Simulating rice yield in Bangladesh

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Rice simulation models

- Over 30 simulation models (as literature shows). In addition, there are few disease & pest models
- Four approaches:
  - Wageningen: Current IRRI models
  - USA: Ceres models under DSSAT platform
  - Japan: Simple models (SIMREW, VSM)
  - Australia: APSIM platform (previous model “maNage Rice”

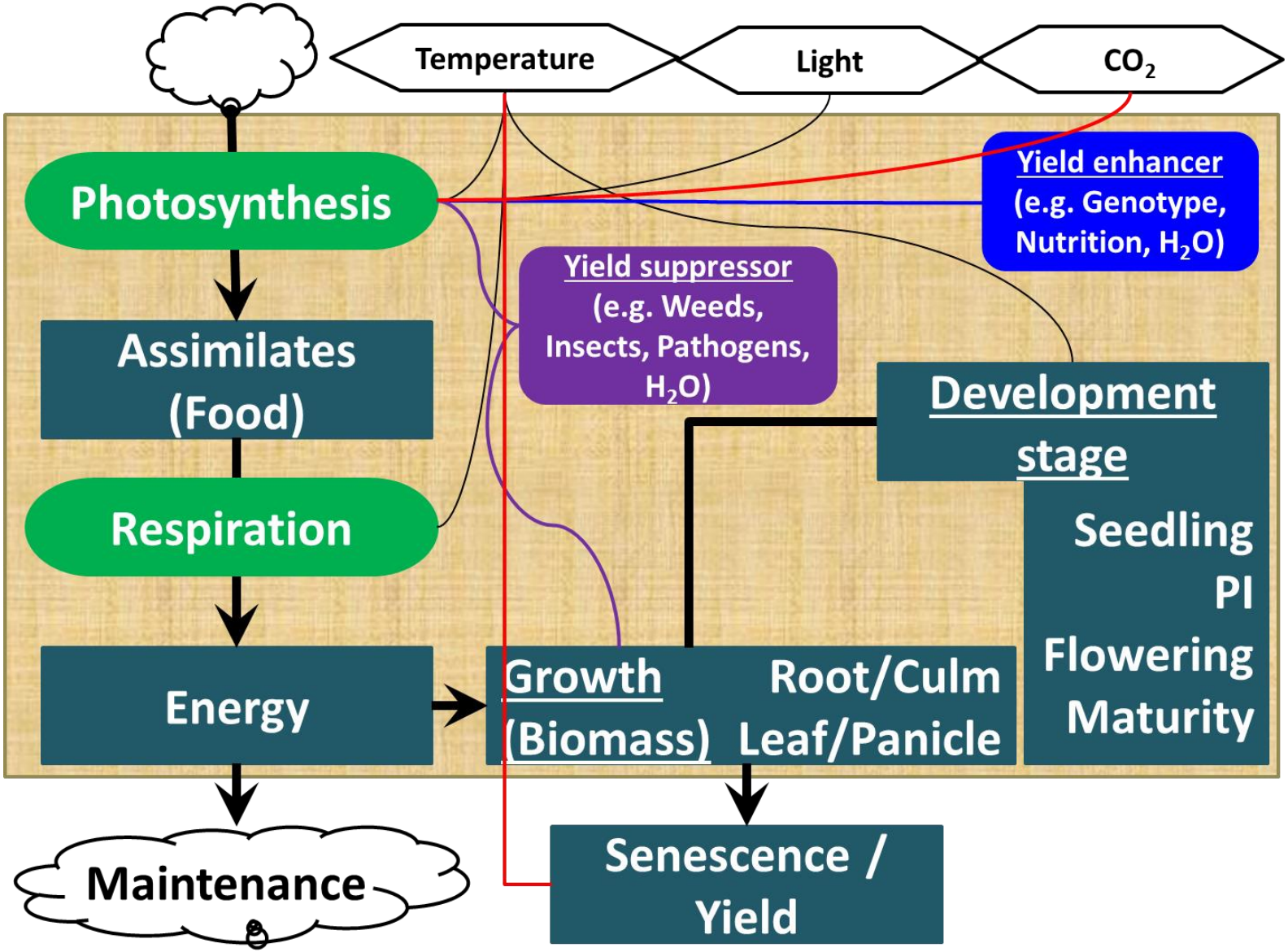
“RYSIM” & Why another model?

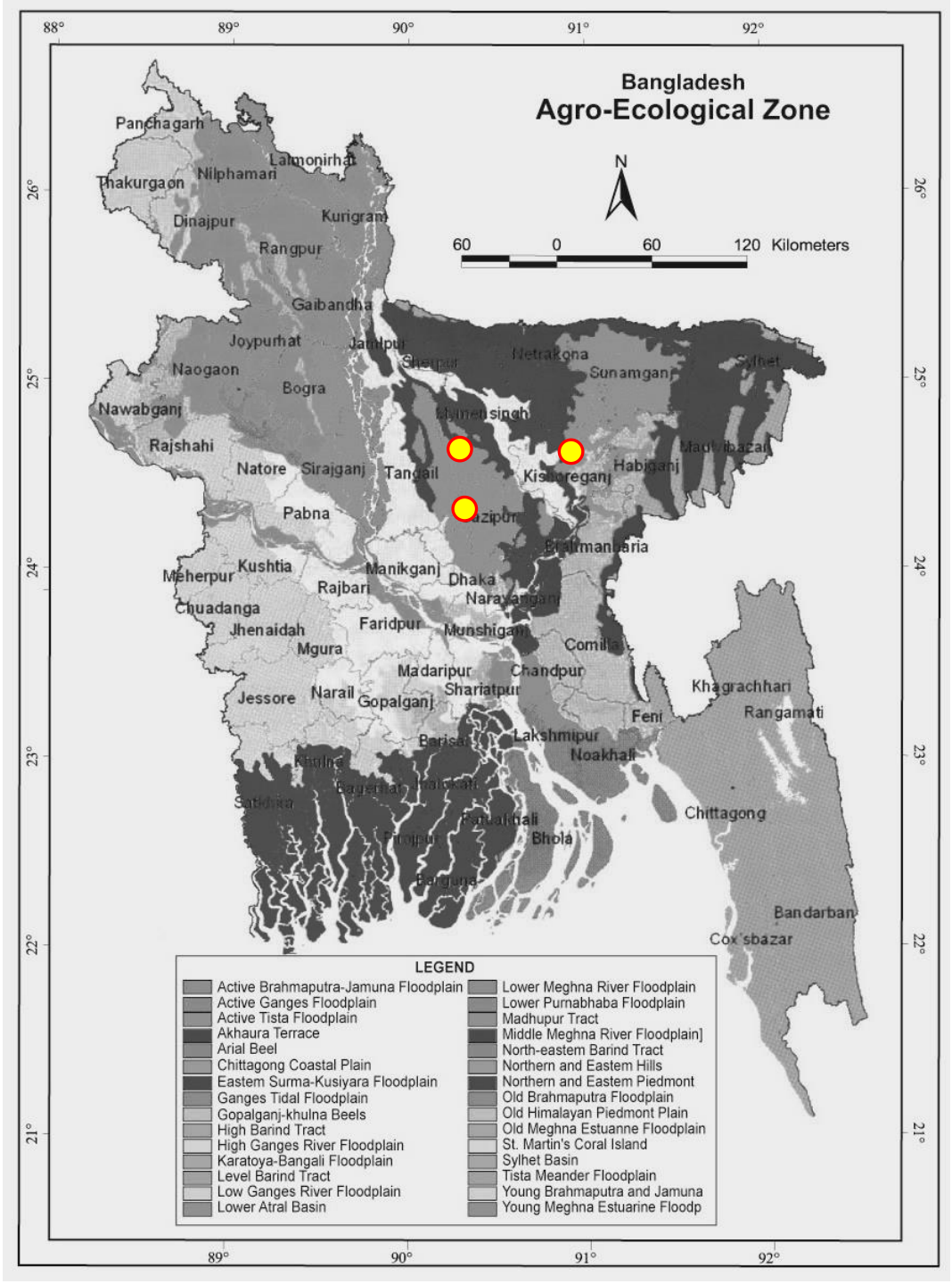
- RYSIM is a revised version of “RIBHAB” model based on Wageningen approach (*Agricultural Systems*, 1994, Volume 46, Issue 3)
- RYSIM
  - is much simpler than IRRI models
  - has few processes newly developed
  - is built in MS-Excel (no programming skill required)
  - is transparent & easy to modify and/or calibrate

The model “RYSIM”

- RYSIM simulates potential yield of transplant rice , not constrained by water, nutrition & yield suppressors except for weather
- Model iteration: 1 day
- Inputs:
  - Weather: Daily maximum & minimum temperature, solar radiation (or sunshine hours)and seasonal CO_2 concentration
  - Crop planting: Date of seeding & age of seedlings to be transplanted
  - Model iteration: 1 day
- Outputs: All growth & development attributes including yield

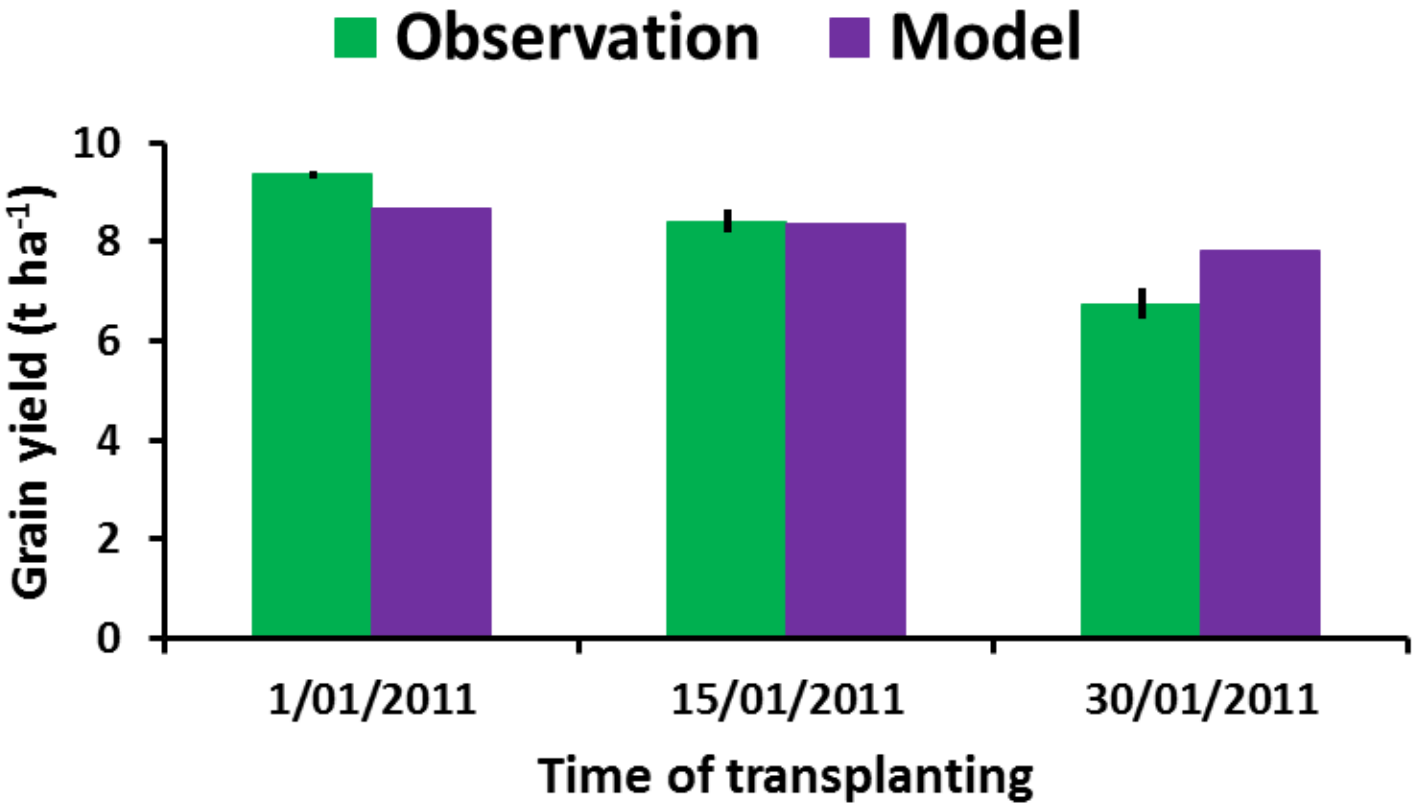
The blue-print of the model “RYSIM”





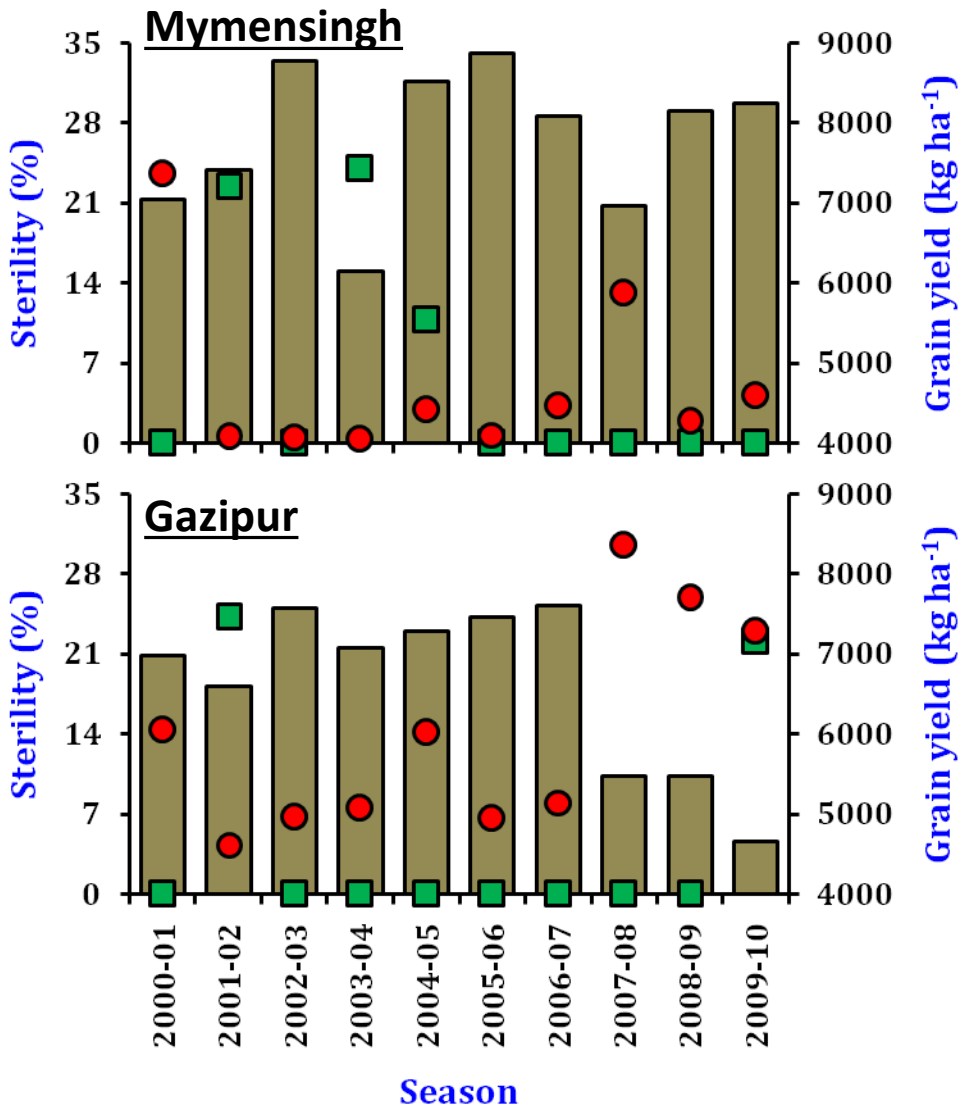
Model testing and application using 'BRRI dhan29' for Boro rice (winter irrigated rice)

Model testing: Mymensingh, seedling age 36 days



Data source: PhD Thesis 2016, Department of Agronomy, Bangladesh Agricultural University (BAU)

Model simulation: seasonal & regional yield variation



Grain yield

Low temperature induced sterility

High temperature induced sterility

Mymensingh: 7821±554 kg ha^{-1}
Gazipur: 6617±650 kg ha^{-1}
± is 95% confidence interval

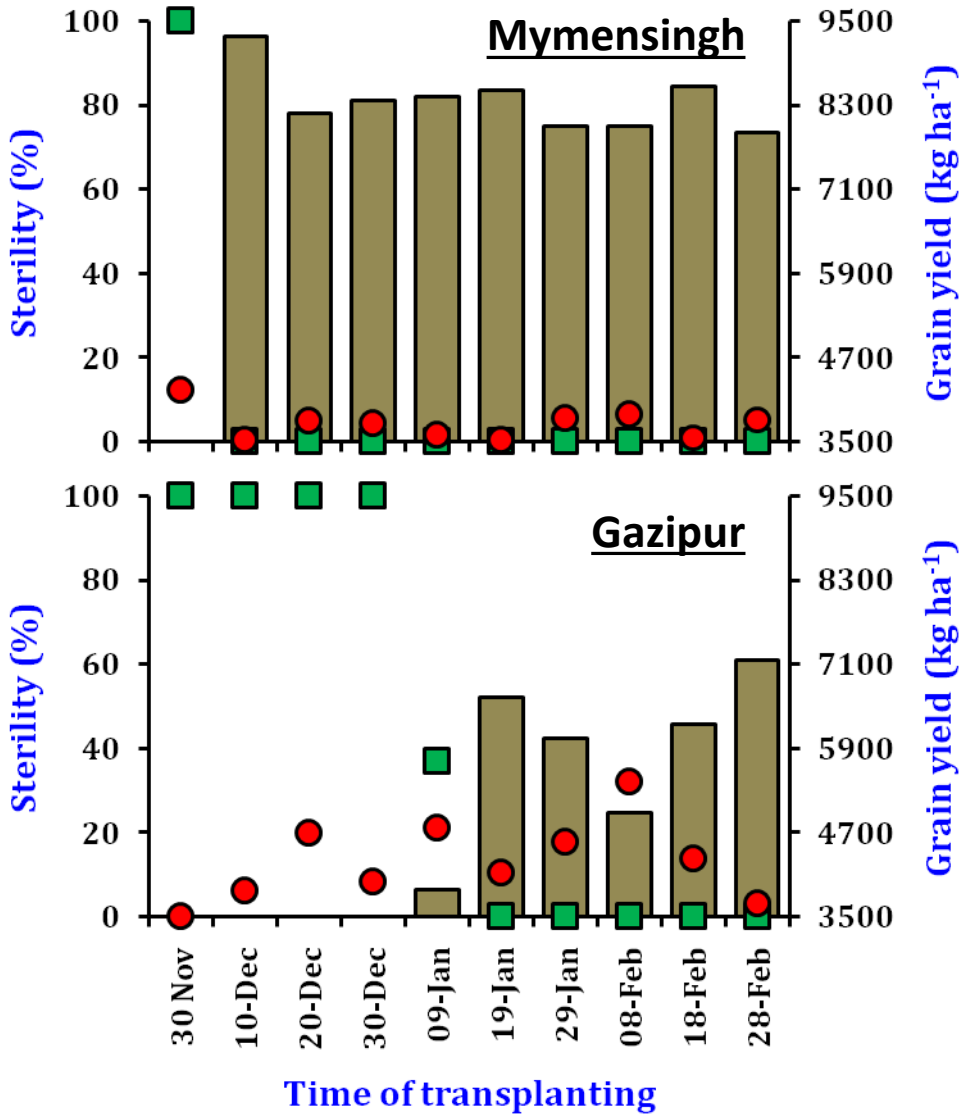
Seedling age: 45 days
Time of transplanting: 10 January

Model simulation: seasonal & regional yield variation

Regression of yield against low and high temperature induced sterility

Location	Intercept	Coefficient: Low T induced sterility	Coefficient: High T induced sterility	*P*	R^2
Mymensingh	8628.42	-70.47	-80.01	0.02	0.68
Gazipur	8225.32	-55.61	-85.85	0.001	0.95

Model simulation: yield × transplanting time in 2009-10



Grain yield

Low temperature induced sterility

High temperature induced sterility

Mymensingh: 78524±1657 kg ha^{-1}
Gazipur: 3496±1944 kg ha^{-1}
± is 95% confidence interval

Seedling age: 45 days
Growing season: 2010-11

Model simulation: climate change, Mymensingh region

Year	CO_2 (ppm)	Grain yield (kg ha^{-1}) by transplanting date			High temperature induced grain sterility (%)		
		1-Jan	15-Jan	30-Jan	1-Jan	15-Jan	30-Jan
2000-11	379	7719 (0%)	7359 (0%)	7017 (0%)	2	1	1
2029-30	427	6486 (16%)	5833 (21%)	5066 (28%)	3	3	14
2069-70	503	5767 (25%)	2367 (68%)	3857 (45%)	5	59	30

Seedling age: 36 days

Future of the model "RYSIM"

- RYSIM, at its current state, has potential for estimating yield and production of *Boro* rice (irrigated winter rice) in Bangladesh – needed weather data.
- RYSIM can be modified and/or further simplified to estimate yield and production in other seasons (*Aus* and Transplant *Aman*) in Bangladesh
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