Drought Impact on Rice Production in Northwest Region of Bangladesh

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Background

Bangladesh is an agricultural country and rice is the main crop (covers >70% land), which requires a large amount of water. Though most of the parts of Bangladesh are more or less prone to adverse impacts of climate change, northwest region is particularly sensitive because of prolonged drought. With climate change, more area would be exposed to severe droughts because of projected change in rainfall pattern and dry spell frequencies. Beside technological (seed, management, site characters etc.) development, non-technological factors (rainfall, temperature and solar radiation etc.) are also important for crop production.

Major Questions

- What is the seasonal pattern of drought in the northwest region of Bangladesh?
- Is rice production hampered by drought?

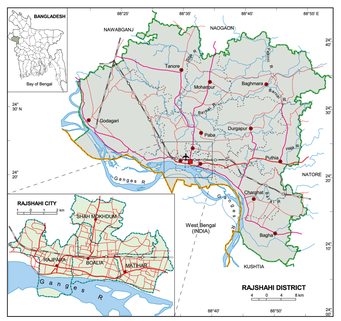
Methodology

Study area: Rajshahi district of Bangladesh.

Draught measurement: The Standardized Precipitation Index (SPI):

$$SPI = \frac{Xi - \bar{X}}{\sigma}$$

Xi, *X* and σ are ith year precipitation, long term mean of precipitation and standard deviation of mean, respectively.



Study area

Diurnal temperature range (DTR): Tmax - Tmin.

The rice productivity index (CPI):

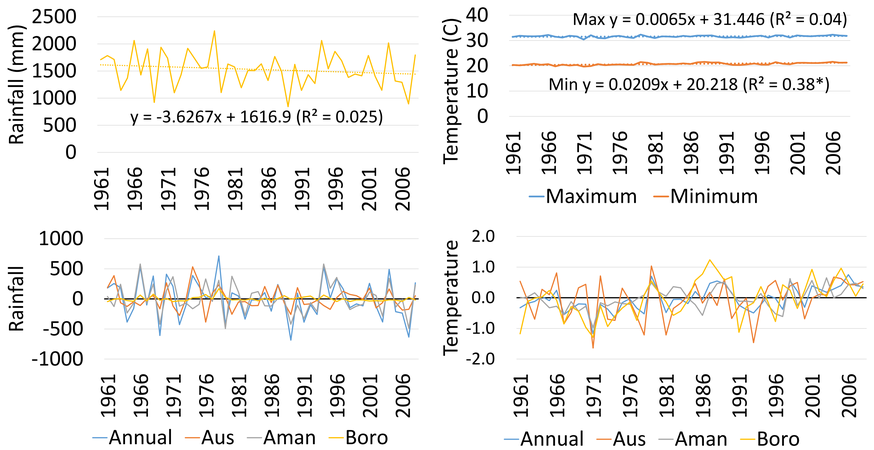
$$CPIi = \frac{(Pi - TPi)}{TPi} 100$$

Pi is the actual productivity for the *i*th year and TP*i* is the technological trend productivity for the *i*th year.

Rainfall and temperature data were separated and analyzed corresponding to *aus* (March to July), *aman* (July to November) and *boro* (November to March) rice seasons.

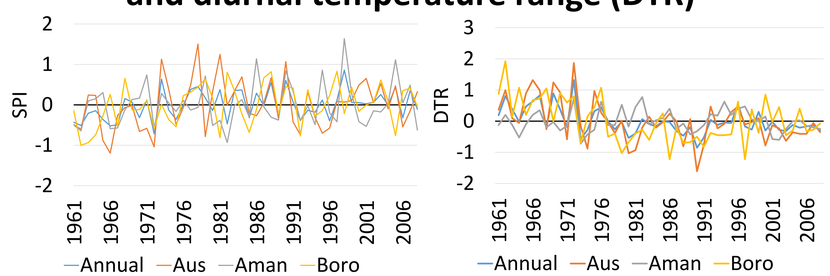
Findings

Trends and variability of rainfall and temperature



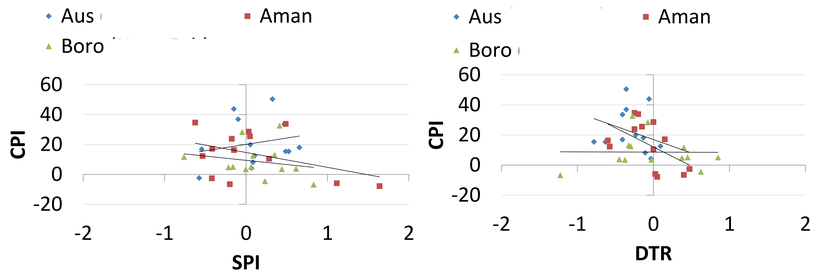
Long-term (1961-2009) data showed a decreasing trend of rainfall and the rate was 3.62 mm per year. Increment rate of minimum temperature was significantly ($P < 0.05$) higher than the maximum. Among the seasons, decreasing rainfall and increasing temperature was comparatively high during *boro* season.

Trends of standardized precipitation index (SPI) and diurnal temperature range (DTR)



The SPI values indicate frequent droughts in recent years, particularly during *boro* season. DTR shows a decreasing trend. Frequent droughts and decreasing DTR are harmful for crop production.

Rice productivity index (CPI) vs SPI and DTR in different rice seasons



Rice productivity index (CPI) and seasonal SPI have insignificant relationships for all rice seasons, while the relationship between CPI and DTR was significant ($P < 0.05$) for *aman* rice.

Rice productivity index, SPI and DTR relationship regression equations and statistics (R^2 and SE)

Season	Regression equation	R^2	SE
Aus	Y = 17.012 + SPIi(0.8089) + DTRi(-17.2472)	0.14	5.521
Aman	Y = 12.921 + SPIi(-8.45) + DTRi(-23.088)	0.41*	3.760
Boro	Y = 10.22 + SPIi(-12.52) + DTRi(-6.894)	0.10	3.625

Among rice seasons, rice productivity index (CPI) and SPI and DTR have significant ($P < 0.05$) multiple regression for *aman* rice. It indicates that seasonal distribution of rainfall in terms of SPI and variation of temperature in terms of DTR accounted for 41% yield variability in *aman* rice.

Conclusion

Frequent droughts and a decreasing DTR are observed in the northwest region of Bangladesh. Although prolonged droughts are found in *boro* season, rice production has been affected significantly during *aman* season due to uncertainty of rainfall and diurnal variation of temperature because of its rainfed nature. Rice production during *boro* season did not affect significantly due to development of irrigation facility. Suitable technologies and varieties should be introduced to sustain the rice production in northwest part of Bangladesh under changing climate.

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