.629	0.0955***	0.500	0.0287*	0.176
Jessore	0.1288***	0.730	0.1759***	0.721	0.0417* **	0.458
Khulna	0.1558***	0.542	0.2056***	0.510	0.0431 * * *	0.333
Barishal	0.2953***	0.780	0.3211***	0.734	0.0199	0.109
Mymensingh	0.0964***	0.838	0.1582***	0.833	0.0563***	0.410
Dhaka	0.1228***	0.847	0.1704***	0.828	0.0424* * *	0.598
Faridpur	0.0647***	0.679	0.1177***	0.670	0.0498* * *	0.430
Sylhet	0.2026***	0.779	0.2466***	0.763	0.0365* * *	0.438
Comilla	0.0992***	0.644	0.1147***	0.622	0.0141 *	0.186
Noakhali	0.0688**	0.236	0.0958**	0.247	0.0253* *	0.216
Chittagong	0.0437	0.015	0.0608	0.026	0.0168* *	0.189
Chit.H.T.	0.0499	0.031	0.0447	0.022	-0.005	0.023
Bangladesh	0.1017***	0.794	0.1410***	0.736	0.0357***	0.453

*** Significant at 1% level, ** Significant at 5% level *Significant at 10% level

Table 4: Percentage of farmers using HYV's seed from various sources by district

Name of the districts	Own (%)	BADC (%)	Hat (%)	Others (%)
Dinajpur	43.64	22.42	30.91	3.03
Panchagar	55.70	13.92	29.11	1.26
Thakurgaon	52.94	15.69	29.41	1.96
Gaibandha	50.00	30.77	19.23	0.00
Kurigram	64.52	6.45	29.03	0.00
Lalmonirhat	48.39	51.61	0.00	0.00
Nilphamari	25.81	43.55	30.65	0.00
Rangpur	30.68	35.23	28.41	5.68
Bogra	45.65	17.39	34.78	2.17
Joypurha	57.14	0.00	35.71	7.14
Pabna	45.00	23.89	28.89	2.22
Sirajgonj	60.16	11.11	25.00	3.70
Nawgaon	67.90	4.94	25.92	1.23
Natore	40.00	42.00	10.00	8.00
Nawabgonj	74.29	2.86	17.14	5.71
Rajshahi	61.54	10.26	28.21	0.00
Jessore	10.59	52.94	36.47	0.00
Jhenaidah	43.64	29.09	16.36	10.91
Magura	42.86	42.86	14.29	0.00
Faridpur	61.45	20.48	14.46	3.61
Rajbari	65.56	26.67	7.78	0.00
Dhaka	62.96	25.93	7.41	3.70
Manikgonj	65.38	19.23	15.38	0.00
Narayangonj	62.50	31.25	6.25	0.00
Narshindi	27.27	45.45	18.18	9.09
Jamalpur	18.37	59.18	20.41	2.04
Chuadanga	48.00	24.00	18.67	9.33
Kushtia	54.67	21.33	20.00	4.00
Meherpur	26.32	63.16	0.00	10.53
B. Baria	40.00	30.00	30.00	0.00
Chandpur	41.67	36.67	20.00	1.67
Comilla	32.81	51.56	13.28	2.34
Tangail	49.07	30.56	17.59	2.78
Kishoregonj	14.89	65.96	19.15	0.00
Netrokona	9.09	90.91	0.00	0.00
Mymensingh	29.79	55.32	12.76	2.13
Sherpur	25.00	41.67	22.22	11.11
All Districts	45.29	29.81	21.91	2.99

Source: Ahmed and Meisner (1996)

Table 5: Percentage of wheat growers using different kinds of fertilizers in the survey area

Fertilizer	Farmers (%)
Cowdung	50.00
Urea	96.00
TSP	91.00
MP	76.00
Gypsum	9.00
Zincoxide	0.80

Lashmipur, Jhalakati, Khulna, Bagarhat, Satkhira, Barguna, Pirojpur and Potuakhali. Among these districts wheat does not exceed 5% of net-cropped area because of salinity problems. But in other districts due to flood, the farmer grows late T. Aman, so that there it is not possible to grow wheat may be for shortage of time for wheat cultivation. In addition, in the greater districts of Chittagong and Chittagong Hill Tracts, the farmers usually grow substitute crops like vegetables which is more profitable than wheat (Ahmed and Meisner, 1996). The part of Panchagar, Nilphamari, Lalmonirhat, Dinajpur, Joypurhat, Chapai Noawabganj, Bogra, Sirajganj, Manikganj, Rajbari, Gopalganj, Madaripur, Tangail, Jamalpur, Naw abganj and Noagaon districts cover wheat by 5-10% of net cropped area. In these area farmers usually grow HYV Boro followed by Aus and T. Aman rice. In addition to these, farmers also grow vegetables during Rabi season. Due to late recedes of floods and profitable vegetables production, the wheat area does not exceed 510% (Bhuiyan *et al*., 1993).
The district of Takurgaon and part of Nilphamari, Kurigram, Ghaibanda, Jamalpur, Tangail, Natore, Pabna and Khustia cover 10-20% of net cropped area by wheat crop. However, 20-30% of net cropped area of districts of Comilla and parts of Chandpur, Chuadanga, Meherpur, Pabna and Bogra is covered by wheat, which is the highest coverage area in the country. This may be due to favourable soil and climatic conditions of these area (Islam, 1998).

Growth in area, production and yield of wheat: All the 17 greater districts of Bangladesh have shown an increasing trend in growth rate of wheat area during 1971-72 to 1991-92 (Table 3). Among the districts, area has increased by 29.5% per annum in Barishal, followed by Dinajpur, Sylhet (20%) and Rangpur (16.8%) per annum. On the other hand, the area of rest of districts have increased more or less by 10% per annum. The planted area of wheat in Bangladesh has increased by 100 per annum during 197172 to 1991-92.
The growth rate of production of wheat of all districts had positive growth rate during 1971-72 to 1991-92. Production of wheat in Barishal district increased by 320 per annum, followed by Dinajpur, Sylhet, Rangpur and Khulna by 25, 24.6, 21.5 and 20.5% per annum respectively. Overall Bangladesh, wheat production has increased by 14% per annum during 1971-72 to 1991-92. Yield of wheat of all districts, except Chittagong Hill Tracts. had positive growth rate ranging 1 to 5% during 1971-72 to 1991-92. But decreased slightly in Chit. H.T. district. However, in Bangladesh, yield growth rate of wheat increased by 3.6% per annum during 1971-72 to 1991-92.

Source of seed: Table 4 presents sources of wheat seed used by the sample farmers of 37 districts of Bangladesh. It revealed that in all districts majority of the farmers (45.29%) used their own home supplied seed. About 29.81% farmers used seed from BADC and 21.91% of them used from local markets and other farmers. About 90% farmers of the Netrokona district purchased seed from BADC followed by the district of Kishorgonj (66%), Meherpur (63%), Jamalpur (59%), Mymensingh (55%) and Jessor (52.9%). On the other hand, the farmers of the district of Joypurhat did not buy BADC seed. Only 2.8% farmers of the district of Nawabgonj, 5% of the district of Nawgaon purchased wheat seed from BADC. In general, the farmers of the northwest and Southwest part of the country were able to produce, preserve and use their own seed. More specifically, about 39.7% farmers of the eastern part of the country used BADC seed whereas 24.5% farmers of the northwest and southwest part of the country used BADC seed.

Time of sowing: While wheat sowing begins in Bangladesh during the last week of October and end by the last week of December, majority of the area is sown in the second and third week of November. It revealed that 65% wheat area was sown at the optimum time in November. Though wheat planting after November is not recommended, late planting is one of the main causes of lower yield of wheat in Bangladesh. Wheat planting after November reduces the yield at the rate of 1.3% per day of delay.

Seed rate: The recommended seed rates of wheat are a) 11.3-13.36 kg ha^{-1} if sown without irrigation; b) 13.3614.98 kg ha^{-1} if sown with 1-2 times irrigation; c) 14.9819.03 kg ha^{-1} if sown with 3-5 times irrigation. However, the survey results indicate that the farmers have used an average seed rates of 24.09 kg ha^{-1} which is higher than the recommended rate. The survey conducted by the Wheat Research Centre in 1990 showed that the farmers in general were using higher seed rate in order to obtain optimum plant population.

Irrigation: From the Table 5 it is observed that the average annual growth rate of irrigation coverage from 1984-85 to 1989-90 was 8.39% which declined to 2,56% during 1990-91 to 1994-95 period. About 66% of the farmers irrigated their wheat crops and on an average of two times during the season. Shallow, deep tube wells and other indigenous methods were used for irrigation. From the results (Table 5) it was observed that growth rate in surface water, LLP, canal and traditional method of irrigation decreased during the period of 1990-91 to 1994-95.

Fertilizer use: Fertilizer use profile of the sample farmers for wheat crops are presented in Table 5. About 50% farmers used cowdung; 96, 91 and 76% of the farmers used urea, TSP and MP, respectively. Gypsum was used by 90 whereas only 0.80 farmers used Zinc Oxide.
The dose of urea applied in wheat was found to be generally lower than the recommended rate. Farmers of only Chuadanga, Narayangonj, Kushtia and B.Baria district used nitrogen very near to the lower limit of the recommended rate. Farmers about 65% of the district surveyed used optimum and above optimum dose of TSP and 57% of the districts used MP at the recommended rate and above (Table 6, 7).

Knowledge Gap: Table 8 and 9 reveals that the respondent farmers belonged to the category of moderate level of

Table 6: District wise fertilizer use by the respondent wheat growers

Name of the districts	Fertilizers (Kg ha^{-1})					
	Cowdung	Urea	TSP	MP	Gypsum	Zinc
Dinajpur	7053.42	147.20	132.58	71.49	44.900	0.00
Panchagar	5456.39	127.76	99.40	61.91	30.16	0.00
Thakurgaon	8030.19	145.82	13141.00	74.24	60.96	35.00
Gaibandha	7539.76	148.58	109.35	68.93	49.85	0.00
Kurigram	187.00	140.48	87.68	60.40	19.00	0.00
Lalmonirhat	5493.90	133.70	118.30	67.94	35.00	0.00
Nilphamari	6385.46	129.32	110.89	57.21	40.07	0.00
Rangpur	7585.73	135.59	122.43	64.72	41.13	53.00
Bogra	7841.22	150.60	112.09	66.97	53.58	0.00
Joypurhat	8080.62	126.75	109.51	57.26	55.41	0.00
Pabna	4271.49	117.25	95.62	47.16	48.61	7.25
Sirajgonj	6349.00	128.87	109.16	58.60	50.19	5.00
Nawgaon	8057.86	138.38	103.23	49.53	39.86	0.00
Natore	5319.25	130.33	130.89	64.03	0.00	0.00
Nawabgonj	6377.94	143.81	119.46	69.95	17.24	0.00
Rajshahi	4949.26	132.72	106.12	52.35	0.00	0.00
Jessore	5375.84	142.75	129.32	71.07	81.08	0.00
Jhenaidah	3998.16	128.94	131.52	72.55	71.43	0.00
Magura	4940.00	131.79	93.86	40.01	78.59	0.00
Faridpur	713.27	143.78	124.42	58.85	44.12	0.00
Rajbari	2855.09	140.29	126.81	83.29	65.73	0.00
Dhaka	633.44	145.82	131.71	66.22	0.00	0.00
Manikgonj	2689.39	151.05	160.85	52.51	0.00	0.00
Narayangonj	4141.30	175.23	191.12	49.36	0.00	0.00
Narshindi	4899.36	162.95	195.54	71.88	0.00	0.00
Jamalpur	1962.66	142.86	130.96	52.01	0.00	0.00
Chuadanga	3897.08	189.26	146.94	72.01	82.01	11.84
Kushtia	4981.17	173.53	133.01	70.62	34.18	10.86
Meherpur	1418.27	154.91	131.36	78.00	0.00	0.00
B. Baria	8689.47	168.45	147.12	72.62	0.00	0.00
Chandpur	3838.91	136.08	124.27	65.86	4.13	0.00
Comilla	4740.62	144.06	144.88	83.88	20.68	0.00
Tangail	1821.15	133.28	113.39	49.63	0.00	0.00
Kishoregonj	2384.07	130.77	106.14	36.55	0.00	0.00
Netrokona	6910.00	126.08	123.50	98.80	0.00	0.00
Mymensingh	7265.00	140.93	114.32	74.38	34.31	0.00
Sherpur	2748.22	115.73	95.23	46.60	0.00	0.00
Total	17981.00	5255.68	4594.37	2359.40	1102.19	122.94
Mean	4861.64	124.04	124.17	63.77	29.79	3.32

Source: Ahmed and Meisner (1996)

Table 7: Recommended fertilizer dozes of wheat cultivation in Bangladesh

Types of irrigation	Amount of fertilizer (kg ha^{-1})		
	Urea	TSP	MP
3-5 times irrigation	230-250	180-210	50-100
1-2 times irrigation	180-210	130-150	40-80
No irrigation	140-160	1 20-1 30	30-70

Source: Fertilizer recommendation guide, 1989

Table 8: Technological knowledge gap of the demonstration and non-demonstration farmers with regard to different practices of wheat cultivation at different thanas of Dinajpur district

Agricultural Knowledge	Maximum attainable score	Mean score obtained		Gap (%)	
		DF	NDF	DF	NDF
Characteristics of MV	6	5.45	4.88	9.17	18.67
Name of MV	4	4.35	3.88	8.75	3.00
Seed rate and sowing time	5	3.62	2.68	27.60	46.40
Fertilizer dose	6	4.50	1.50	25.00	75.00
Intercultural operation	16	3.51	10.52	78.06	34.25
Plant protection	9	5.18	5.25	42.44	41.67
Information of harvesting	4	3.88	3.76	3.00	6.00

Table 9: Technological knowledge gap of the Demonstration and non-demonstration farmers with regard to different practices of wheat cultivation at different thanes of Jamalpur district

Agricultural Knowledge	Maximum attainable score	Mean score obtained		Gap (%)	
		DF	NDF	DF	NDF
Characteristics of MV	6	5.33	5.12	11.16	14.67
Name of MV	4	2.67	2.21	35.25	44.75
Seed rate and sowing time	5	3.00	3.33	40.00	33.40
Fertilizer dose	6	1.80	2.00	70.00	66.67
Intercultural operation	16	10.00	11.01	37.7	31.19
Plant protection	9	5.00	6.33	44.44	29.67
Information on harvesting	4	3.00	3.00	25.00	25.00

knowledge gap in most of the practices of modern wheat cultivation. These practices were seed rate and sowing time, fertilizer dose and intercultural operation and plant protection. Among these practices, the farmers found to have maximum knowledge gap about recommended fertilizer dose. Regarding the name of MV wheat, the farmers had also maximum knowledge . In some practices, the knowledge of wheat technology decreases from Demonstration Fermer's (DF) to Non-Demonstration Farmer's (NDF). For some practices, no systematic trend was observed (Table 8 and 9). Similar results also observed in Jamalpur district. The highest knowledge gap was observed for fertilizer dose both in DF and NDF in Dinajpur district followed by intercultural operation, plant protection and seed rate and sowing time. The highest knowledge gap was fertilizer dose both in DF and NDF in Jamalpur district followed by plant protection (DF) and name of MV (NDF) and intercultural operation (DF and NDF).

However, the overall data showed a significant difference between the practices recommended and the existing technological knowledge of the farmers in case of some practices such as time of sowing, seed rate, irrigation, fertilizer dose etc. But for some practices the knowledge gap were minimum. It was found that the Farming System Research (FSR) and Multi-Location Testing WILT) site farmers had more knowledge on wheat technology than that of other farmers. For that, the wheat demonstration was not the only contributor. The different FSR and MLT activities enhanced their knowledge. The findings of the present study found to be consistent with other studies (Rahman and Islam, 1991), it was revealed that there were significant differences between the practices recommended and the existing technological knowledge of the farmers. Dangi and Intodia (1990) revealed that there were significant difference between the technological packages recommended and the existing knowledge of the farmers at the time of investigation with regard to main area of cotton and wheat cultivation.

Insect and pest: There are many insects and pests infest wheat crop, the major insect found in the field level are: I) click betle, ii) Termite, iii) Aphid, etc. The major disease of wheat also recorded as I) Stem rust, ill Loose smut and iii) Leaf rust. However, the farmers do not aware of about this diseases clearly. As a result a large amount of wheat crops losses every year.

Concluding remarks: Wheat area, production and yield increased by about 10, 14 and 3.5% per annum, during 1971/72 to 1991/92. Hundred per cent of the wheat acreage in the country were planted to modern varieties. Among the wheat varieties, the adoption index of Kanchan variety was excellent. Now-a-days farmers generally cultivate wheat by irrigation and they do no prefer to grow wheat under non-irrigated condition. The farmers were able to learn about modern technology through on-farm trial agriculture. But the farmers did not usually adopt the complete set or whole package of the technology. The study revealed that the farmers had moderate knowledge gap in most of the practices off modern wheat cultivation. However, maximum knowledge gap was found for recommended fertilizer dose. There were significant difference between the practices recommended and the existing knowledge of the farmers in case of practices of time sowing, seed rate, fertilizer dose, intercultural operation, plant protection and harvesting.

The study also reveals that the demonstration farmers at FSR and MLT sites had higher knowledge than those of other farmers. The farmers at the on-farm research sites were connected with the field research experiments.

There should be arrangement of various training programmes to provide better understanding to the farmers on the operational and technical aspects of the package recommendations.

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