Electronic Appendix for "A deep learning framework for prediction of crop yield in Australia under the impact of climate change"

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Appendix A. Additional tables

Rescaled mean absolute error (rMAE), rescaled root mean square error (rRMSE), and mean absolute scaled error (MASE) values of random forests (RF), ANN, SVM, ARDL, ARIMAX, and DNN methods for each crop type are given in Table A1. The raw versions of MAE and RMSE are reported in Table A2. The smallest error values for each crop type is given boldfaced in both tables.

Table A1. rMAE, rRMSE, and MASE values of random forests (RF), ANN, SVM, ARDL, ARIMAX, and DNN methods for each crop type.

Crop	**rMAE**					
Type	**RF**	**ANN**	**ARDL**	**SVM**	**ARIMAX**	**DNN**
Oat	0.151	0.139	0.139	0.147	0.242	**0.120**
Corn	0.159	0.201	0.136	0.127	0.261	**0.102**
Rice	0.054	0.063	0.040	0.044	0.049	**0.030**
Wheat	0.228	0.245	0.155	0.137	0.094	**0.092**
	rRMSE					
	RF	**ANN**	**ARDL**	**SVM**	**ARIMAX**	**DNN**
Oat	0.199	0.193	0.174	0.166	0.259	**0.156**
Corn	0.186	0.237	0.173	0.168	0.323	**0.154**
Rice	0.071	0.068	0.065	0.054	0.061	**0.039**
Wheat	0.296	0.292	0.209	0.154	**0.107**	0.129
	MASE					
	RF	**ANN**	**ARDL**	**SVM**	**ARIMAX**	**DNN**
Oat	0.565	0.521	0.523	0.551	0.905	**0.360**
Corn	0.803	3.212	0.684	0.641	1.316	**0.514**
Rice	0.604	0.353	0.454	0.499	0.548	**0.335**
Wheat	0.780	0.420	0.530	0.470	0.322	**0.315**

Table A2. MAE and RMSE values of random forests (RF), ANN, SVM, ARDL, ARIMAX, and DNN methods for each crop type.

Crop	**MAE**					
Type	**RF**	**ANN**	**ARDL**	**SVM**	**ARIMAX**	**DNN**
Oat	0.221	0.204	0.204	0.215	0.354	**0.176**
Corn	0.824	1.040	0.701	0.657	1.349	**0.528**
Rice	0.447	0.523	0.337	0.370	0.406	**0.248**
Wheat	0.381	0.410	0.259	0.230	0.158	**0.154**
	RMSE					
	RF	**ANN**	**ARDL**	**SVM**	**ARIMAX**	**DNN**
Oat	0.291	0.283	0.255	0.243	0.379	**0.228**
Corn	0.963	1.224	0.896	0.870	1.668	**0.797**
Rice	0.590	0.564	0.538	0.450	0.507	**0.329**
Wheat	0.497	0.490	0.350	0.258	**0.180**	0.217

Observed and the artificially generated data under four scenarios of the changes in CO2 emissions, temperature anomalies, and cropland between 2020 and 2025 are given in Table A3, where the boldfaced cells denote the actual observations, and the rest of the cells are artificially created under each scenario for climate change.

The forecasts for oats, corn, rice, and wheat yield between 2020 and 2025 for all the scenarios are tabulated in Table A4.

Table A3. Artificial data under six scenarios (Scn) of the changes in CO2 emissions, temperature anomalies (TempA), rainfall anomalies (RanfA), and crop area (CornA, OatsA, RiceA, WheatA) between 2020 and 2025.

Scn	Year	CornA	OatsA	RiceA	WheatA	Fert	TempA	RainfA	CO2
I	2021	50.562	948.155	46.365	12985	88.298	1.150	20.560	428878326
I	2022	50.562	948.155	46.365	12985	88.298	1.150	20.560	446033459
I	2023	50.562	948.155	46.365	12985	88.298	1.150	20.560	463874798
I	2024	50.562	948.155	46.365	12985	88.298	1.150	20.560	482429790
I	2025	50.562	948.155	46.365	12985	88.298	1.150	20.560	501726981
II	2021	50.562	948.155	46.365	12985	88.298	1.208	20.560	412383006
II	2022	50.562	948.155	46.365	12985	88.298	1.268	20.560	412383006
II	2023	50.562	948.155	46.365	12985	88.298	1.331	20.560	412383006
II	2024	50.562	948.155	46.365	12985	88.298	1.398	20.560	412383006
II	2025	50.562	948.155	46.365	12985	88.298	1.468	20.560	412383006
III	2021	50.562	948.155	46.365	12985	88.298	1.208	20.560	412383006
III	2022	50.562	948.155	46.365	12985	88.298	1.268	20.560	412383006
III	2023	50.562	948.155	46.365	12985	88.298	1.331	20.560	412383006
III	2024	50.562	948.155	46.365	12985	88.298	1.398	20.560	412383006
III	2025	50.562	948.155	46.365	12985	88.298	1.468	20.560	412383006
IV	2021	50.562	948.155	46.365	12985	88.298	1.208	19.532	428878326
IV	2022	50.562	948.155	46.365	12985	88.298	1.268	18.555	446033459
IV	2023	50.562	948.155	46.365	12985	88.298	1.331	17.628	463874798
IV	2024	50.562	948.155	46.365	12985	88.298	1.398	16.746	482429790
IV	2025	50.562	948.155	46.365	12985	88.298	1.468	15.909	501726981
V	2021	50.562	948.155	46.365	12985	88.298	1.162	19.532	395887686
V	2022	50.562	948.155	46.365	12985	88.298	1.173	18.555	380052178
V	2023	50.562	948.155	46.365	12985	88.298	1.185	17.628	364850091
V	2024	50.562	948.155	46.365	12985	88.298	1.197	16.746	350256088
V	2025	50.562	948.155	46.365	12985	88.298	1.209	15.909	336245844
VI	2021	58.982	757.892	42.632	12477	90.717	1.003	21.863	452421303
VI	2022	58.885	746.831	40.395	12532	91.115	1.025	22.379	458006271
VI	2023	58.788	735.769	38.158	12588	91.514	1.047	22.895	463591240
VI	2024	58.691	724.707	35.921	12643	91.913	1.069	23.411	469176208
VI	2025	58.594	713.645	33.684	12698	92.311	1.091	23.928	474761176

Table A4. Forecasts for oats, corn, rice, and wheat yield between 2020 and 2025 for all the scenarios.

Scenario	Year	Oats	Corn	Rice	Wheat
I	2021	1.824	7.648	10.407	2.437
I	2022	1.888	7.846	10.648	2.428
I	2023	1.972	8.037	10.833	2.418
I	2024	2.120	8.222	10.970	2.407
I	2025	2.300	8.394	11.086	2.396
II	2021	1.824	7.465	10.110	2.444
II	2022	1.876	7.484	10.081	2.446
II	2023	1.899	7.502	10.050	2.449
II	2024	1.918	7.516	10.015	2.453
II	2025	1.935	7.529	9.986	2.458
III	2021	1.770	7.438	10.122	2.439
III	2022	1.787	7.428	10.103	2.433
III	2023	1.806	7.414	10.080	2.427
III	2024	1.799	7.391	10.051	2.419
III	2025	1.786	7.357	10.012	2.410
IV	2021	1.891	7.669	10.391	2.439
IV	2022	2.029	7.885	10.602	2.437
IV	2023	2.171	8.093	10.786	2.437
IV	2024	2.322	8.294	10.937	2.442
IV	2025	2.480	8.487	11.043	2.452
V	2021	1.638	7.220	9.830	2.452
V	2022	1.453	6.968	9.587	2.458
V	2023	1.267	6.703	9.297	2.461
V	2024	1.051	6.425	8.973	2.461
V	2025	0.870	6.142	8.801	2.459
VI	2021	1.950	7.484	10.669	2.314
VI	2022	2.006	7.538	10.712	2.322
VI	2023	2.061	7.592	10.753	2.330
VI	2024	2.116	7.644	10.792	2.339
VI	2025	2.171	7.696	10.829	2.347