

Table 2: Summary of the performance of CSM-CERES-Rice model to simulate phenology, growth, and yield for different management practices in south Asia and China.

S. No	Experiment	Variables										References				
		Anthesis	Maturity	LAI/Leaf area	Grain yield	Flowering /Pl/other stages	Above ground biomass	Grain No./ No. of ears/ m ²	Grain size/ weight	N uptake	ET		SWC/ moisture	HI grain/m ²		
1	Elevation and precipitation/ multiple planting methods and cultivars	✓	✓		✓										China	Zhou <i>et al.</i> , 2022
2	RMSE	2.8 to 5.9	2.7 to 6.2		652-754										China	Tian <i>et al.</i> , 2021
3	Different irrigation methods (water-saving irrigation)	✓	✓		✓										China	Tian <i>et al.</i> , 2021
4	R ²	0.6-0.8	0.6-0.8		0.6-0.9										Pakistan	Anser <i>et al.</i> , 2020
5	Adaptation Strategies/ Climate Change	✓	✓		✓										India	Jha <i>et al.</i> , 2020
6	RMSE	1.58	2.91		273										China	Gua <i>et al.</i> , 2019
7	Different management strategies	✓	✓		✓										China	Zhang <i>et al.</i> , 2019
8	RMSEn	2.75%	1.04%		4.04%										India	Kant <i>et al.</i> , 2018
9	Climate Change	✓	✓		✓										China	Zhang <i>et al.</i> , 2018
10	RMSEr ²	13-17	13-18		11-15										India	Debnath <i>et al.</i> , 2018
11	Climate change	✓	✓		✓										India	Shrivastava <i>et al.</i> , 2018
12	Rice cultivars/different N-levels	✓	✓		✓										China	Zhang <i>et al.</i> , 2018
13	RMSE	2.1-6.12	5.9-9.8		197-499										India	Debnath <i>et al.</i> , 2018
14	Different varieties and N rates	✓	✓		✓										India	Shrivastava <i>et al.</i> , 2018
15	R ²	5.4%	6.9%		0.71										China	Lv <i>et al.</i> , 2018
16	Irrigated/rainfed/soil variation	✓	✓		✓										India	Mehdi <i>et al.</i> , 2017
17	RMSEn	5.4%	6.9%		14.5%										India	Goswami <i>et al.</i> , 2016
18	Soil moisture and evapotranspiration simulations	✓	✓		✓										India	Vysakh <i>et al.</i> , 2016
19	RMSE	2.1-2.4			1039-1186										India	Mote and Kumar, 2016
20	Climate change	✓	✓		✓										India	Subba Rao <i>et al.</i> , 2016
21	Cultivars/varying levels of nitrogen.	✓	✓		✓										India	Kadiyala <i>et al.</i> , 2015
22	Error	-23 to +10%			-19 to +8%										India	Bhuvaneshwari <i>et al.</i> , 2014
23	Climate Change/irrigated/rainfed.	✓	✓		✓										China	Zhou <i>et al.</i> , 2019
24	Establishment methods/rainfed, aerobic and flooded systems.	✓	✓		✓										Sri Lanka	Dharmarathna <i>et al.</i> , 2014
25	RMSE	4-11	6-10		84-687										Pakistan	Ahmad <i>et al.</i> , 2013
26	Climate change	0.86	1.8		0.97										China	Zhang and Tao, 2013
27	R ²	0.83	0.79		0.77										India	Dass <i>et al.</i> , 2012
28	Cultivar/elevated carbon dioxide and temperature	3	6		800										India	Shammim <i>et al.</i> , 2012
29	Difference	✓	✓		✓										India	Shammim <i>et al.</i> , 2012
30	Planting date/4 varieties	✓	✓		✓										India	Shammim <i>et al.</i> , 2012
31	Three plant densities/five irrigation regimes	✓	✓		✓										India	Shammim <i>et al.</i> , 2012
32	RMSE	1.12-1.29	333-395		365-385										India	Shammim <i>et al.</i> , 2012
33	Climate change/Variability in different climatic zones	✓	✓		✓										India	Shammim <i>et al.</i> , 2012
34	RMSE	2.2-6.2			✓										India	Shammim <i>et al.</i> , 2012
35	Weather-based rice yield models	✓	✓		✓										India	Shammim <i>et al.</i> , 2012
36	R ²	0.71-0.99			1822										India	Shammim <i>et al.</i> , 2012
37	Two rice varieties/SRI/three irrigation schedules and two planting spacings	✓	✓		✓										India	Shammim <i>et al.</i> , 2012
38	%d:	5-11.4%			166										India	Shammim <i>et al.</i> , 2012
39	Simulating the phenology, growth and yield of aromatic rice cultivars	✓	✓		✓										India	Shammim <i>et al.</i> , 2012
40	RMSE	4.28	0.23		1.58										India	Shammim <i>et al.</i> , 2012

Table S3: Summary of the performance of CSM-CERES-Maize model to simulate phenology, growth, and yield for different management practices in south Asia and China.

S. No	Experiment	Variables										References				
		Anthesis	Maturity	LAI/Leaf area	Grain yield	Emergence/other stages	Above ground biomass	Grain No./ No. of ears/m ²	Grain size/ weight	Grain filling duration	Grain/Biomass/canopy protein/ Nitrogen/N uptake		ET SWC	WUE/CWP/ FUE	HI gram/N	
1	Planting density and cultivars	✓	✓		✓		✓								China	Zhang <i>et al.</i> , 2022
	RMSE	0-5.7	0-5.7		17-1201		844-3733									
2	Temperature and heat stress/ different cultivars in different maize planting regions	✓	✓		✓										China	Huang <i>et al.</i> , 2021
	RMSER ²	3.3-3.9	3.2-3.6		11.7-11.9											
3	In-season N recommendation strategy for maize/6 N rates and 3 planting densities			✓	✓		✓								China	Wang <i>et al.</i> , 2021
	R ²			0.65-0.86	0.82-0.94		0.88-0.95									
4	Simulating summer maize growth under film mulching	✓	✓	✓	✓	✓	✓							China	Shen <i>et al.</i> , 2021	
	RMSER ²	1.9-3.6	0.8-2.65	9-11	0.82-0.94	0-16%	7-8.5		1.2-2.5		6.7-8.7					
5	Irrigation Management and Sowing Dates/13 sowing dates with 32 irrigation scenarios and rainfed treatment	✓	✓	✓	✓	✓	✓							China	Rugina <i>et al.</i> , 2021	
	RMSER ²	0.99-2.42	0.81-1.16	17	1.9-13	0.77-1	624-1928				2.3-25.3	2.6-7.9				
6	Sowing Window and Yield Forecasting for Maize/5 sowing dates/3 Maize hybrids	✓	✓		✓		✓							Bangladesh	Choudhary <i>et al.</i> , 2021	
	MAPE	2.54-3	3.59-3.77		13.2-14.01		7.2-7.9									
7	Sustainable crop intensification				✓									China	Ren <i>et al.</i> , 2021	
	RMSE				1070											
8	Nitrogen fertilizer schedule under drip irrigation	✓	✓		✓	✓								China	Bai and Gao 2021	
	MAE	3			163	0							001.5-0.024			
9	Climate change													India	Srivastava <i>et al.</i> , 2021	
	d-value						✓	0.99					✓			
10	Adaptation strategies/future climate change	✓	✓		✓		✓							China	Saddique <i>et al.</i> , 2020	
	RAE%	1.3	1.4	8.0	4.2		3.3									
11	Effects of Drought on Summer Maize	✓	✓		✓	✓								China	Shen <i>et al.</i> , 2020	
	RMSER ²	5	0.86		3.7	16.7										
12	Genotype-environment-management interactions/Climate change/Different agro-ecological zones	✓	✓		✓									China	Zhang <i>et al.</i> , 2020	
	R ²	0.97	0.89		0.82											
13	Simulating maize growth and yield under water stress conditions	✓	✓		✓	✓								China	Song and Jin 2020	
	ARE%	3.5			6.1		0.25		2.7							
14	Simulating water consumption and yield of maize/ using the two different ET options, i.e., Priestley-Taylor/Ritchie PT and FAO-56 Penman-Monteith PM			✓	✓		✓							China	Ran <i>et al.</i> , 2020	
	NSE			0.77-0.76	0.05 to -0.18		0.05-0.19						0.43-0.53		0.003 to -0.09	
15	Dynamic within-season irrigation scheduling for maize production		✓		✓	✓								China	Chen <i>et al.</i> , 2020	
	ARE%		0-3.8		0-6.8	0-3.2	7.2-13.3									
16	Optimization of irrigation and fertilization of drip-irrigated corn	✓	✓		✓		✓							China	Fu <i>et al.</i> , 2020	
	ARE%	1.1	0.68		18.8		20		9.5				✓		48.9	
17	Adaptation strategies for maize production under climate change for semiarid	✓	✓	✓	✓		✓							Pakistan	Ahmad <i>et al.</i> , 2020	

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18	d-value Different Irrigation and Manure Application Rates	0.97	0.97	0.90	0.97	0.94	0.94	✓	0.94	India	Babel <i>et al.</i> , 2019
19	RMSE CERES-Maize Calibration under Different Irrigation Strategies Using PEST Optimization	3.2	3.2	3.2	300	700	700	✓	700	China	Fang <i>et al.</i> , 2019
20	CV% Optimizing the Sowing Date and Irrigation Strategy to Improve Maize Yield	11-47	11-47	11-47	11-47	4-19	4-19	✓	4-19	China	Saddique <i>et al.</i> , 2019
21	RAE% Assessment of Summer Maize Drought Loss	0.45-2.11	-0.36-3.89	4.19-5.40	8.38-7.60	0	-4.1-5.4	✓	0	China	Wei <i>et al.</i> , 2019
22	RMSE Assessing spring maize responses to irrigation and nitrogen regimes	3.55	3.55	2.17	2.17	0	6.29	✓	8.7-9.8%	India	Kaur and Arora 2018
23	R ² Predicting water and nitrogen requirements ³ irrigation regimes/5 N rates	0.46-3.90	1.0-3.9	✓	0.63	0.37	0.37	✓	0.55	Pakistan	Hammad <i>et al.</i> , 2018
24	SE Climate variability on maize	0.46-3.90	1.0-3.9	✓	161-469	✓	✓	✓	8-28	Pakistan	Ahmed <i>et al.</i> , 2018
25	Error% Yield Forecasting of Spring Maize Using Remote Sensing and Crop Modeling	2.6-2.8	1.7-2.8	3.1-6.8	0.08-0.9	1.1-4.9	1.1-4.9	✓	✓	Pakistan	Ahmed <i>et al.</i> , 2018b
26	MAE Summer maize yield loss caused by drought stress	2.4	2.3	2.3	878	0.22	0.22	✓	0.22	China	Geng <i>et al.</i> , 2018
27	CRM Climate change and crop management on phenology of maize-based/adaptation/planting dates and cultivars	0.81-0.88	0.81-0.86	0.81-0.86	0.01-0.17	0.01-0.17	0.01-0.17	✓	0.01-0.17	Pakistan	Abbas <i>et al.</i> , 2017
28	R2 Potential Impacts of Climate Change and Adaptation/planting depth/planting dates/row spacing/fertilizer	0.81-0.88	0.81-0.86	0.81-0.86	0.70	0.82	0.19	✓	0.19	China	Lin <i>et al.</i> , 2017
29	NSME Modelling irrigation management for water conservation/planting dates/irrigation schedules	0.63	0.63	0.63	0.70	0.82	0.19	✓	0.19	China	Jiang <i>et al.</i> , 2016
30	RMSEn% simulated maize phenology with more frequent supra-optimal temperature under climate warming	2.1	2.1	2.1	0	6.25	2.9-4.9	✓	2.9-4.9	China	Guo <i>et al.</i> , 2016
31	R ² Maize yield gaps differentiate entry points for intensification in the rainfed mid-hills of Nepal	0.099	0.099	0.099	0.83	0.99	0.99	✓	0.99	Nepal	Devkota <i>et al.</i> , 2015
32	RMSE Long-term fertilization on maize yield and soil C/N dynamics	1.7	1.3	1.3	432	742	196	✓	196	China	Yang <i>et al.</i> , 2013
33	ME Impacts of climate change as a function of global mean temperature	602-1050	602-1050	602-1050	602-1050	602-1050	602-1050	✓	0.1-1.1	China	Tao and Zhang, 2011
34	RMSE Simulating maize yield at enhanced level of temperature	8.9	12.4	✓	1348	✓	✓	✓	✓	India	Lone <i>et al.</i> , 2020
35	R ² Validation of CERES-Maize model for growth, yield attributes	0.94	0.94	0.94	0.76	0.89	0.89	✓	0.89	India	Kumar <i>et al.</i> , 2010
	Abs diff	2.1	6.1	217	25.8	28	28	✓	28	India	Kumar <i>et al.</i> , 2010

Table S6: Summary of the performance of CSM-CANEGRO-Sugarcane (a), CSM-OILCROP-Sunflower (b), and CSM-SUBSTOR-Potato (c) models to simulate phenology, growth, and yield for different management practices in south Asia and China.

S. No	Experiment	Variables													Countries	References		
		Emergence	Anthesis	Tuber initiation	Maturity	Peak tillering	Total dry matter/ yield	LAI/ Leaf area	Fresh cane yield	Stalk fresh mass	Sucrose mass	Achene yield	Oil content	SWC			LeafN	ET
a Sugarcane																		
1	Four cultivars/3 sowing dates	✓		✓	✓	✓		✓									India	Singh <i>et al.</i> , 2018
	RMSE	2.29-4.07		7.32-8.42	3.37-4.79		0.19-0.34	467-865										
2	Ten cultivars							✓		✓							India	Bhengra <i>et al.</i> , 2016
	RMSE								5960-7500	9250-11750								
b Sunflower																		
1	N productivity/4 irrigation/3 N rates		✓		✓	✓	✓				✓	✓	✓	✓	✓		Pakistan	Awais <i>et al.</i> , 2017
	Error ⁹⁵ %		0-6		0--4		0.4-18	25 to +6			5-17	15 to 12		0.16-0.71				
2	Sunflower hybrids under different agro-meteorological conditions		✓		✓	✓					✓	✓	✓				Pakistan	Nasim <i>et al.</i> , 2016
	RMSE					5.22					1.66							
c Potato																		
1	Climate warming/potato phenology			✓	✓												Pakistan	Naz <i>et al.</i> , 2022
2	Climate change/potato productivity					✓											India	Goswami <i>et al.</i> , 2018
	RMSE										2730-3810							