

Climate Change and Wheat Production in Drought Prone Areas of Bangladesh – A Technical Efficiency Analysis

Presented by-

ASM Golam Hafeez

Associate Professor

Department of Agricultural Finance, Faculty of Agricultural Economics, Bangladesh Agricultural University, Mymensingh, Email: ghkennedy01@yahoo.com

Outline of the presentation

- **Background information**
- **Objectives**
- **Methodology**
- **Major findings**
- **Conclusion and Policy Implication**

BACKGROUND

- Bangladesh is known as one of the most vulnerable countries to climate change;
- Many of the anticipated adverse effect of climate change such as Sea level rise, higher temperature, enhanced monsoon precipitation and increase in drought intensity aggravate the development of Bangladesh, particularly food security;
- Wheat is the second most important cereal crop in Bangladesh, can play a significant role towards ensuring food security and employment generation;
- Enhancing technical efficiency of wheat is necessary as there is limited scope for further expansion of cultivated area;

OBJECTIVES

- i. to assess production variability of wheat due to adverse effect of climate change;
- ii. to estimate variability in cost, return and profitability of wheat due to climate change;
- iii. to estimate the technical efficiency of wheat production under changing climatic condition.

METHODOLOGY

Study Area, Sample Size , Sampling Technique And Data Collection

- Thakurgaon district was purposively selected from drought prone AEZ of NW Bangladesh.
- The study employed farm level cross sectional data taken from 100 farmers using simple random sampling technique from three upazilas of Thakurgoan district of Bangladesh.
- Selected three upazilas were Thakurgaon sadar, Ranishankail and Pirganj upazila
- Data were collected throgh direct interview with the farmers using pre-designed interview schedule based on the year 2006 and 2007.



Analytical Technique

- The program FRONTIER 4.1 was used to estimate of the parameters of Cobb-Douglas stochastic frontier production function and technical inefficiency effect model for wheat production.
- **Production Variability Analysis**

To estimate the production variability of wheat the following semi-logarithmic regression model was used:

$$\ln Y = \beta_0 + \beta_1 D_1 + U \quad (1)$$

Where,

\ln = Natural logarithm ;

Y = Output of wheat (kg/ha) ;

D_1 = Dummy for drought (1= drought occurrence in the study area; 0=otherwise)

β_1 = Slope coefficient of dummy for drought

U = Random error term



Analytical Technique

Profitability analysis

i. Net Return Analysis

To determine the net returns following equation was used for each of the selected farmers:

$$\Pi = P_m * Y_m + P_b * Y_b - \sum_{i=1}^n (P_{x_i} * X_i) - TFC \quad (2)$$

Where,

Π = Net return;

P_m = Price of main product per unit ;

Y_m = Total quantity of main produce ;

P_b = Price of by-product per unit ;

Y_b = Quantity of by-product ;

P_{x_i} = Price of ith input per unit used for wheat production ;

X_i = Quantity of the ith input used for wheat production ;

TFC = Total fixed cost

$i = 1, 2, 3, \dots, n$ (number of input)



Analytical Technique

ii .Benefit-Cost Ratio (BCR) (Undiscounted)

Benefit-Cost Ratio = Present net worth of benefits/ Present net worth of cost

➤ Technical efficiency analysis

The stochastic production function of Cobb-Douglas form for the sample wheat growers was specified by following equation:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + V_i - U_i$$

Where,

\ln = Natural logarithm ;

Y = Observed farm output (kg/ha) ;

X_1 = Area under wheat cultivation (ha) ;

X_2 = Seed (kg/ha);

X_3 = Human labor (man-days/ha) ;

X_4 = Pesticide (kg/ha) ;

X_5 = Tillage cost (Tk/ha) ;

X_6 = Irrigation cost (Tk/ha) ;

X_7 = Manure (kg/ha);

X_8 = Fertilizer (kg/ha) ;

β_i = Unknown parameters to be estimated

$V_i - U_i$ = Error terms



Analytical Technique

Technical inefficiency effect model

The technical inefficiency effects U_i 's can be defined as

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + W_i$$

Where,

Z_1 = Education level (Years of schooling) ;

Z_2 = Family size (Persons /family) ;

Z_3 = Farming experience (Years)

Z_4 = Dummy for credit (1= credit receiver; 0=otherwise)

Z_5 = Dummy for extension contact (1= linkage with extension service; 0=otherwise)

Z_6 = Dummy for training (1=trained; 0=otherwise)

Z_7 = Farm size (ha)

δ_i = Parameters of the respective technical inefficiency variable to be estimated
($i=1, 2, \dots, 7$)

W_i = Unobservable random variables or classical disturbance terms



MAJOR FINDINGS

Table.1 Effect of drought on wheat production

Variable	Coefficient	Standard error	t value	Significant
Constant	3.281	0.069	47.69	0.000
Dummy of Drought	-0.174	0.097	-1.781	0.076

Wheat production was decreased by 17.4 percent on an average due to drought occurrence in the drought year in the study areas.

Climate change - mainly occurrence of drought leads to significant reduction in wheat production in 2006 but due to favourable climate wheat production increased in 2007.



MAJOR FINIDNGS

Table.2 Gross return, gross margin, net return and benefit-cost ratio of wheat in normal and drought years (Per hectare)

Sl. No.	Particulars	Normal year	Drought year
A	Gross return	86858.13	51650.13
B	Total variable cost	41915.06	39553.11
C	Gross margin(A-B)	44943.07	12097.02
D	Total fixed cost	9880.00	9880.00
E	Total cost (B+D)	51795.06	49433.12
F	Net return(A-E)	35063.07	2217.01
G	BCR(undiscounted)(A/E)	1.68	1.04

Wheat production costs/ha were Tk. 51795.06 and Tk. 49433.12 in the normal and drought years respectively.

Gross returns/ha were Tk. 86858.13 and Tk. 51650.13 in normal and drought years respectively.

Benefit cost ratio (BCR) corresponding to the normal and drought years were 1.68 and 1.04.



MAJOR FINIDNGS

Table.3 ML estimates of the parameters of Cobb-Douglas stochastic frontier production function for wheat

Variable	Parameters	Normal year		Drought year	
		Coefficient	Standard error	Coefficient	Standard error
Intercept	β_0	1.2020*	0.5857	0.1602	1.0163
Area	β_1	-0.3066	0.0687	-0.2927	0.1479
Seed	β_2	0.5267**	0.1201	0.6876**	0.1128
Human labour	β_3	0.2216	0.166	-0.1315	0.1405
Pesticide	β_4	0.0066**	0.0020	-0.0025	-0.0030
Tillage Cost	β_5	0.2540**	0.0671	0.2477*	0.0987
Irrigation Cost	β_6	-0.0577	0.8302	0.2070**	0.0579
Manure	β_7	0.0866	0.0622	-0.0252	0.0537
Fertilizer	β_8	0.1772**	0.0641	0.1700*	0.0793

** indicates significant at 1 % ; * indicates significant at 5 %

MAJOR FINDINGS



Table.4 ML estimates of the parameters of technical inefficiency effect model for wheat

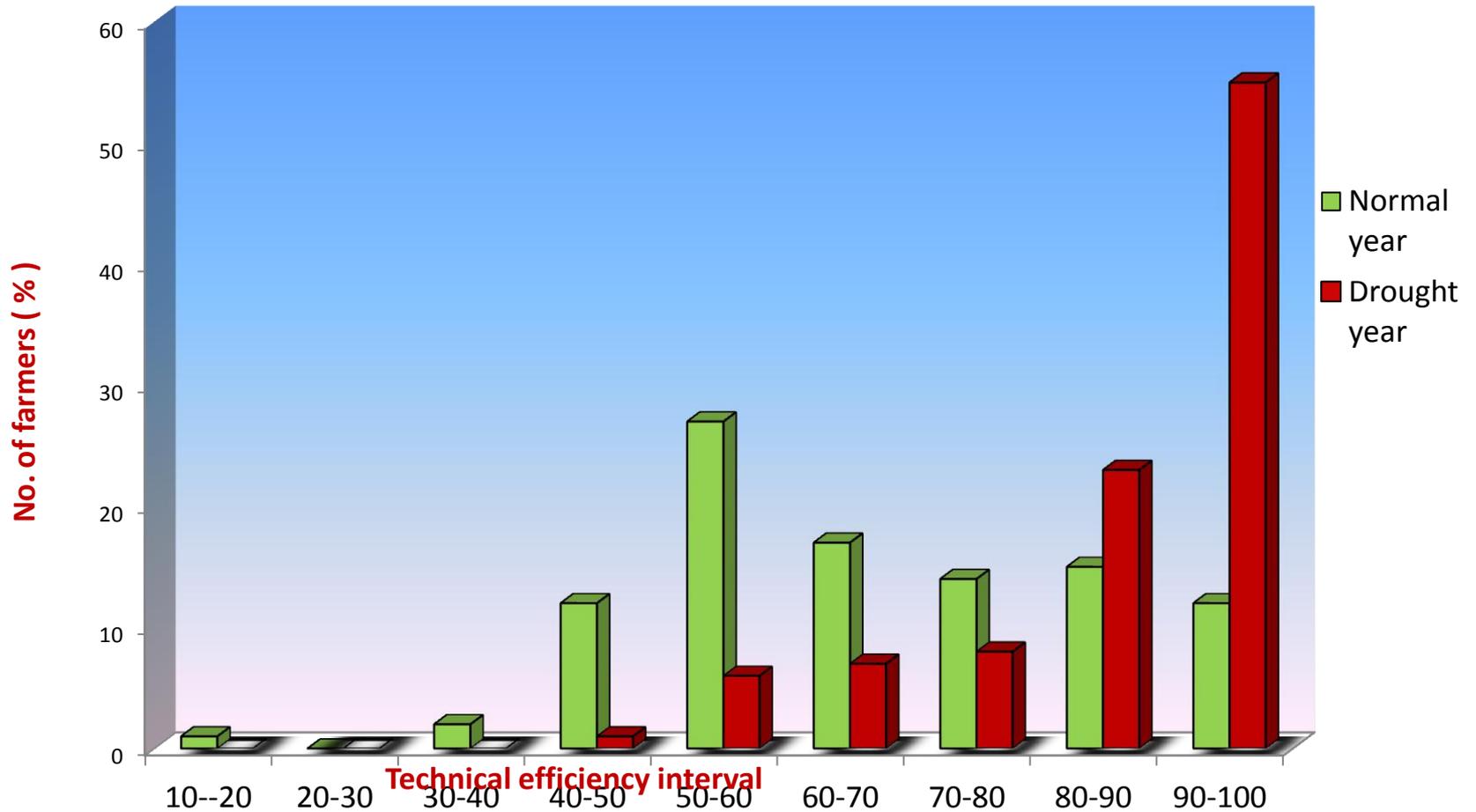
Variable	Parameters	Normal year		Drought year	
		Coefficient	Standard error	Coefficient	Standard error
Intercept	δ_0	0.4665*	0.2258	0.2385	0.1980
Education	δ_1	0.0186	0.0193	0.0502*	0.0199
Family size	δ_2	-0.0025	0.1263	0.0152	0.0293
Farming experience	δ_3	-0.0027	0.0089	-0.0011	0.0089
Credit (dummy)	δ_4	-0.2835	0.1485	-0.2787*	0.1305
Extension contact (dummy)	δ_5	0.0802	0.1438	-0.1150	0.1180
Training (dummy)	δ_6	-0.0582	0.1331	-0.1631	0.0928
Farm size	δ_7	-0.0065	0.0521	-0.0890	0.0627
Sum of coefficients	-	0.908	-	0.860	-
Sigma squared	σ^2	0.1101**	0.02493	0.0677**	0.0199
Gamma	γ	0.9999**	0.00099	0.2315	0.6295
Log Likelihood function	-	0.5817	-	-0.4712	-

** indicates significant at 1% ; * indicates significant at 5 %

MAJOR FINDINGS



The frequency distribution of the technical efficiency



MAJOR FINDINGS



Table.5 Mean , maximum & minimum efficiency in normal and drought

particulars	No. of farmers	
	Normal year	Drought year
Mean efficiency	67.00	86.4
Maximum efficiency	99.8	98.5
Minimum efficiency	16.7	48.7

- ✓ Technical efficiency varied from 16.7 to 99.8 percent for wheat growers in normal year;
- ✓ While technical efficiency varied from 48.7 to 98.5 percent in drought year;
- ✓ The mean technical inefficiency was 67.00 percent in normal year and 86.4 percent in drought year implied farmers were 19.4 percent more efficient in drought year than that of normal year.



CONCLUSION AND POLICY IMPLICATION

- Production of wheat is profitable in favourable climate and less profitable in unfavourable climate;
- On an average, wheat production has decreased by 17.4 percent due to drought;
- The findings of the study showed that wheat growers were efficient in wheat production and able to produce maximum output with existing inputs;
- Mean technical efficiency showed that there was a huge potential for increasing wheat production through improvement of technical efficiency of wheat growers in the normal and drought years;
- Farmers were more efficient in using existing inputs and technology to cope with adverse effect of climate change on production.



CONCLUSION AND POLICY IMPLICATION

- Farmers should be provided additional training on climate change adaptation strategies, extension services, micro- credit to operate their farm efficiently;
- Initiatives related to climate change adaptations should be made through field-level application and community involvement;
- Government should take immediate initiative for creating awareness among farmers about vulnerability to climate change and to frequent drought occurrence;
- Integrated efforts should be made by the government as well as NGOs and international organizations to mitigate the impact of drought.



Making Research on Climate Change in Bangladesh More Effective

- THANK YOU -

ASM Golam Hafeez
Associate Professor

Department of Agricultural Finance, Bangladesh
Agricultural University, Mymensingh, Bangladesh

E-mail: ghkennedy01@yahoo.com

[insert logo here if
applicable]

