



## Outline

- Importance of hybrid rice for Bangladesh
- Expansion of R&D in hybrid rice
- Yield and profitability gains at farm level
- Conclusions

## Rice for food security in Bangladesh

- Rice accounts for 95% of staple food consumption
- It contributes to 70% of energy intake and half of the agricultural income
- Rice accounts for 30% of the consumption basket: 50% for the poor households
- Achieving self-sufficiency in rice production has always been a key element of government's agricultural policy

## Rice seasons in Bangladesh

Season/ Crop	Time of Crop establishment	Time of Harvesting	Area (million ha)	
			1969-70	2006-07
<b>Wet season</b>				
Deepwater aman	Mar-Apr	Nov	2.09	0.48
Transplanted aman	Jul-Aug	Nov-Dec	3.92	4.93
<b>Dry season</b>				
Traditional boro	Nov-Dec	Apr-May	0.65	0.14
Modern boro	Dec-Feb	May-Jun	0.24	4.59
Traditional aus	Mar-Apr	Aug-Sep	3.41	0.43

- Three rice seasons: Aus (pre-monsoon), Aman (monsoon) and Boro (winter)
- Farmers adopt varieties of rice to fit different elevations of land
- Area under low-yielding deepwater aman and aus rice has been diverted to grow irrigated boro rice and vegetables
- At present, transplanted aman and MV boro are dominant rice crops
- Hybrid rice is grown mostly in the boro season

## Trend in rice production, all seasons

	1969-71	1989-91	2005-07
Area (m.ha)	10.11	10.35	10.54
Yield (t/ha)	1.68	2.36	3.75
Production (m.ton)	17.05	24.29	39.55

Source: Bangladesh Bureau of Statistics

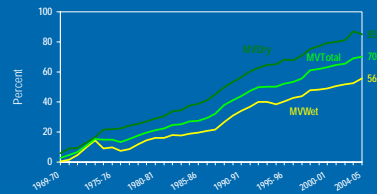
- Rice production more than doubled since independence in 1971
- Growth was slower than population during the first two decades
- Rapid progress achieved since late 1980s with a growth of production of 3.6 percent per year
- Technological progress and yield dominant factors behind growth

## Trend in rice production, wet and dry seasons

Acceleration of growth since late 1980s was almost entirely on account of dry season crops

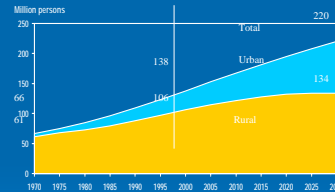
Irrigation based boro rice production has grown by over 5.2% per year during 1990-07 period: both from expansion of area and increase in yield

### The adoption of modern varieties has reached the ceiling in the dry season



- Modern varieties now cover nearly 70% of the rice area
- Coverage is almost complete in the irrigated dry season
- Coverage is still low (56%) in the wet season
- One-third of the land is deeply flooded, not suitable for growing dwarf MVs.
- Hybrid rice is a proven technology for further increase in yield in the dry season

### Challenges to food security from population growth



- Population is still growing by 2 million every year
- Rice supply must increase by half a million ton every year to feed the growing population
- The diffusion of hybrid rice is key to maintaining the demand-supply balance in future

### Evolution in hybrid rice R&D

- Bangladesh research system had not yet developed hybrid rice, though varieties are available in China and India
- The government allowed private sector companies to import hybrid seeds to make up the deficit in production after the disastrous floods in 1998
- It was stipulated that companies importing seed would produce seed in Bangladesh within three years
- A number of companies imported seeds from India and China for cultivation in the 1999 boro season
- Indian varieties did not perform well, but a Chinese variety, Sonar Bangla performed well with an yield gain of 20% over inbreds
- Since then a number of companies have been importing seeds from China

### Progress in hybrid rice breeding and seed production

- Bangladesh Rice Research Institute (BRRI) has a low-key hybrid breeding program through collaboration with IRRI since early 1990s
- A number of scientists were trained at IRRI for breeding and seed production
- BRRI developed a hybrid rice variety in 2001, but it was not accepted by farmers
- The government gave a special grant to BRRI to promote hybrid rice development but success remained limited
- A number of private sector companies have developed facilities for seed production with imported parent materials
- BRAC and Supreme Seed Co. Ltd has developed research facility for breeding
- BRAC has already succeeded in developing a hybrid variety and got is approved by the seed certification agency, and a few advanced lines are in the pipeline

### BRAC's Hybrid Rice Program

- Collaboration with the Chinese company
  - Parent line
  - Technical assistance from Chinese experts on seed production in Bangladesh
- Hybrid rice seed production through contract growers and in own farms
- Human resources in seed production
  - Graduate in Agricultural Science: 20
  - Diploma in Agricultural Science: 50
  - Trained in IRRI, BRRI, China, India, Philippines

### Status of Hybrid Rice in BRAC

- Evolution occurred in 3 steps
  - Direct seed import from India and China during 1998-2000
  - Import parent materials to produce seed in Bangladesh
  - Breed varieties with IRRI parent materials
- Released: 4 hybrid varieties
- Five advanced lines are under testing

## F1 Hybrid Rice



## Supply of hybrid rice seeds and expansion of area under hybrid rice

Year	Imports (ton)	Domestic production (ton)	Total supply (ton)	Estimated area (000ha)*
1999-00	150	0.3	150	9.7
2000-01	200	27	227	15
2001-02	215	143	320	23
2002-03	350	206	556	36
2003-04	621	182	803	52
2004-05	1080	392	1,472	95
2005-06	2250	685	2,935	189
2006-07	4650	1874	6,524	421
2007-08	7755	2271	10,026	647

Source: Interview of private seed companies and BADC  
Note: \* Estimated using the seed rate 15.5 kg/ha reported by farmers

## Expansion of capacity of domestic seed production

Organization	Seed production (tonnes)		Percent of total supply	
	2006	2008	2006	2008
BRAC	408	1131	58	100
Supreme Seed	212	550	17	15
ACI Ltd	-	250	-	12
Aftab B. Farm	35	150	14	25
East-West Seed	-	50	-	4
Mallica Seed	20	40	6	4
Others	10	100	1	20
Total	685	2271	29	23

•Many companies have Started producing seed within the country

•BRAC and Supreme Seed company have Developed substantial Capacity for seed Production

•In 2008, almost one-fourth of total supply came from domestic production

## Economics of hybrid rice farming: sources of data

- A sample survey of 120 hybrid rice growers conducted by BIRRI in three regions in 2005
- A national level sample survey on rice variety diversity conducted by IIRI in 2006
- A national level sample survey on rural livelihood systems conducted by Socio-consult Ltd for BRAC in 2008
- Data were collected through interviews using a structured questionnaire

## Yield gains in hybrids over inbred boro varieties, 2004 to 2007

Year	Yield (ton/ha)	Gain	% gain over inbred	
2004 survey (n=120)	7.20	5.80	1.40	24
2005 survey (n=781)	7.60	5.86	1.74	30
2007 survey (n=89)	7.32	5.81	1.51	26

- Hybrids are grown mostly in the boro season
- Hybrids gave about 1.4 to 1.74 ton higher yield compared to inbred boro varieties
- The yield advantage varied from 24 to 30% depending on the year
- If hybrid rice spread to all 4.5 million ha of boro land, Bangladesh can produce another 6.8 million tons of rice, enough to feed another 27 million people

## Yields of specific inbred and hybrid rice varieties in 2005

Varieties	No of cases	Mean yield (t/ha)	Coefficient of variation
<b>Inbreds</b>	<b>16,642</b>	<b>5.47</b>	<b>26</b>
BR 29	6,388	6.13	23
BR 28	5,310	5.11	22
BR 16	765	5.20	23
Bhajan	6.23	5.99	27
<b>Hybrids</b>	<b>785</b>	<b>7.32</b>	<b>22</b>
Heera	514	7.54	21
Jagoran	148	7.08	21
Sonar Bangla	77	6.28	30

- The highest yielding inbred variety is Brri Dhan 29 a long duration variety grown in low-lying areas
- The highest yield hybrid variety is Heera marketed by Supreme Seed Co. Ltd
- The yield of Heera is about 1.43 ton higher compared to Briddhan 29: an yield advantage of 23%
- Sonar Bangla, the lowest yielding hybrid (introduced in 1999) has an yield gain of 1.08 ton per ha compared to Briddhan 28, the lowest yielding short maturity boro variety (yield gain of 23%)

### Yield advantage of hybrid by socioeconomic groups, 2005 survey

Groups	Yield (t/ha)	% gain	T-value	
Farm size	Hybrid	Inbred		
Up to 0.4 ha	7.31	5.82	26	6.40
0.4- 1.0	7.35	5.52	33	14.26
Over 1.0 ha	7.76	6.11	27	5.66
Tenure				
Owner	7.67	5.99	28	6.45
Tenant	7.56	5.62	35	12.33
All farm	7.60	5.86	30	10.23

- Yield is marginally higher on larger farms both for inbreds and hybrids
- Yield gains in hybrids over the inbreds are almost the same for different farm size and land tenure groups

### Input use in hybrids and inbred rice farming, 2007

Inputs	Hybrid	BR29	BR28
Fertilizer (kg/ha)	403	364	342
Seed (Tk/ha)	1882	1198	1229
Pesticides (Tk/ha)	1043	675	785
Irrigation (Tk/ha)	9109	10,405	10,316
Labor (days/ha)	118	124	110
Total cost (Tk/ha)	50,091	50,851	48,672

- The seed cost is about 60% higher in hybrids
- Farmers take better care of the hybrids, as indicated by higher use of fertilizers and pesticides
- The cost of irrigation is however lower due to shorter maturity of the hybrids
- Total cost of cultivation is almost the same in hybrids and inbreds
- Part of the yield gains appears to be due to better crop management

### Profitability in hybrid rice farming, 2007

Items	Hybrids	BR 29	BR 28
Yield (t/ha)	7.32	6.04	5.39
Price (Tk/kg)	10.55	10.15	10.93
By-products (Tk/ha)	3,011	3,332	3,282
Gross Value (Tk/ha)	80,237	64,638	62,195
Costs of production (Tk/ha)	50,091	50,851	48,672
Net return (Tk/ha)	30,146	13,787	13,523

- The hybrids fetch 3.5% lower price in the market than the best quality inbred (BR 28)
- But the gross return is about 24% higher due to 30% yield gains
- The benefit-cost ratio is 1.68 for hybrids compared to 1.27 for Brrri Dhan 29 and 1.28 for Brrri Dhan 28
- The net return is about 1.2 times higher in hybrid cultivation compared to inbreds
- The hybrid rice farming is thus highly profitable

### Economics of hybrid seed production by contract seed growers, BRAC hybrids, 2007

Items	Jagoran		Alloran	
	Tk/ha	% of cost	Tk/ha	% of cost
Patent fees	43,926	35	45,006	33
Chemicals	26,868	21	31,830	22
Irrigation	11,115	9	11,509	9
Labor	30,710	24	35,050	25
Land rent	14,820	11	14,820	11
Total cost	127,440	100	138,210	100
Yield (kg)	1,487		2,870	
Cost (Tk/kg)	85.70		48.16	
Price (Tk/kg)	90.00		75.00	
Return (Tk/ha)	6,394		77,030	

- BRAC produces hybrid seed through contract growers
- It pays fees for parent lines imported from China
- The patent fees account for one-third of the cost of seed production
- The seed production is highly labor-intensive (320 days/ha)
- The profitability in seed production depends on seed yield
- For Alloran, the seed yield is about 2.87 t/ha but for Jagoran the yield is 1.49 t/ha
- For Alloran, farmers get a return of Taka 77,000, almost double the return from hybrid rice farming

### Farmers perceptions of quality of hybrid rice, BRR1 survey 2005

Quality/characteristic	Farmers reporting same or superior compared to inbreds (%)
Grain appearance	71
Taste of cooked rice	33
Stickiness of cooked rice	47
Bad smell	82
Expansion after cooking	49
Quality if kept longer after cooking	20

- Farmers complain of inferior quality of hybrid rice compared to inbreds
- Taste of cooked rice and deterioration of quality of cooked rice when kept for next meal are major quality concerns
- Traders mix hybrid rice with inbred varieties for marketing

### Farmers' perception of hybrid rice, BRR1 survey 2005

#### Positive aspects

- Higher yields compared to inbreds
- High tillering ability
- Shorter maturity compared to BRR1 dhan 29
- Lodging resistance compared to BRR1 dhan 28

#### Negative aspects

- Cannot keep seed from own harvest
- High price of seed
- Poor quality of cooked rice
- Sluggish market demand leading to lower prices

78% of the sample farmers wanted to continue hybrid rice cultivation in the next season

## Conclusions

- Hybrid rice farming has expanded rapidly in recent years and has reached about 12% of dry season area
- The expansion is however based on import of hybrid seeds and parent lines from China by the private sector
- Bangladesh has made limited progress in developing hybrid varieties in the NARS system
- The hybrids are grown mostly in the boro season and give 20 to 30% yield gains compared to the best inbreds
- Part of the yield gains is due to better crop management practices
- Hybrid rice farming is highly profitable despite price disadvantage due to inferior grain quality

## Policy implications

- Bangladesh should promote hybrid rice farming to meet the growing food needs from increasing population
- The government should promote public-private sector collaboration for development of hybrid rice and seed production in Bangladesh
- BRRI may focus its efforts for testing suitability of hybrid varieties imported by the private sector
- The public sector may also organize training of farmers on hybrid rice seed production
- Bangladesh must also evaluate suitability of hybrid production from the monsoon and pre-monsoon seasons

## Thank you