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Prospects of Triticale as Fodder and Feed in Farming of Bangladesh

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방글라데시 농업에서 트리티케일의 조사료 및 곡물사료이용 전망

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ABSTRACT

트리티케일은 호밀과 밀의 교잡에 의한 작물로서, 방글라데시에서 조사료 및 곡물로 재배가능하나 농가재배는 아직 시범단계에 있는 상태이다. 본 논문은 방글라데시농업에 있어서 비전통적인 작물로서 트리티케일의 재배 현황을 검토하고 최근 몇 년간의 시험연구 자료에 의거하여 트리티케일이 축산조사료와 곡물사료로 사용됨에 따르는 경제성을 비교하였다. 트리티케일과 밀 옥수수 재배의 수익성을 비교한 결과 트리티케일이 가장 높고 다음은 옥수수, 밀의 순으로 나타났다. 트리티케일의 재배대안별 수익성은 파종후 2회(파종후 35일째와 50일째 절단) 조사료로 절단 재배(4.9~20.2 t/ha)하고 이어서 곡물(1.1~2.4 t/ha)로서 재배하는 경우가 가장 높게 나타났으며, 이때 B/C ratio는 1.62로 나타나서 경제성이 있다는 것을 입증했다.

한편 시범농가재배결과에 의하면 트리티케일을 젖소의 조사료로서 사용한 경우가 볏짚을 사용한 경우보다 젖소의 우유생산량과 젖소의 체중을 36~46% 포인트 증가시키는 결과를 가져왔다. 아울러 트리티케일은 방글라데시 양계사육에 있어서 밀을 대체할 수 있는 좋은 곡물사료로 나타났다. 시험연구결과와 시범농가재배결과에 의하면 트리티케일을 조사료와 동시에 곡물로 이중목적으로 재

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배하는 것이 방글라데시 축산업에서 만성화 되어있는 조사료부족(특히 건기)현상을 경감할 뿐 아니라 소규모 방글라데시 농가의 소득에도 기여할 수 있는 잠재성이 있다고 판단된다.

핵심어 : 트리티케일, 조사료, 곡물사료, 방글라데시 농가

I. Introduction

Bangladesh is primarily an agrarian economy. Agriculture is the single largest producing sector of economy since it comprises about 30% of the country's GDP and employing around 60% of the total labour force. Agricultural holdings in Bangladesh are generally small(averaging 0.68 ha per household). The crop sub-sector dominates the agriculture sector contributing about 72% of total production. Fisheries, livestock and forestry sub-sectors are 10.33%, 10.11% and 7.33%, respectively. Dairying and poultry production are important parts of the rice-based mixed farming systems in Bangladesh and are preferred options for small-scale farmers to generate income and alleviate poverty. But in Bangladesh only 3% land belongs under shrublands, savanna, and grasslands. Among them the position of grass land alone will be less than 1% of total land area. This amount of land is too low to supply the feed requirements for our livestock. Consumers face an acute shortage of milk and meat livestock products, which fail to meet the requirements of over 80% of the population. The per capita daily availability of milk is just 33 ml compared with a requirement of 250 ml, while 10 g of meat is consumed but 120 g is needed(Saadullah 2002). Fodder and feed scarcities are major limiting factors in ruminant livestock and poultry production in Bangladesh (Haque et al.,, 2006). Each year Bangladesh requires about 27 million tons of roughage to achieve reasonable production levels from its current herds, but the existing supply meets less than 50 percent of total demand(Saadullah 2002). Imports to fill the gaps are rarely feasible or economic, and seasonal feed shortages mean high fodder prices and poor livestock production performance. The situation is worse in areas often affected by drought and salinity, and during March to May when the quantity of fodder is insufficient and its protein and energy values are low. Only small amounts of quality fodder and feed are available because of small land holdings and multiple attractive crop options during the cool dry(*Rabi*) season from November to March. Rice straw is by far the most important crop residue fed to ruminants in Bangladesh, contributing 〉90% of the feed energy available(Saadullah 2002), but it has relatively low protein quality and energy value.

Triticale is a relatively new cereal which has a high yield potential and is widely adapted. It is a hybrid cereal derived from an interspecific cross between wheat*(Triticum durum)* and rye

(Secale cereale)(Sell et al.,, 1962). The value of the grain as a poultry and animal feedstuff has been tested in experiments with chicks (Bragg and Sharby, 1970; Avila and Cuca, 1971), rats (Knipfel, 1969), swine(Bowland, 1968; Shimada et al., 1971) and ruminants(McCloy et al., 1971). Also, the cereal has been tested as a food for humans(Kies and Fox, 1970). Triticale is a useful dual-purpose crop for grain and forage biomass(Andrews et al., 1991). Triticale can improve returns significantly on poorer soils, and is a good rotational crop to add diversity and flexibility to farming systems. In Bangladesh, it is a non-traditional cereal that grows well during the cool and dry Rabi season(November-March) when small-scale dairy farmers face a severe shortage of quality fodder(Ahmed and Meisner 2002, Haque et al., 2006). It can be grown during the cool Rabi season in existing rice-based cropping systems. November to February is the lean period for most popular fodder grasses like Napier and Para in Bangladesh. To meet the shortage of green fodder in the Rabi season, farmers can produce 6-15 t/ha of triticale fodder, followed by grain yields that are similar to those from wheat for cattle or poultry feed(Jahan et al., 2001, Haque et al., 2006). Triticale grain could be a cheaper alternative to wheat and maize grain for poultry enterprises. Thus dual-purpose triticale was identified as an exciting new option for forage and grain production(Ahmed and Meisner 2002, Jahan et al., 2001, Haque *et al.*, 2006). In this paper we will examine the potentiality of triticale used as grain feed as well as fodder for the livestock farming in Bangladesh.

II. Current Status of Fodder in Bangladesh

Livestock, being one of the major components of the farming systems, plays vital role in agriculture. In an intensive agrarian country like Bangladesh, feed resources for ruminants are derived mainly from crop residues, cereal by-products, shrubs, fodder trees, and grasses growing in wayside bunds and embankment. The available cattle feeds in Bangladesh can be grouped into agro-industrial by-products which include agricultural crop residues such as straws, sugarcane tops, bagasse etc; by-products from agroindustries such as molasses, oil-cakes, pineapple wastes, shrimp waste, etc; and milling by-products such as brans. Green roughage include non-cultivated indigenous grasses grown on road side, embankment, bunds etc; leaves of the jack fruit and mango tree, ipil ipil, etc; and aquatic plants such as water hyacinths, dol grass, azolla, duck weed etc. Cultivated fodder includes both perennials, such as Napier, Para, German, Splendida, Andropogon, and Gamboo grasses; and seasonal crops such as maize, cowpea, khesari, oat, sunhemp, etc. There are about 626,000 ha of cultivable waste land mostly in the form of roadsides, embankments and communal fallow. Very little grain is available for feeding the animals in the country.

It is estimated that about 190,000 MT(metric tons) of grain is available for livestock feeding, contributing only about 15.7 percent of the total amount of concentrate feed.

Fodder plant : Usually the food is composed of entire plants, including leaves, stalks and grain. In Bangladesh paddy straw and dry plant residues of pulses constitute the major fodder component. Cattle and other grazing animals also browse on green leaves and twigs of many shrubs and trees in hilly forest areas. Numerous species of fodder grasses, shrubs and trees are available in Bangladesh. Introduced or exotic fodder species include Napier Grass(*Pennisetum purpureum*), Guinea Grass(*Panicum maximum*), Para Grass(*Brachiaria mutica*), Stylo(*Stylosanthes* species), and *Centrosema pubescence*. Use of triticale as an alternative feed for pigs is usually reported in the literature as very successful(Briggs, 2001). Jaikaran et al., 2000 concluded that triticale could be used as a substitute for wheat with no significant loss of performance. An energy value for the triticale of 95-100% of maize was estimated. Brendemuehl et al., 1996 compared the effects of maize, wheat and triticale on carcass composition and on taste and quality characteristics of pork and found that grain source did not affect carcass lean meat content or meat quality characteristics. Commercial adoption of triticale for pig rations has already occurred internationally(e.g. in Australia, USA, Brazil, Poland and Germany) (Briggs, 2001).

Pasture land : Ground covered with grass or herbage is used for the grazing of livestock. In Bangladesh there is no well-defined pasture area. There are about 626,000 ha of cultivable waste land mostly in the form of roadsides, embankments and communal fallow. Although these areas are used as pasture for all kinds of ruminants, these are not maintained for improving its yield. Productivity of this pasture is seasonal and can yield up to 20 MT of fresh biomass per hectare per cutting during monsoon. While during the dry periods (December-April) there is little or no yield in the pasture. These pastures comprise of low biomass yielding native grasses mostly, *Cyanidon dactylon*. Chemical composition of mixed growths varies with season. Metabolizable energy and protein(10-21%) content of these pastures are relatively better than conventional straw. As triticale has wide adaptability to grow even in the less management system, so triticale could be used in the such unused pasture land.

III. Experimental Discussion

1. Growing condition of triticale

Triticale will grow in a range of rainfall zones, from 250 mm to more than 800 mm. In good wheat growing conditions with rainfall to 400 mm, triticale yields are about 10% less than wheat. However in areas above 500 mm, triticale will generally outyield wheat. Triticale will also perform better than other cereals

where soil fertility, disease, weed, pH or water logging problems exist which reduce the yields of wheat, barley or oats. Triticale has a more vigorous root system than wheat, barley or oats, binding light soils and extracting more nutrients from the soil. Triticale is well adapted to a broad range of conditions including low fertility sands, shallow soils, sodic soils and very low or very high pH. On alkaline soils where other cereals are affected by manganese, zinc or copper deficiency, triticale is less affected (McDonough and Cooper, 2004). The growing condition of Bangladesh are favorable for Triticale.

2. Nutritional value of triticale as feed grain

Triticale generally has nutritional advantages over barley for stock feed. It has similar nutritional value to wheat, and can be directly substituted for wheat for grazing ruminants. Triticale is often preferred to wheat in stock rations, because of its slightly higher lysine content, and its higher starch digestibility for ruminants. It is now generally accepted that the cereal grain in pig and poultry rations can be all triticale(about 50% of total ration). Triticale has an advantage over barley in dairy rations due to its higher metabolisable energy and lower fibre content. It can be fed to 100% of a cow's grain consumption(McDonough and Cooper, 2004). Table 1 shows the chemical composition of a typical triticale variety. Feeding trials in North Dakota, Canada, and Minnesota indicate that triticale has potential as a feed grain. The protein content of triticale lines has ranged from 10 to 20 percent on a dry weight basis, which is higher than wheat. The amino acid composition of the protein is similar to wheat, but may be slightly higher in lysine(Oelke et al., 1989).

Feeding trials with cattle in North Dakota showed that when triticale was the only grain used in fattening rations, both gains and feed efficiency were reduced compared to barley rations. Recent feeding trials at the University of Minnesota, conducted by Wright and others with calves, indicated that starter rations containing up to 27 percent triticale as dry matter equaled weight gains and starter intakes in calves fed rations containing soybean meal (Oelke et al.,, 1989).

Table 1. The chemical composition of a typical triticale variety

Component (% of Dry matter)								
Protein	Fiber	Fat	Calcium	Phosphorus	Total sugar(as invert)			Starch
19.71	3.10	1.61	0.12	0.44	5.74			67.78
Amino acids (% of dry matter)								
Threonine	Valine	Methionine	Isoleucine	Leucine	Phenylalanine	Lysine	Histidine	Arginine
0.39	0.93	0.40	0.76	1.23	0.85	0.57	0.45	0.80

Source: Oelke et al., 1989.

Table 2. Nutritional quality of triticale and other cereal grains in Bangladesh

	Dry matter (%)	% Dry matter				Metabolizable Energy (MJ/kg Dry Matter)
		Ash	Crude protein	Acid Detergent Fiber	Digestible Organic Matter In Dry Matter	
Triticale	90.3	2.6	15.9	4.8	74.5	11.2
Wheat	89.1	15.8	*11.8	3.9	74.7	11.2
Maize	89.5	13.1	11.1	4.6	74.5	11.2
Barley	87.5	4.5	12.1	-	75.7	11.4

Source: Haque et al., 2006.

Table 3. Nutritional value of triticale grain by number of times cut, Bangladesh, 2001-02

	Dry matter (%)	% Dry matter				Metabolizable Energy (MJ/kg Dry Matter)
		Ash	Crude protein	Acid Detergent Fiber	Digestible Organic Matter in Dry Matter	
Uncut grain	83.3	7.7	18.5	4.2	74.6	11.2
One cut grain	83.8	2.5	17.8	3.4	74.8	11.2
Two cut grain	80.9	2.3	17.1	5.6	74.2	11.1
Significance	P<0.001	P<0.001	NS	P<0.01	P<0.01	P<0.001
Standard error	0.8	1.6	0.5	0.6	0.2	0.0

Source: Haque et al., 2006.

Triticale grain samples averaged 15.9% crude protein and had metabolizable energy values of 11.2 MJ/kg dry matter(Table 2). Cutting had relatively little effect on the quality of triticale grain(Table 3). The digestibility and energy content of triticale grain were similar irrespective of cutting. Grain from cut plants had slightly (but not significantly) lower crude protein contents. The ash content of grain from uncut plants was higher than the ash content of first or second cut grain(Table 3).

3. Triticale used as forage

Triticale is a very high quality grass forage in Bangladesh, comparable to lathyrus, ipil-ipil (*Leucaena* spp.) and gliricidia leguminous forages (Gohl 1981). Triticale was compared in terms of nutritional value with other common legumes (Table 4) and with other common cereals of Bangladesh(Table 2). From both the Table 4 & 2 it was clearly shown that Triticale is one of the quality feed in terms of high content of crude protein both in the fresh grass(24.7%)

as well as in the grain(15.9%). The protein content of its forage is three times higher than other grass forages such as napier grass, para or cynodon and its fibre content is one third that of lathyrus, napier grass and black gram. Energy content is similar to grasses with 70% digestibility(AFRC 1995) and digestible organic matter and energy contents were similar to or higher than cynodon, cowpea, lathyrus, and napier grass.

So as a good source of crude protein triticale might be accepted to our farmers if we are able to convey this message. At the beginning of triticale introduction to the farmers to grow their field, farmers asked about the nutritional value of triticale forage for cattle and the grain for poultry. Triticale green forage, hay, straw and grain from 2001-02 were analyzed for nutritional quality. Triticale fresh forage was very high quality, with 24.7% crude protein in the dry matter and metabolizable energy values of 10.6 MJ/kg dry matter(Table 4). Triticale hay and straw were also high quality.

The average daily milk yield of cows in the triticale silage group(4.65 l/d) was significantly ($p<0.05$) higher than the rice straw(3.41 l/d) group but there was no significant difference in milk dry matter and crude protein between the two groups(Table 5). The ratio between triticale silage group and rice straw group is highest in the increase of milk(1.88) followed by the milk yield(1.36)

The average daily live weight gain of cows in the silage group(1.27 kg/d) was significantly ($p<0.05$) higher than those fed rice straw(0.87 kg/d) (Table 6).

Table 4. Nutritional quality and value of triticale in Bangladesh, 2001-02

	Forages	Dry matter (%)	% Dry matter				Metabolizable energy (MJ/kg dry matter)
			Ash	Crude protein	Acid detergent fiber	Digestible organic matter in dry matter	
Nutritional quality compared with common legumes.	Triticale	16.2	10.4	24.7	12.0	71.2	10.7
	Lathyrus	16.5	15.4	22.7	34.0	66.6	10.0
	Black gram	24.9	11.4	10.5	36.0	66.0	9.9
	Cowpea	19.3	13.4	6.6	7.3	73.8	11.1
Nutritional value of triticale depending on use	Fresh forage	16.3	10.4	24.7	12.0	71.2	10.6
	Hay	83.2	10.0	6.8	32.0	67.2	10.1
	Straw	99.2	6.7	8.4	42.0	63.3	9.5
	Grain	90.3	2.6	15.8	4.8	74.4	11.1

Source: Haque et al., 2006.

4. Fodder and grain production from triticale

Forage yield and quality investigations of triticale at the University of Minnesota (1978-79) by Cherney and Marten and at the University of Wisconsin by Brinkman and Albrecht(1986-88) found that barley, oat, and triticale had similar dry matter yields. However, oat yielded significantly less dry matter than triticale in 1979 at the University of Minnesota, St. Paul. Wheat often had the lowest dry matter yields. Triticale, cut slightly before boot stage, makes the best silage similar to other small grains, but dry matter yields are higher at later maturity stages(Oelke et al., 1989).

Excellent quality, palatable hay can be produced from all triticale varieties. Of particular note is triticale's ability to produce relatively high biomass in low rainfall conditions and good quality

Table 5. Effect of triticale silage and rice straw feeds on milk yield and quality of mid lactating cows at BLRI, Savar, Bangladesh, 2005-06

Parameters means	Experimental groups		Ratio (A/B)
	Triticale silage group (A)	Rice straw group (B)	
Group mean initial milk yield (L./day)	3.14 (0.48)	3.14 (0.82)	1.00
Group mean milk yield (L/d)	4.65 (0.05)*	3.41 (0.07)*	1.36
Group mean increase of milk (L/day)	0.51 (0.02)*	0.27 (0.03)*	1.88
Group mean milk dry matter (%)	12.47 (0.42)	12.42 (0.26)	1.00
Group mean milk fat (%)	4.43 (0.07)	4.17 (0.09)	1.06
Milk protein (%)	3.28 (0.09)	3.11 (0.05)	1.05

Note: SE= standard error of mean,
Figures in the parentheses represent percentages of total: *Significant at 5% level.
Source: N.R Sarker et al., 2006.

Table 6. Mean daily live weight gain of triticale silage and rice straw groups of lactating cows during 9 weeks at BLRI, Savar, Bangladesh, 2005-06

Parameters means	Experimental groups		Ratio (A/B)
	Triticale silage group (A)	Rice straw group (B)	
Initial body weight (kg)	228.29 (4.78)*	235.43 (2.13)*	0.97
Final body weight (kg)	299.86 (3.63)*	274.71 (2.14)*	1.09
Daily live weight gain(kg/d)	1.27 (0.30)*	0.87 (0.07)*	1.46

Note: SE= standard error of mean,
Figures in the parentheses represent percentages of total: *Significant at 5% level.
Source: N.R.Sarker et al., 2006.

attributes in high rainfall conditions. The crop should be cut at flowering, preferably early in the day after the dew has dried off, to ensure the highest nutritional value and fastest drying. Consider that it may be more economic to cut frosted crops for hay rather than to leave in the hope of grain production. Chaff and silage can also be made from triticale crops using standard techniques(McDonough and Cooper, 2004).

Two cuts gave around 60% more fodder than one cut in all years. Across 44 experiment locations in 2001-02, the mean fodder yield for WRF-7 was 3.65 t/ha after one cut and 5.95 t/ha after two cuts. Grains yields averaging 1.54 t/ha were reported from previously cut triticale on several of the farms in 1999- 2000 and 2000-01, compared with 1.83 t/ha for uncut triticale.

Cutting significantly influenced all traits under study including fodder and grain yield(Table 7). Heading and maturity was delayed to some extent with later cutting times. The higher grain yield from one cut at 35 days and 40 days than no cut, might be due to the application of an extra urea top-dress with irrigation after grass cutting, which was not done in no cut treatment. The green fodder yield was significantly increased with delayed cutting but grain yield decreased when cutting was delayed beyond 40 days.

IV. Farmer Level Demonstrations with Triticale

In on-farm demonstrations with WRF-7 during 2005-06,the green fodder yield ranged from 4.9 to 20.0 t/ha fresh mass(0.7 to 2.7 t/ha dry mass) from one cut at 35 days and 7.0 to 28.0 t/ha fresh mass from two cuts at 35 and 50 DAS. Although grain yield and grain-size decreased with increased frequency and latter timing of grass cutting, high grain yields(up to

Table 7. Effect of timing and frequency of grass cutting on yield and other characters of triticale at WRSS, Dinajpur, Bangladesh, 2005-06

Treatment	Green fodder (t/ha)	Straw yield (t/ha)	Grain yield (t/ha)	Plant height (cm)	Heading (days)	Maturity (days)
No cut	0	6.24	3.08	112	68	113
Once at 35 days	6.13	5.29	3.11	108	72	114
Once at 40 days	8.13	5.50	3.13	107	72	115
Once at 45 days	11.65	4.72	2.75	105	73	116
Once at 50 days	12.36	4.78	2.58	105	75	118
Twice (35, 50 days)	12.34	4.80	2.71	106	74	115

Source: Z.I. Sarker et al., 2006.

Table 8. Summary results from on-farm demonstrations with WRF-7 triticale in Bangladesh during 2001-02 and 2005-06

Number of cuts for green fodder	Year	Number of demonstrations	Green fodder (t/ha)	Dry mass (t/ha)	Straw yield (t/ha)	Grain yield (t/ha)
One cut (35 days)	2001-02	44	1.2-8.3 (3.65)	- -	- -	1.4-3.6 (2.07)
	2005-06	66	4.9-20.0 (10.58)	0.7-2.7 (1.43)	1.5-7.1 (3.51)	1.1-4.1 (2.07)
Two cuts (35, 50 days)	2001-02	44	1.4-14.8 (5.95)	- -	- -	1.3-3.2 (1.83)
	2005-06	79	7.0-28.0 (10.45)	1.1-4.3 (1.62)	0.8-6.2 (3.5)	0.9-3.5 (1.84)

Note: Figures in the parentheses represent mean of the range value.
Source: Z.I. Sarker et al., 2006.

Table 9. Uses of first cut triticale in North West Bangladesh, 2005-06

Fodder use	Percentage (Number of farmers)
Fed green fodder to cows	73.70 (123)
Dried fodder for hay and fed to cows by mixing with rice straw	6.60 (11)
Sold fodder	0.60 (1)
Fed green fodder + made hay and fed with rice straw	19.20 (32)
Missing data	0.60 (1)
Total	100 (167)

Source: N.R.Sarker et al., 2006.

Table 10. Farmer assessments of milk production and quality after feeding triticale green fodder, North West Bangladesh, 2005-06

Milk Production	Percentage (Number of farmers)
Production increased	99.4 (166)
No change	0.6 (1)
Not applicable	0.6 (1)
Quality improved	97.6 (164)
No change	0.6 (1)
Not applicable	1.8 (3)

Source: N.R.Sarker et al., 2006.

3.5 t/ha) were obtained from WRF-7 after two cuts on-farm(Table 8). Straw yields ranged from 0.8 to 7.1 t/ha dry mass(Table 1). These fodder yields with WRF-7 were 76 % larger than those measured in 2001-02, although grain yields were almost identical in both years (Table 8). We believe the improved yields of high quality green fodder achieved by farmers in 2005-06 was because the farmers managed their crops better after receiving training in the project.

Table 9 showed that about 74% of farmers fed triticale as green fodder to their cows. About 19% farmers made triticale hay, mixed it with rice straw and fed that to their cows.

Almost all farmers said that milk yield had increased by 30-100% in some cases(Table 10) and some reported that the quality of milk (in terms of fat content) had increased during January, February and March 2006. Therefore, the availability of green fodder during the lean season will be increased and some farmers plan to add additional cows to their herds soon.

V. Economic Analysis of Triticale Production in Bangladesh

Triticale could be grown both in favorable and unfavorable environments. In some cases, the fallow land was cultivated or wheat grown area was replaced for producing dual purpose triticale fodder. The cost of production of triticale was almost similar for wheat, maize but the gross return was the highest for triticale followed by maize and wheat. The undiscounted B/C ratio was the highest for lentil followed by triticale and maize or wheat(Table 11).

The cost of production of lentil was much lower than any competing crops or that of triticale. The gross margin of triticale based cropping pattern ranked the highest while the net return was the highest for potato based cropping pattern followed by Lentil-Fallow-T. Aman pattern. From the following discussion (in table 12 and 13)we attempt to estimate cost of production and net return of Triticale based on Bangladesh Agricultural Research Institute, 2006.

Table 11. Comparision of cost and benefit of triticale with other common crops in Bangladesh

Unit: Tk

Crop	Total cost (A)	Gross benefit (B)	Net income (B-A)	B/C ratio (B/A)
Triticale	32503.88	52750.00	20246.12	1.62
Wheat	33503.88	43000.00	9496.12	1.28
Maize	31450.50	48130.00	16679.5	1.53

Note: 1 US$ =70Tk

Source: Bangladesh Agricultural Research Institute, 2006.

Table 12. Costs of production of triticale per hectare

1) Non-material input costs:

Items of operation	Animal labor cost (Tk 60/pair/day)	Human labor cost (Tk 50/head/day	Subtotal of labor costs Tk/ha
Preparation of land by ploughing & laddering (5 times)	5 x 7=35	5 x 7=35	3850.00
Trimming of ails and removal of stubbles and weeds.	—	6	300.00
Carrying & application of manures and fertilizers	—	3	150.00
Seed treatment and sowing of seeds in rows	—	25	1250.00
Driving out of birds from the fields (5 days)	—	5	250.00
Weeding (2 times)	—	25 x 2=50	2500.00
Irrigation (2times)	—	4 x 2=8	400.00
Top dressing of fertilizer & spraying of insecticides.	—	3	150.00
Rouging	—	3	150.00
Harvesting & carrying	—	30	1500.00
Threshing, drying, cleaning & weighing	3	35	1930.00
Heaping of straw	—	5	250.00
Sub total of non-material input costs (A)			**Tk 12680.00**

2) Material input costs

Name of the material input	Quantity Kg/ha	Price rate Tk/kg	Cost Tk/kg
Seeds	140	25	1540.00
Fertilizer			
Urea	240	6.50	1560.00
TSP	190	14.00	2660.00
MP	75	10.00	750.00
Irrigation	—	—	1000.00
Pesticides	—	—	300.00
Miscellaneous	—	—	300.00
Sub total material input costs (B)			**Tk 8110.00**

Therefore, total input costs (TIC) = A+B = Tk. (12680.00 + 8110.00) = Tk. 20790.00

3) Overhead costs or fixed costs

Cost Item	Value (Tk)
Interest on input cost (12.50% per annum of 6 months)	1299.38
Interest on value of land (12.50% per annum of 6 months, value of land TK. 150,000.00)	9375.00
Miscellaneous fixed cost (5%of the variable cost arbitrarily)	1039.50
Sub total of overhead costs	**Tk 11713.88**

Therefore, total cost of production (TCP) = TIC + TOC = Tk (20790.00 + 11713.88) =Tk 32503.88

Table 13. Gross income of triticale based on the dual purpose

Production	Yield (Kg/ha)	Price rate (TK./kg)	Value (TK./ha)
Product (Triticale grain)	2500	9.00	40,500.00
By product (straw)	2500	.50	2250.00
Green fodder (Twice at 35, 50 DAS)	10000	1.00	10000.00
Total returns			**Tk 52750.00**

Net income per hectare

= Gross income - total costs of production

= Tk (52750.00 - 32503.88)

= Tk 20246.12

$$B/C = \frac{\text{Total return}}{\text{Total cost of production}} = \frac{52750.00}{32503.88} = 1.62$$

Based on the dual purpose Triticale with two cuts the net income per hectare was Tk 20246.12 and B/C ratio was 1.62 which is greater than 1. So production of dual purpose triticale could ensure better farm profitability to the small-scale dairy keepers. Therefore, it is recommended to strengthening and up-scaling of triticale program in Bangladesh.

VI. Conclusion

Dairying is a preferred option for many small-scale farm households in Bangladesh to increase their income and to accumulate assets. Fodder and feed scarcity, which is marked in the lean season, is a major factor limiting milk production on small-scale dairy farms in this country. Finding fodder technologies that complement current cropping patterns, practices and needs for feed with acceptable changes in inputs and risks are keys to satisfying the aspirations of many resource-poor Bangladeshis.

The on-farm experiments conducted throughout Bangladesh from 1999 to 2002 showed that 6-15 t/ha of fresh mass fodder can be produced

from two cuts within 50 days. Triticale crops can then grow on to yield 1.1-2.4 t/ha of grain for poultry feed or human food. The results suggest that farmers can easily harvest good amounts of fresh fodder and some grain produced with low amounts of inputs, including fertilizer and water. Feeding trials conducted by Bangladesh Livestock Research Institute(BLRI) indicated that cattle performance (as measured by live weight gain) increased significantly and contributed to higher dairy production. From the experimental results it was seen that dual-purpose triticale fits well into Bangladesh rice-based cropping systems to meet the demands for quality fodder and grain during the lean season. The crop grows well with a minimum field management of fertilizer and water. Staggered plantings of triticale from early November to mid December will provide a steady lean season fodder supply. Triticale straw was twice as nutritious as rice or wheat straw in Bangladesh. Thus, dual-purpose triticale has the potential to significantly reduce fodder and feed scarcity in Bangladesh, increasing smallholder milk and meat production.

From the last 6-7 years research station trial as well as farmer level demonstration results of triticale, simply it can be concluded that triticale is a forage as well as grain crop with good potential to significantly reduce the serious feed shortages faced by farmers during the lean season and increase the income of small-scale and commercial dairy and poultry producers in rural Bangladesh. Normally small farm holders will not be grown any crop from where they will get only fodder but if they find any crop from where they will get both fodder and grain, it will be easy to accept that crop to grow their field. As triticale can grow both for forage with good potential grain yield. So the prospects of triticale cultivation is bright for the farmers of Bangladesh if the Scientists can reach this message with efficient extension for wide adoption of triticale by the farmers of Bangladesh.

ABSTRACT

This paper reviews the present situation of Triticale cultivation and examines the potentiality of contribution to livestock as well as poultry sector in Bangladesh Agriculture. Triticale is a human-made cross between rye and durum wheat that has the ability to produce quality green fodder, and then re-grow after first and second cutting to produce grain. In Bangladesh, it is a non-traditional cereal that grows well during the cool and dry Rabi season (November-March) when fodder and feed scarcity is a major limiting factor for ruminant livestock. In Bangladesh Triticale was started to grow in the late Ninety's. The scientists of Bangladesh Agricultural Research Institute (BARI) were first introduced triticale in Bangladesh. Still now the situation of Triticale is grown as fooder and feed in Bangladesh within the scientists under trial. High quality grass fodder was obtained by

cutting green triticale plants twice, at 35 and 50 days after seeding, while later the ratooning tillers produced grain to a yield of 1.1-2.4 t/ha of grain for poultry feed or human food. Triticale straw was twice as nutritious as rice or wheat straw and its grain contained more protein than other cereals. Researchers and farmers have also successfully made triticale hay and silage from a mixture of triticale green cuttings, rice straw and molasses. A feeding trial at Bangladesh Livestock Research Institute(BLRI), Savar station showed a large(46%) increase in cow live weight gain and a 36% increase in milk yield (but no change in milk quality or dry matter intake) in cows fed triticale silage compared with those fed rice straw over a period of nine weeks. In another feeding trial, it was found that triticale grain was a good replacement for wheat in the feed blend for chickens in Bangladesh.

So it will be a good chance to alive our livestock as well as poultry sector if triticale enters to our existing cropping system as fodder cum grain. The challenge in Bangladesh is to identify fodder technologies that match existing small-scale farmer cropping patterns without needing major inputs or increasing risks. Preliminary field experiments revealed that triticale is a crop with good potential to produce quality fodder and grain for small scale farmers in Bangladesh

Key words: Triticale, Fodder, Feed, Farmers of Bangladesh

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Appendix 1. Mean intake of nutrient by lactating cows fed as triticale silage and rice straw with concentrate mixture at Savar, Bangladesh, 2005-06

Parameters means	Experimental groups		Level of significance
	Triticale silage group	Rice straw group	
Roughage dry matter intake (kg/d)	3.16 (0.06)	3.73 (0.04)	NS
Concentrate dry matter intake(kg/d)	3.84 (0.06)	3.18 (0.05)	NS
Total dry matter intake (kg/d)	7.00 (0.06)	6.91 (0.05)	NS
Total dry matter intake as % of live weight	2.87 (0.03)	2.79 (0.03)	NS
Total dry matter intake(g/kg W0.75/d)	113.00 (1.03)	110.74 (1.09)	*
Total ME intake (MJ /d)	49.06 (0.42)	48.42 (0.55)	*
Total MP intake (kg/d)	524.78 (4.77)	509.43 (5.89)	*

SE: standard error of mean; NS: Non-significant; ME: Metabolizable energy; MP: Metabolizable Protein; MJ: Mega joule; kJ: kilo joule; d: day; *Significant at 5% level.
Source: N.R Sarker *etal*.2006.

Appendix 2. Coefficient of digestibility of some nutrients in mid lactating cows fed triticale silage and rice straw at BLRI, Savar, Bangladesh, 2005-06

Parameters means	Experimental groups		Level of significance
	Triticale silage group	Rice straw group	
Dry matter (DM)	67.37 (1.94)	59.28 (1.94)	*
Organic matter (OM)	69.97 (5.75)	59.38 (5.50)	*
Acid Detergent Fiber (ADF)	59.15 (2.22)	56.93 (1.52)	*
Crude Protein (CP)	64.19 (4.23)	59.73 (3.89)	*
Ash	78.07 (0.71)	70.25 (0.95)	*

SE: standard error of mean; NS: Non-significant; *Significant at 5% level.
Source: N.R Sarker etal.2006.

Appendix 3. Effect of seed rates and row spacing on yield and other traits of dual-purpose triticale at WRSS, Dinajpur, Bangladesh, 2005-06.

	Seed rate (kg/ha)	Heading (days)	Maturity (days)	Plant height (cm)	Spikes/m^2	Grains/ spike	Green fodder (t/ha)	Straw yield (t/ha)	Grain yield (t/ha)
Effect of seed rates	100	76	115	105	215	48.3	8.77	5.62	2.96
	125	76	116	104	248	50.3	11.67	5.76	3.28
	150	77	116	105	260	48.6	10.78	5.83	3.33
	LSD (0.05)	NS	NS	NS	19.8	NS	1.36	NS	NS
	Spacing (cm) (line to line)	Heading (days)	Maturity (days)	Plant height (cm)	Spikes/m^2	Grains/ spike	Green fodder (t/ha)	Straw yield (t/ha)	Grain yield (t/ha)
Effect of row spacing	15	77	115	104	240	50.0	10.76	5.27	2.98
	20	76	115	104	241	48.6	10.47	5.91	3.28
	25	77	116	105	243	49.6	10.36	5.90	3.32
	30	76	116	105	241	48.1	10.03	5.87	3.18
	LSD (0.05)	NS	NS	NS	NS	NS	0.42	0.34	0.15

Source: Z.I. Sarker *etal*, 2006.