Czech University of Life Sciences Prague

Faculty of Environmental Sciences

Department of Water Resources and Environmental Modeling

Diploma Thesis

Forecast of societal instability due to extreme drought by data-driven methods

Arman Zhussipbek

Declaration

I hereby declare that I have independently elaborated the diploma/final thesis with the topic of: "Forecast of societal instability due to extreme drought by data-driven methods" and that I have cited all the information sources that I used in the thesis and that are also listed at the end of the thesis in the list of used information sources.

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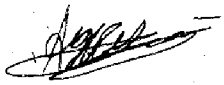

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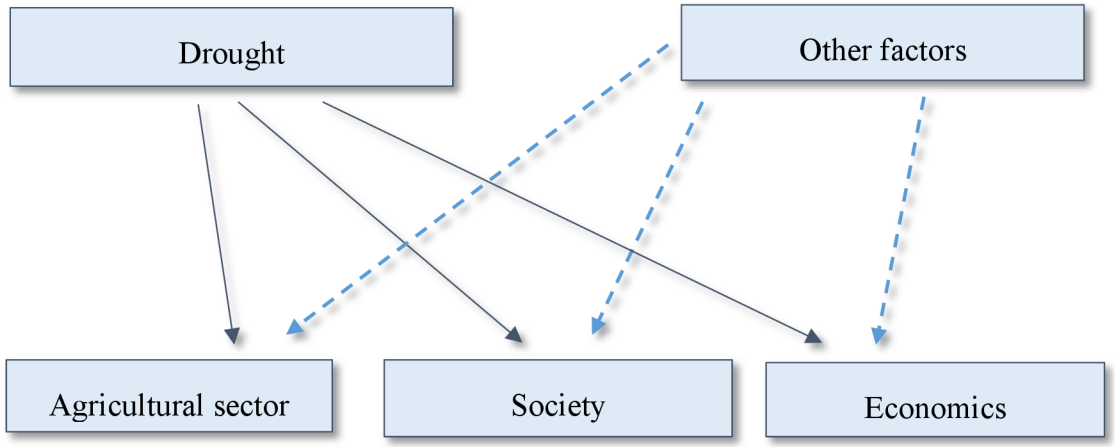

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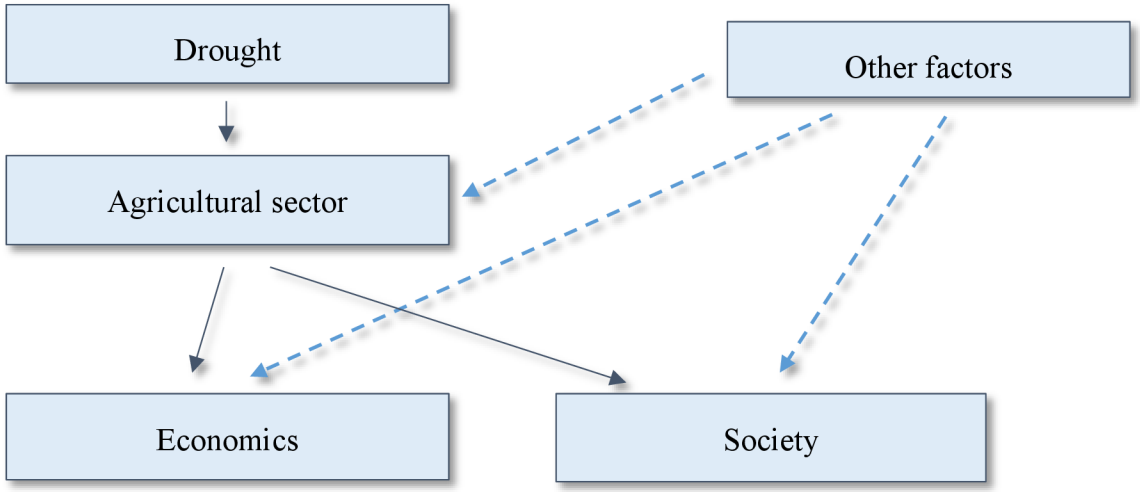

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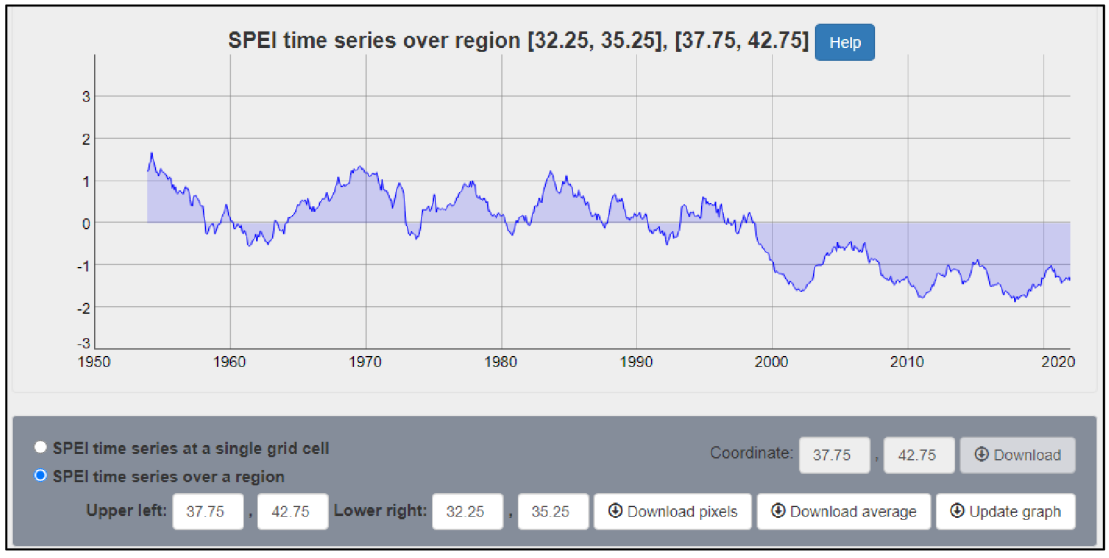

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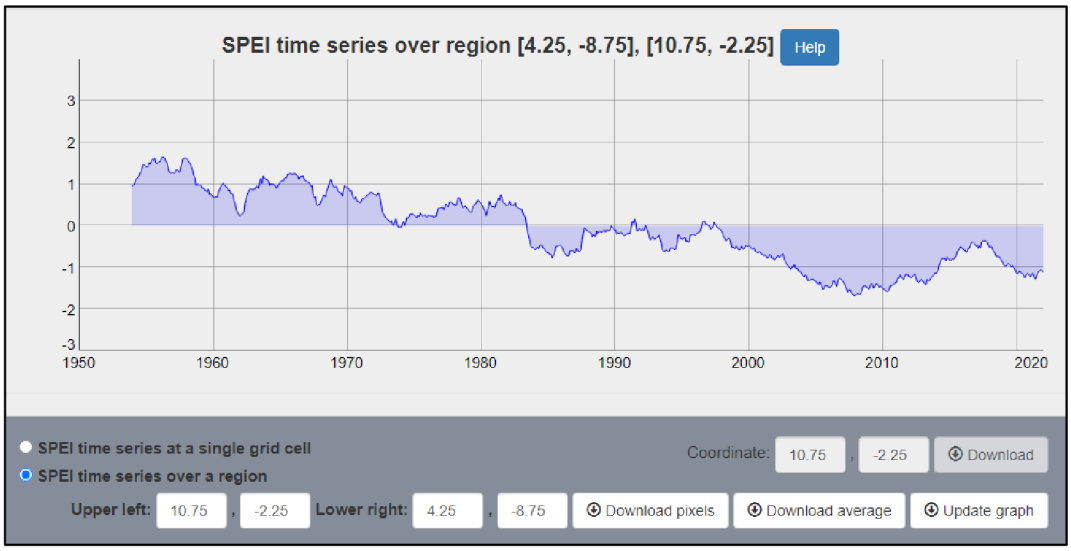

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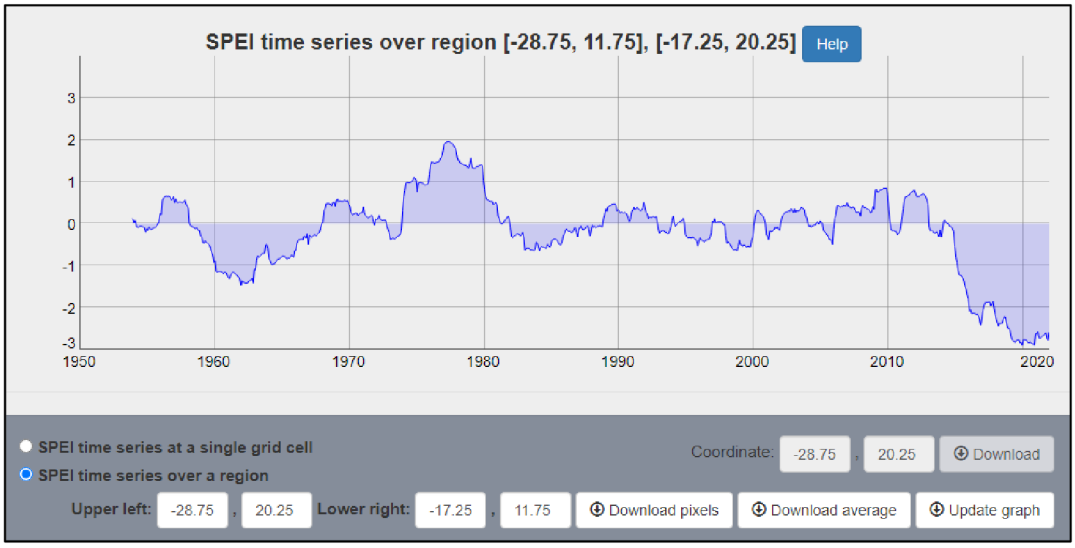

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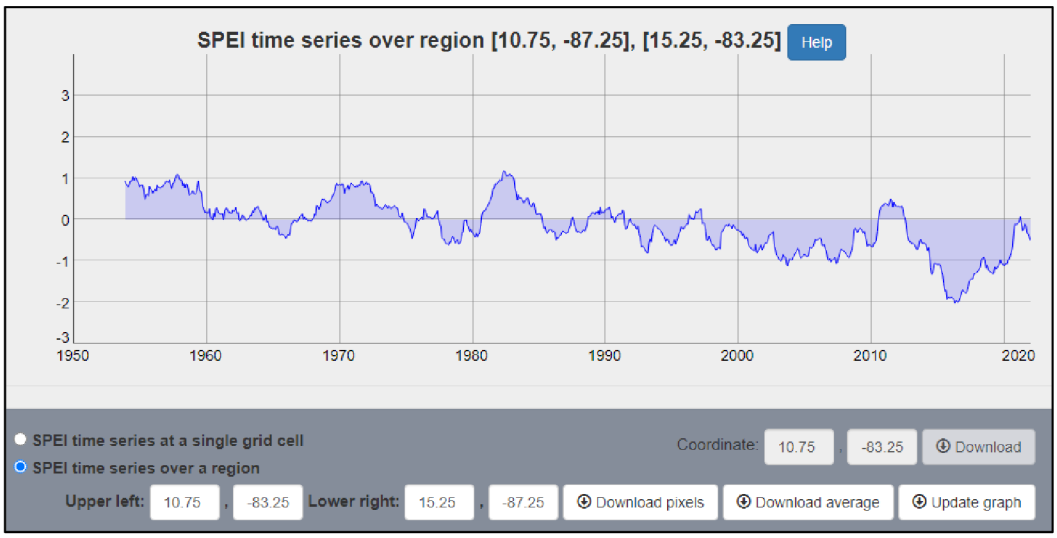

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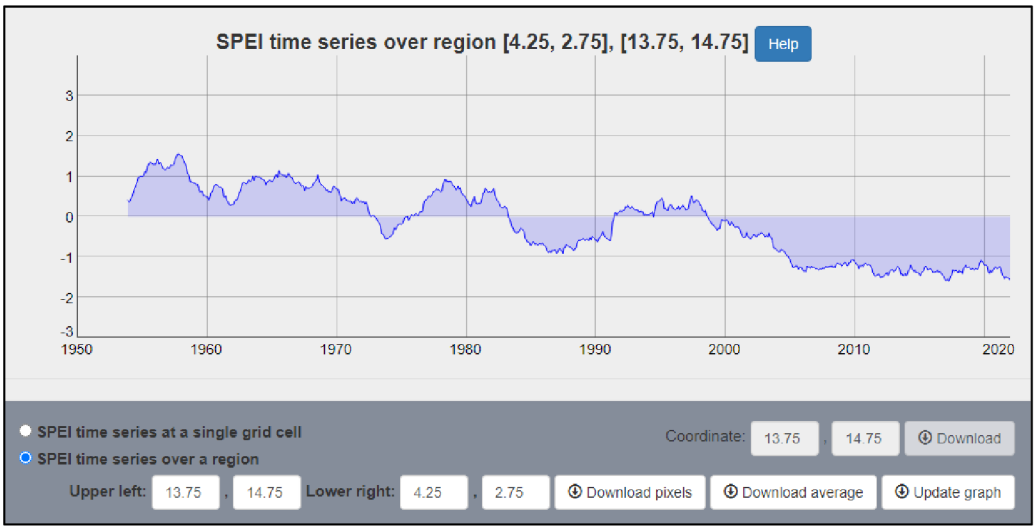

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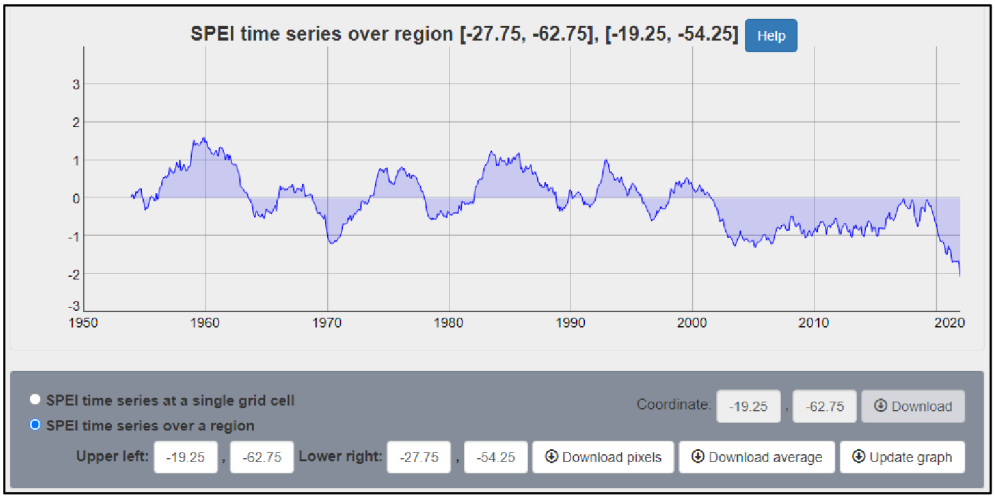

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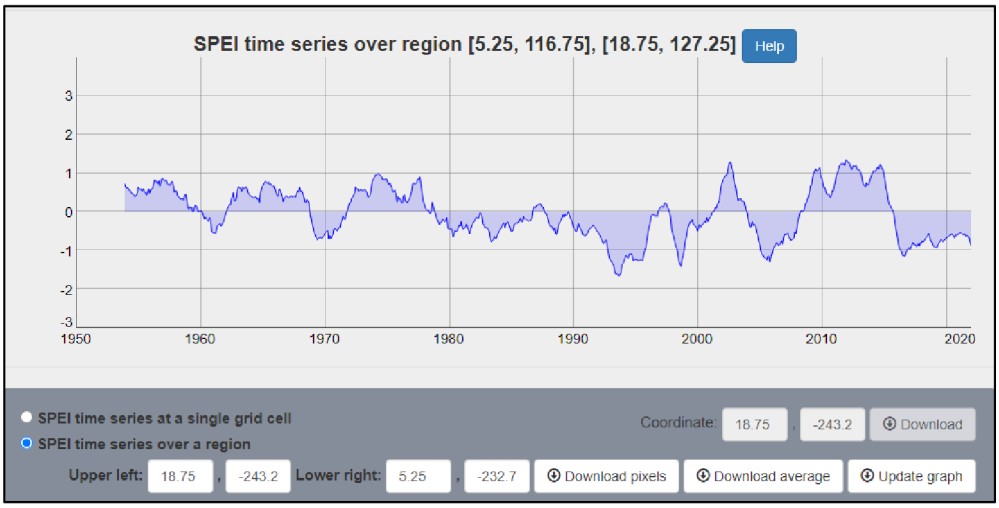

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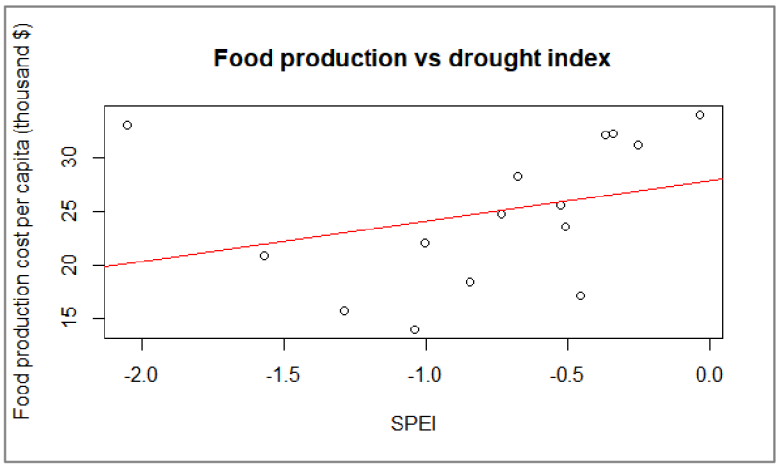

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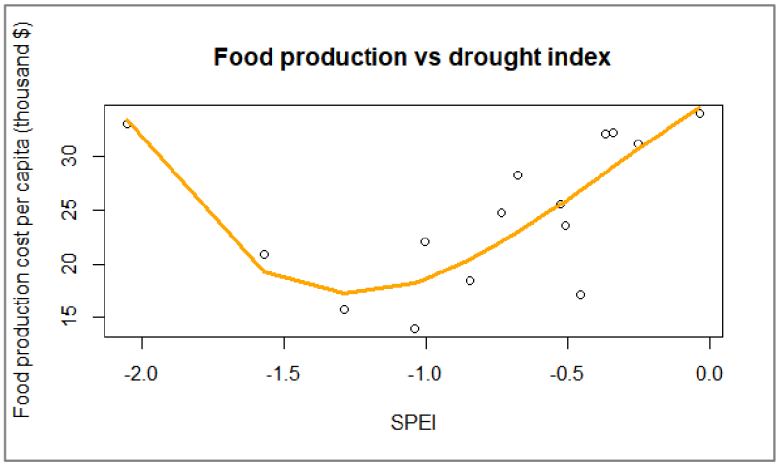

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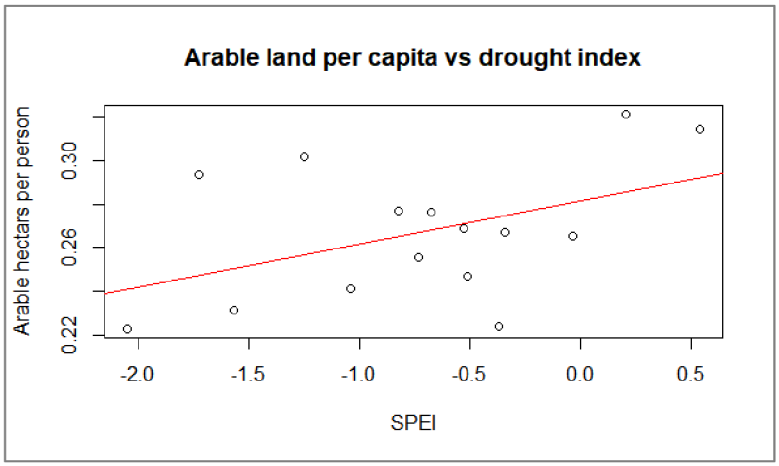

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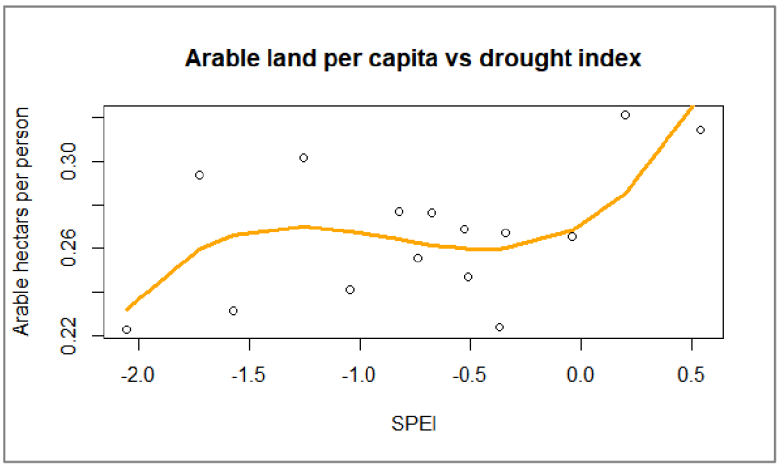

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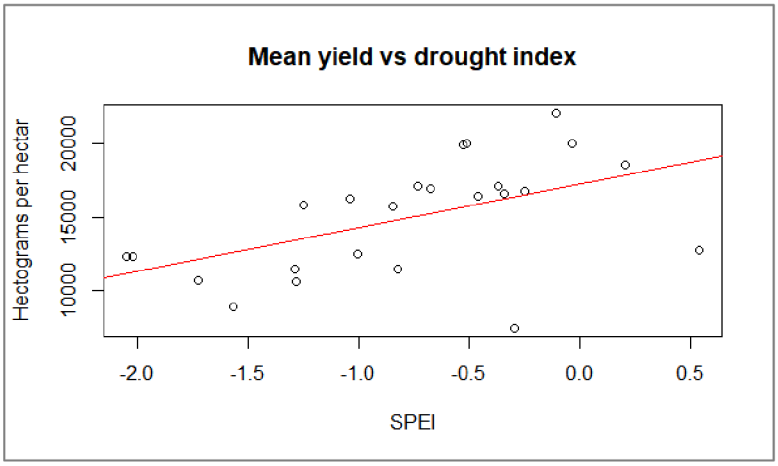

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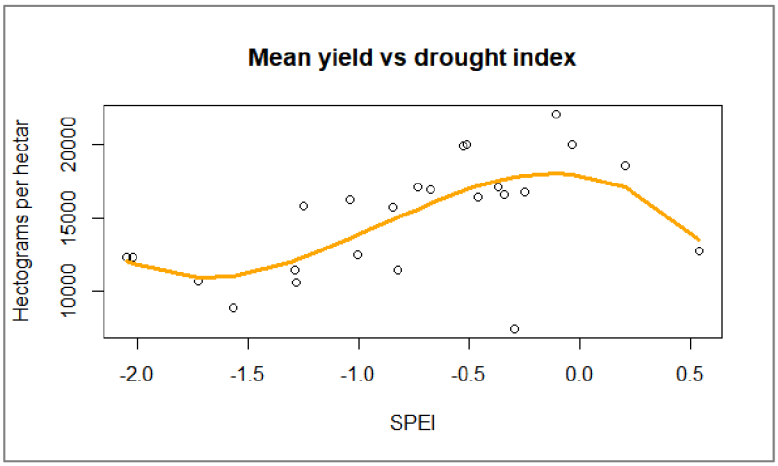

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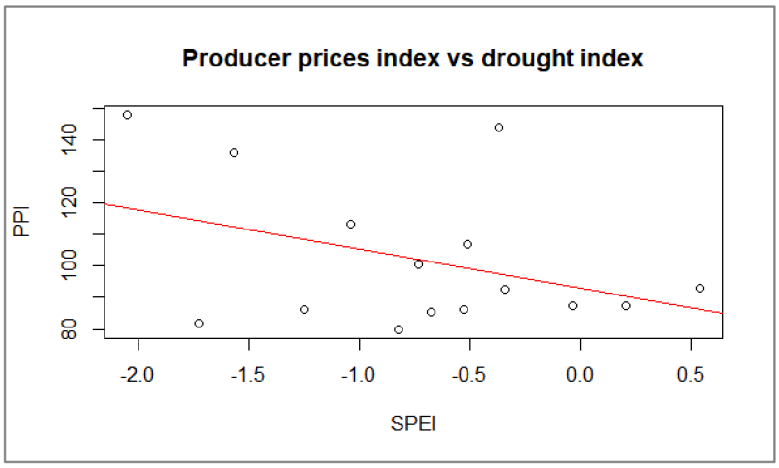

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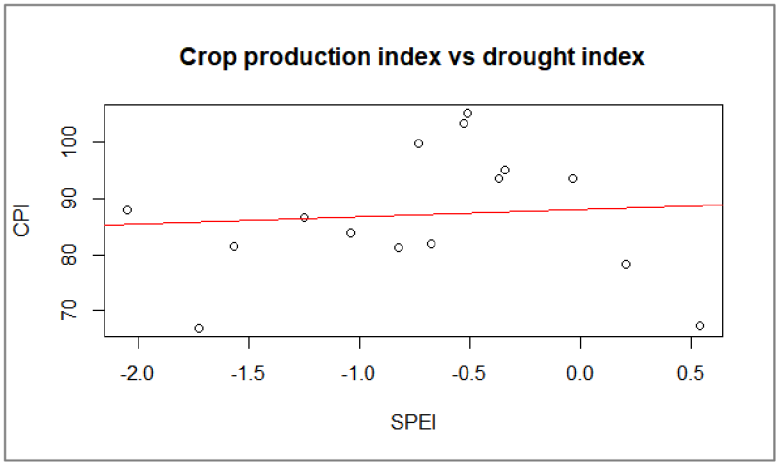

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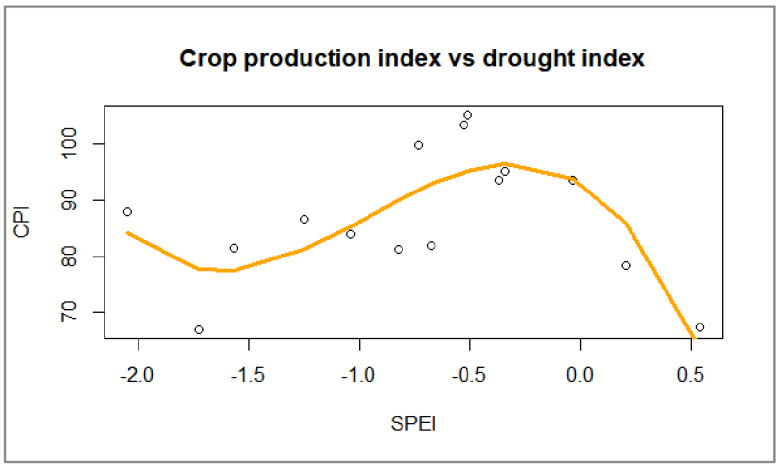

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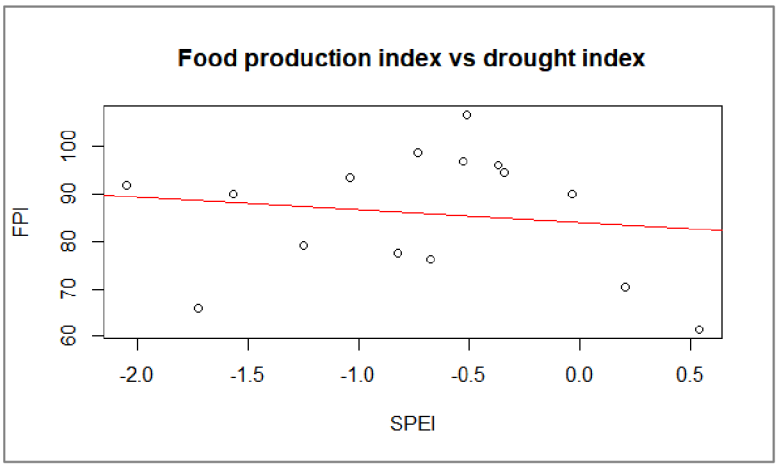

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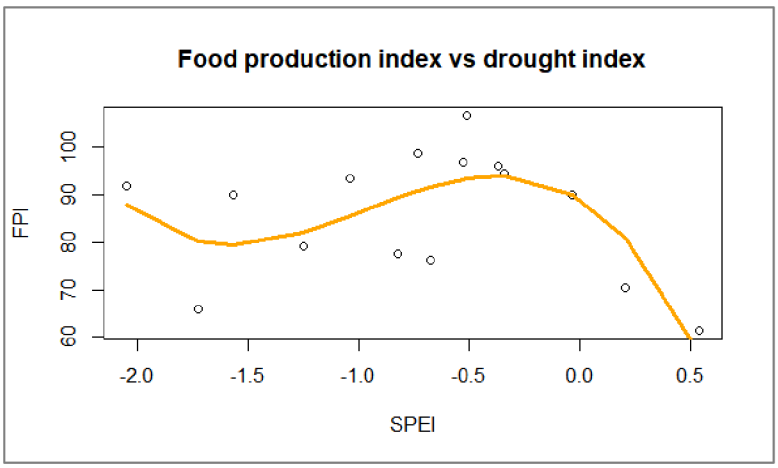

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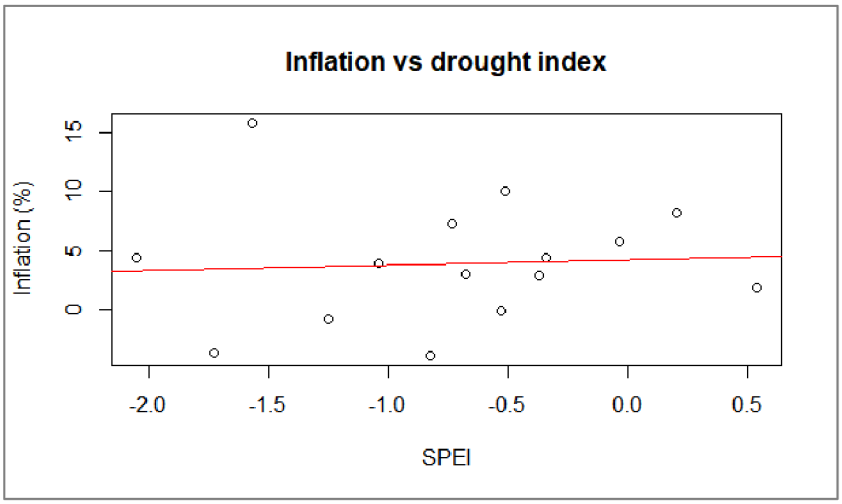

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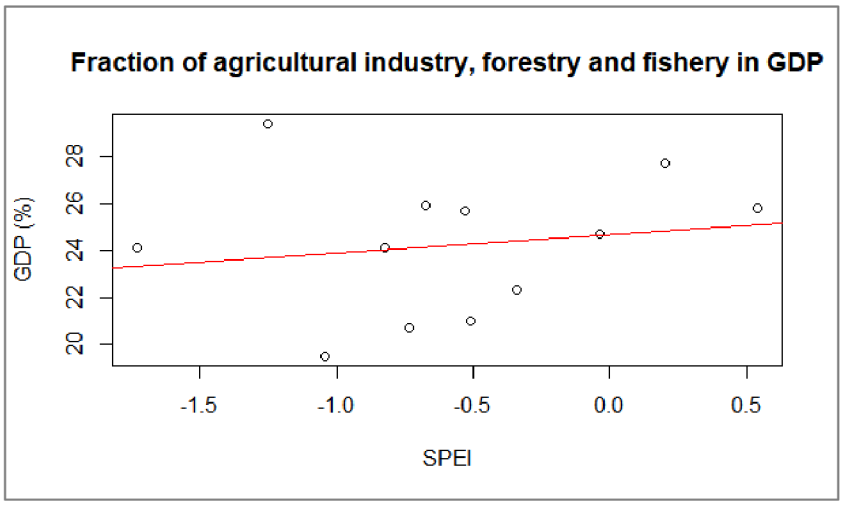

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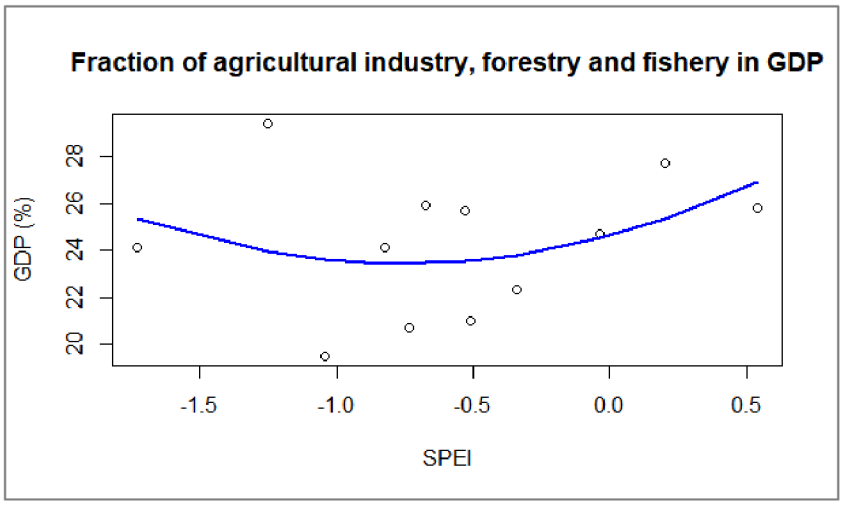

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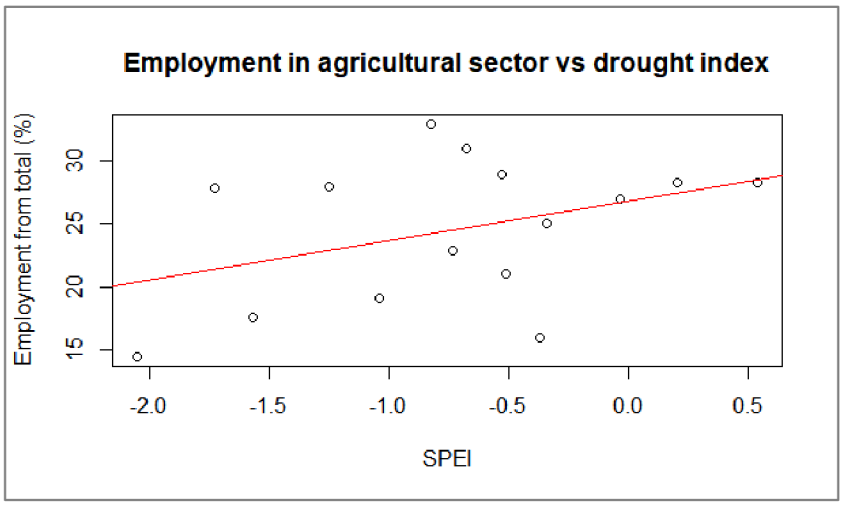

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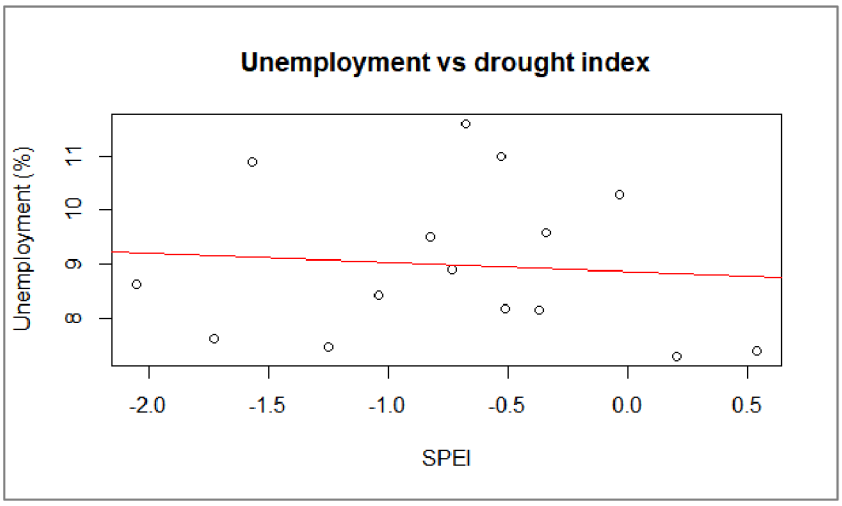

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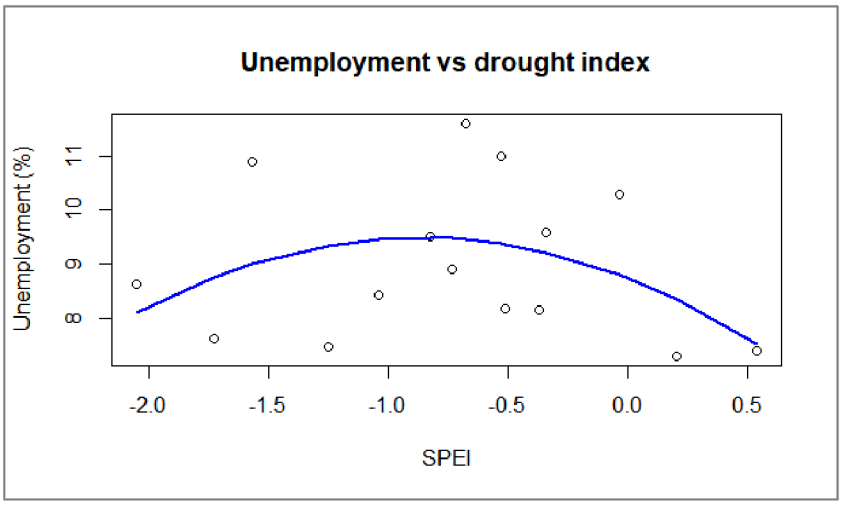

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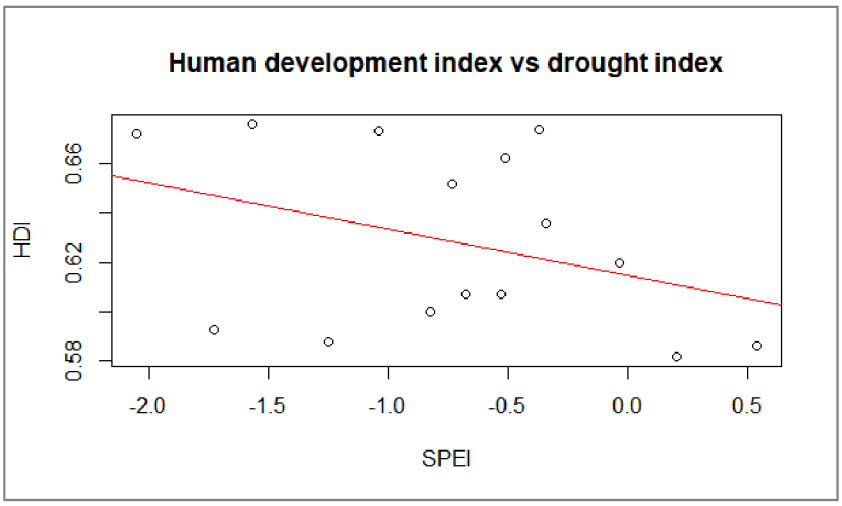

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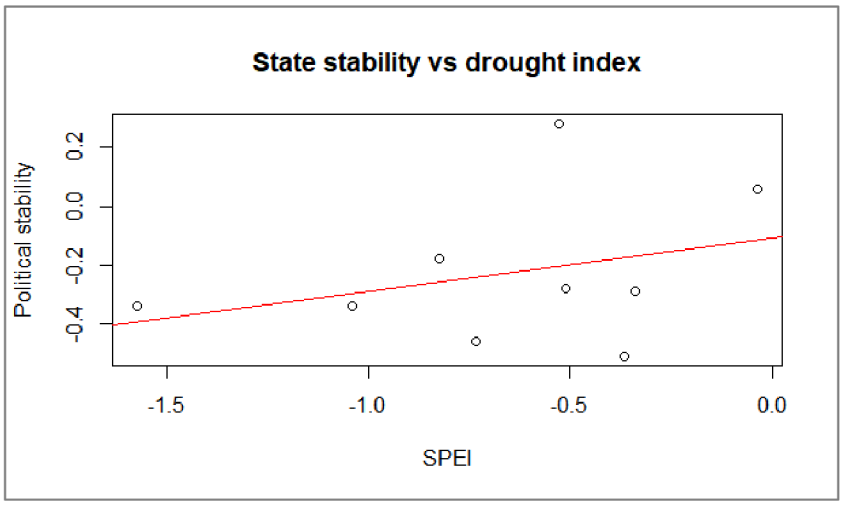

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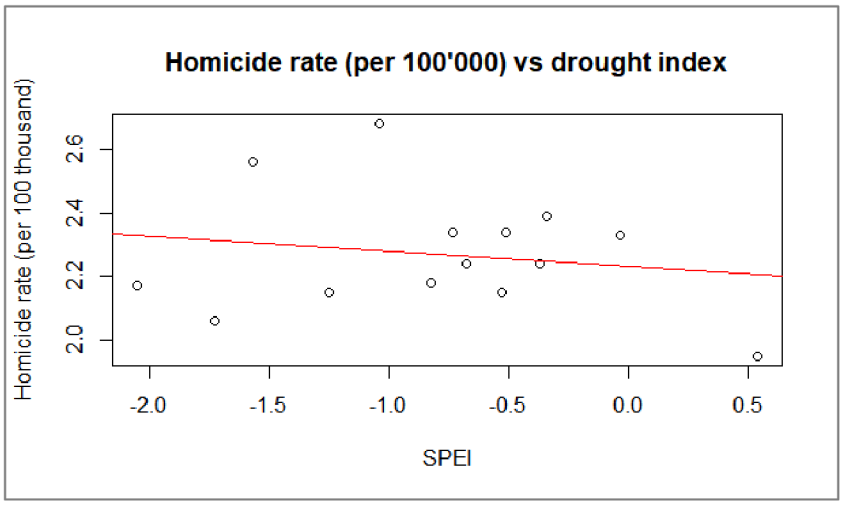

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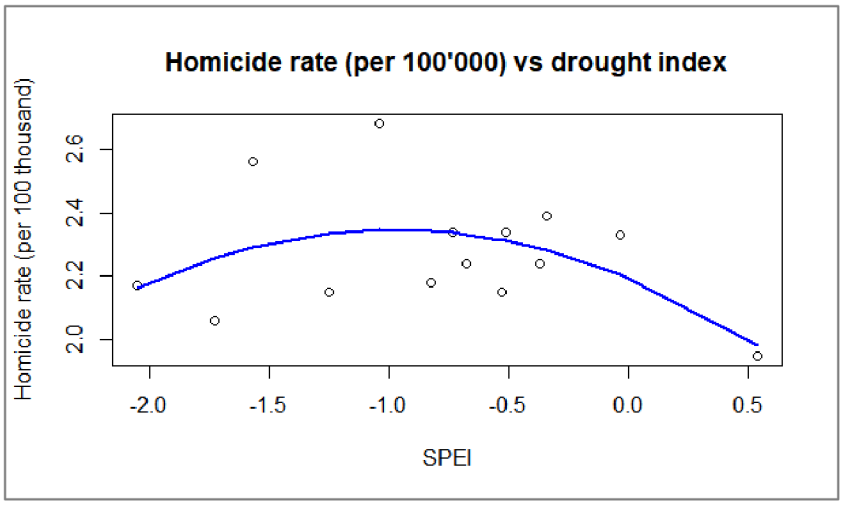

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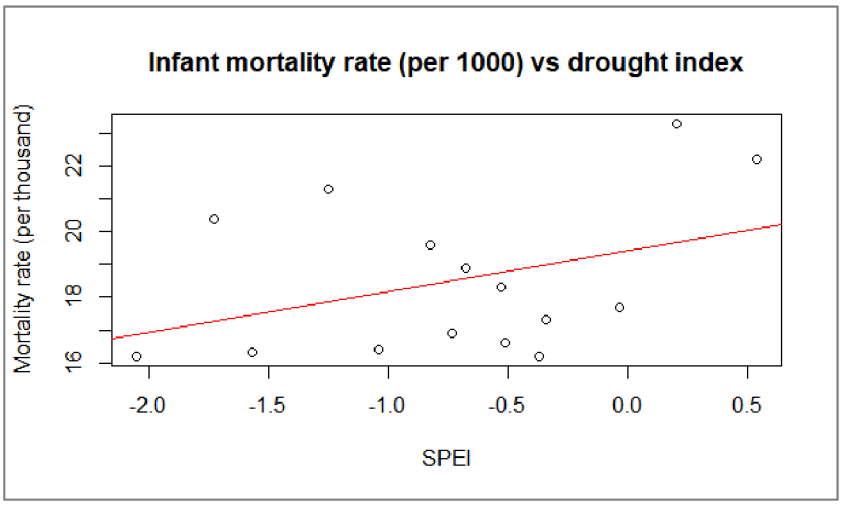

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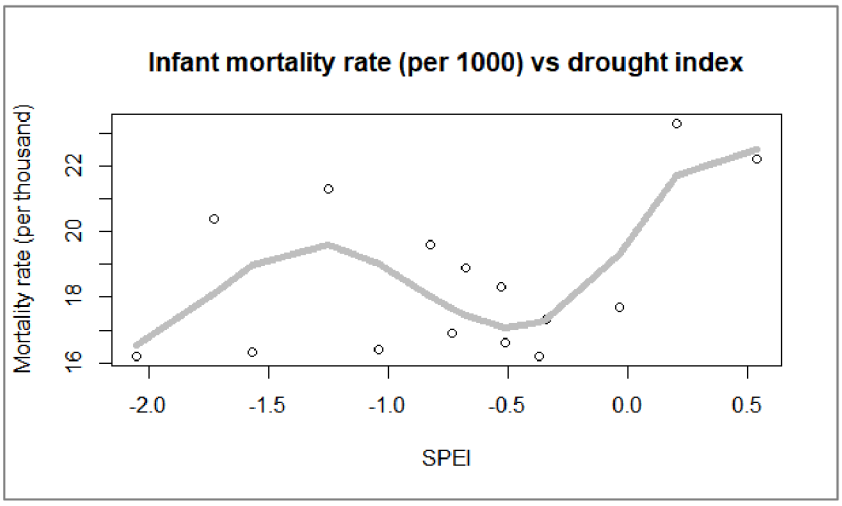

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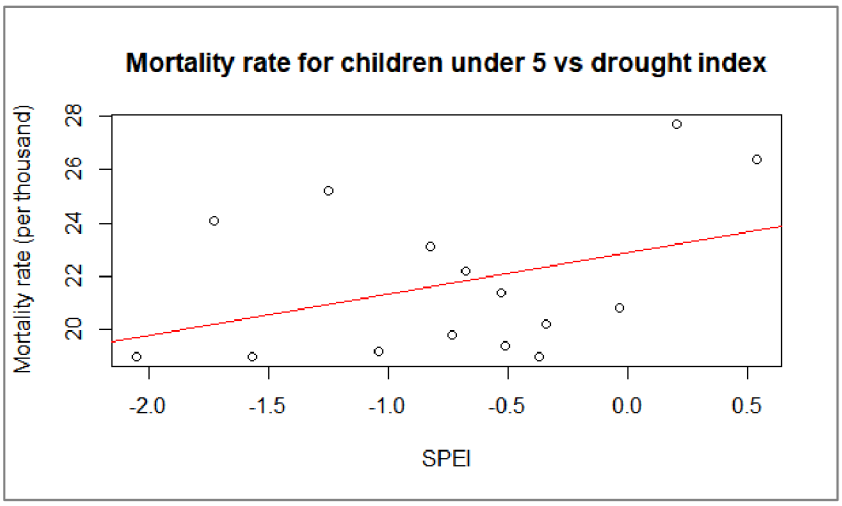

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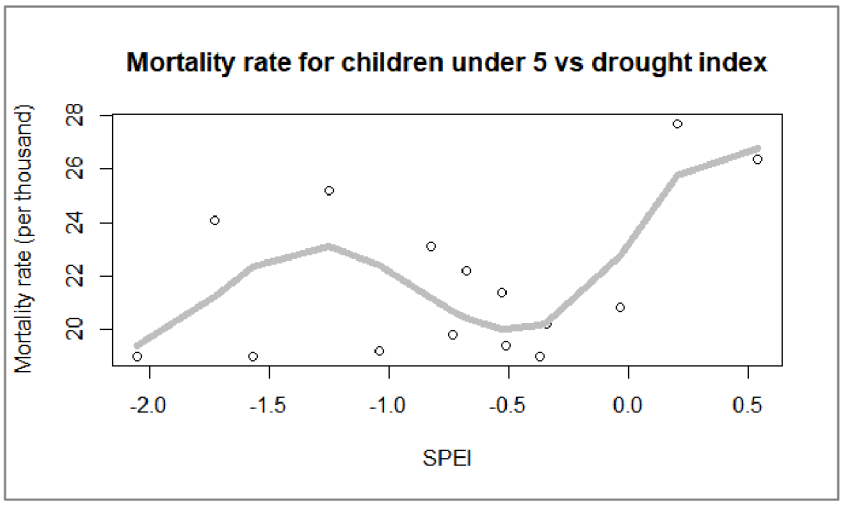

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Tables:

Index [units]:	Type of index:	Theoretical reaction to drought:
Food production economic variability [thousand $ per capita]	Agricultural	Less precipitation would decrease production in total which would decrease subsequent economic output
Arable land used per person [hectars per capita]	Agricultural	Long-term drought might decrease total area which agricultural industry is able or has will to use
Mean agricultural yield (cereals per used land area) [hectograms per hectar]	Agricultural	For area with non-advanced or straightforwardly primitive agriculture (in terms of irrigation) less precipitation would decrease total output
Ratio of agricultural, forestry and fishery in GDP [%]	Agricultural	If sectors of economics not related to agriculture are assumed to maintain same economic output, then smaller output of agricultural industry would result in smaller portion of GDP (as agriculture)
Producer prices index []	Agricultural	Food producers might increase prices in order to reduce financial losses from drought
Crop production index []	Agricultural	Dry conditions would decrease output due to crop failures
Food production index []	Agricultural	Dry conditions would decrease output due to impact on livestocks and crops
Consumer inflation [%]	Economic	Some increase in prices might be expected

Employment in agricultural sector [%] (from total available workforce)	Economic	Long-term drought can negatively impact stability of agricultural enterprises and leave part of population unemployed
Unemployment fraction [%] (from total available workforce)	Economic	Long-term drought can negatively impact stability of agricultural enterprises and leave part of population unemployed
Human development index []	Social	Long-term drought would damage society by means of worsening standards of life, deterioration of health conditions and economics (for example: increase of unemployment might occur)
Political stability index []	Social	Long-term drought vould damage society by means of worsening overall conditions in society, causing additional social strain and increase of crime level
Homicide rate [per 100'000] (does not include politically motivated violence)	Social	Increase of crime level could be expected due to higher unemployment and deterioration of economics
Infant mortality rate [per 1000]	Social	Long-term drought could lead to increase of health issues in society, decrease available usable water resources and increase of mortality rate
Mortality rate (among children under age of 5) [per 1000]	Social	Long-term drought could lead to increase of health issues in society, decrease available usable water resources and increase of mortality rate

Table 1. Impact of drought on statistical parameters (direct correlations).

Polynomial power	Adjusted R-squared	P-value
1 (linear)	0.02025	0.2767
2	0.5907	0.001865
3	0.606	0.003835
4	0.5675	0.01254
5	0.5242	0.03257

Table 2. Food production economic variability vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	0.1458	0.08856
2	0.1429	0.1572
3	0.2739	0.09245
4	0.2605	0.1381
5	0.2253	0.2062

Table 3. Arable land used per person vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	0.2317	0.01004
2	0.2298	0.02481
3	0.338	0.01019
4	0.3033	0.02646
5	0.3104	0.03544

Table 4. Mean cereal yield (per used land area) vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	0.08222	0.1571
2	0.06203	0.2701
3	0.07633	0.2986
4	0.01222	0.4323
5	-0.09281	0.599

Table 5. Producer release prices index vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	-0.07024	0.7802
2	0.23	0.08264
3	0.5301	0.009751
4	0.5292	0.01857
5	0.4795	0.04651

Table 6. Crop production index vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	-0.05457	0.6084
2	0.1783	0.1221
3	0.3952	0.03641
4	0.3716	0.06843
5	0.3118	0.1349

Table 7. Food production index vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	-0.07282	0.827
2	-0.1597	0.9648
3	-0.2439	0.9668
4	-0.2684	0.8973
5	-0.4041	0.9571

Table 8. Household/consumer inflation vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	-0.06903	0.6022
2	-0.05673	0.5196
3	-0.1878	0.7435
4	-0.102	0.5908
5	-0.2458	0.7257

Table 9. Ratio of agriculture, forestry and fishery to GDP vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	0.09052	0.1458
2	0.04061	0.3092
3	0.0597	0.3244
4	-0.0291	0.4989
5	-0.1383	0.663

Table 10. Employment in agricultural sector vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	-0.06897	0.7608
2	0.03394	0.3224
3	-0.004335	0.4373
4	-0.1029	0.6253
5	-0.1645	0.6991

Table 11. General unemployment vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	0.06868	0.1775
2	0.0274	0.3357
3	0.055	0.332
4	-0.002708	0.4559
5	-0.0949	0.6019

Table 12. Human development index vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	-0.02597	0.4015
2	-0.1651	0.6672
3	-0.3718	0.8399
4	-0.5067	0.8475
5	-0.5356	0.8011

Table 13. Political stability index vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	-0.0506	0.5523
2	0.1284	0.1874
3	0.04131	0.3635
4	-0.02342	0.4904
5	-0.02973	0.5118

Table 14. Rate of homicides vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	0.07914	0.1616
2	0.1557	0.1436
3	0.2845	0.08582
4	0.2722	0.1291
5	0.5184	0.03417

Table 15. Infant mortality rate vs drought index.

Polynomial power	Adjusted R-squared	P-value
1 (linear)	0.07998	0.1604
2	0.1656	0.1338
3	0.2941	0.08018
4	0.2809	0.1227
5	0.3005	0.1432

Table 16. Mortality rate (among children under age of 5) vs drought index.

Index	Polynomial degree	Adjusted R-squared	P-value
Food production economic variability	3	0.606	0.003835
Arable land used per person	3	0.2739	0.09245
Mean agricultural yield (cereals per used land area)	3	0.338	0.01019
Ratio of agricultural, forestry and fishery in GDP	2	-0.05673	0.5196
Producer prices index	1	0.08222	0.1571
Crop production index	3	0.5301	0.009751
Food production index	3	0.3952	0.03641
Consumer inflation	1	-0.07282	0.827
Employment in agricultural sector	1	0.09052	0.1458
Unemployment fraction	2	0.03394	0.3224
Human development index	1	0.06868	0.1775
Homicide rate	2	0.1284	0.1874
Infant mortality rate	5	0.5184	0.03417
Mortality rate (among children under age of 5)	5	0.3005	0.1432
Political stability index	1	-0.02597	0.4015

Table 17. Table of correlations between indices vs SPEI (Syria).

Food production economic variability	Direct proportional correlation can be seen which also has low probability of being explained by random non-correlated distribution
Arable land used per person	Correlation is very weak, although P-value is relatively low
Mean agricultural yield (cereals per used land area)	Direct proportional correlation can be seen which also has low P-value
Ratio of agricultural, forestry and fishery in GDP	Most probable explanation is null hypothesis (absense of dependence)
Producer prices index	If correlation exists, it is very weak (on scale of years)
Crop production index	Direct proportional correlation can be seen which also has low P-value
Food production index	Weak anti-correlation together with low P-value is observed
Consumer inflation	On scale of years no correlations are found. Most probable explanation is null hypothesis (absense of dependence)
Employment in agricultural sector	Correlations are weaker then the threshold
Unemployment fraction	Correlations are weaker then the threshold
Human development index	Most probable explanation is null hypothesis (absense of direct dependence)
Political stability index	Most probable explanation is null hypothesis (absense of direct dependence)
Homicide rate	Most probable explanation is null hypothesis (absense of direct dependence)
Infant mortality rate	Relatively strong anti-correlation is observed with low P-value, although this could be the result of combination of drought related effect with long-term decrease in infant mortality with development of healthcare (Worldbank, 2021e)
Child mortality rate	Relatively strong anti-correlation is observed, although this could be the result of combination of drought related effect with long-term decrease in infant mortality with development of healthcare (Worldbank, 2021e)

Table 18. Correlations analysis.

Influencing parameter:	Dependent indice:	Relationship:
Mean agricultural yield (cereal)	Political stability	Stability would drop with drop of agricultural yield
	Producer prices	Producer prices would drop with increase of agricultural yield (inverse proportion)
	Crop production	Crop production would be directly proportional to agricultural yield
	Food production economic variability	Variability would drop with drop of agricultural yield
	Food production	Food production would be directly proportional to agricultural yield
	Infant mortality rate	Mortality rate would drop with growth of yield (inverse proportion)
	Child mortality rate	Mortality rate would drop with growth of yield (inverse proportion)
	Consumer inflation	Inflation would increase with drop of agricultural yield (inverse proportion)
Food production economic variability	Political stability	Stability would drop with drop of variability
	Infant mortality rate	Mortality rate would grow with drop of variability (inverse proportion)
	Child mortality rate	Mortality rate would grow with drop of variability (inverse proportion)
	Consumer inflation	Inflation rate would be inversely proportional to variability (inverse proportion)
Crop production index	Political stability	Stability could drop with drop of crop production
	Infant mortality rate	Mortality rate would grow with drop of crop production (inverse proportion)
	Child mortality rate	Mortality rate would grow with drop of crop production (inverse proportion)
	Consumer inflation	Inflation rate would be inversely proportional to crop production (inverse proportion)

Table 19. Secondary connections between agricultural data and socio-economic indices.

Influencing parameter:	Dependent indice:	Polynomial degree	Adjusted R-squared	P-value
Mean agricultural yield (agricultural)	Political stability	5	0.6908	0.1203
	Producer prices	1	-0.01226	0.3787
	Crop production	1	0.4238	0.005108
	Food production economic variability	5	0.1807	0.2498
	Food production	1	0.1437	0.09026
	Infant mortality rate	1	-0.07184	0.8078
	Child mortality rate	1	-0.07136	0.7992
	Consumer inflation	5	0.5724	0.02115
Food production economic variability	Political stability	1	-0.1151	0.6891
	Infant mortality rate	3	0.7222	0.0005892
	Child mortality rate	3	0.7266	0.0005417
	Consumer inflation	1	0.1267	0.1053
Crop production index	Political stability	1	-0.06865	0.5082
	Infant mortality rate	1	0.3254	0.01549
	Child mortality rate	1	0.3327	0.01433
	Consumer inflation	1	0.008547	0.309

Table 20. Table of correlations (Syria)

Index	Polynomial degree	Adjusted R-squared	P-value
Food production economic variability	3	0.04664	0.4207
Arable land used per person	1	-0.005675	0.3585
Mean agricultural yield (cereals per used land area)	3	0.7775	0.00673
Ratio of agricultural, forestry and fishery in GDP	5	0.1376	0.3843
Producer prices index	4	0.9258	0.1819
Crop production index	2	0.08421	0.305
Food production index	2	0.09352	0.2943
Consumer inflation	1	-0.01574	0.3838
Employment in agricultural sector	1	-0.08308	0.6409
Unemployment fraction	1	-0.05916	0.5485
Human development index	3	-0.06729	0.5369
Homicide rate	N/A	N/A	N/A
Infant mortality rate	3	-0.0286	0.4844
Mortality rate (among children under age of 5)	3	-0.0276	0.4831
Political stability index	1	-0.01186	0.372

Table 21. Table of correlations between indices vs SPEI (Côte d'Ivoire).

Influencing parameter:	Dependent indice:	Polynomial degree	Adjusted R-squared	P-value
Mean agricultural yield (agricultural)	Political stability	1	0.1224	0.1716
	Producer prices	4	0.9904	0.06585
	Crop production	1	0.4181	0.02575
	Food production economic variability	2	-0.105	0.5692
	Food production	1	0.4338	0.02285
	Infant mortality rate	1	0.4414	0.02154
	Child mortality rate	1	0.4394	0.02188
	Consumer inflation	5	0.8167	0.02671
Food production economic variability	Political stability	5	0.7013	0.1147
	Infant mortality rate	5	0.5584	0.1957
	Child mortality rate	5	0.56	0.1948
	Consumer inflation	1	0.04777	0.2751
Crop production index	Political stability	5	0.9292	0.004197
	Infant mortality rate	2	0.9665	2.862e-06
	Child mortality rate	2	0.9637	3.787e-06
	Consumer inflation	1	0.1488	0.1474

Table 22. Table of correlations (Côte d'Ivoire)

Index	Polynomial degree	Adjusted R-squared	P-value
Food production economic variability	1	0.5384	0.01477
Arable land used per person	1	0.2978	0.05947
Mean agricultural yield (cereals per used land area)	1	-0.1408	0.9145
Ratio of agricultural, forestry and fishery in GDP	3	0.7031	0.008724
Producer prices index	4	0.9809	0.0926
Crop production index	1	0.3716	0.06392
Food production index	1	0.2942	0.0951
Consumer inflation	5	0.6404	0.06063
Employment in agricultural sector	1	0.2066	0.09014
Unemployment fraction	1	-0.08524	0.72
Human development index	4	0.5334	0.06935
Homicide rate	2	0.3112	0.4792
Infant mortality rate	1	0.5196	0.007417
Mortality rate (among children under age of 5)	1	0.4384	0.01576
Political stability index	1	0.3273	0.0385

Table 23. Table of correlations between indices vs SPEI (Namibia).

Influencing parameter:	Dependent indice:	Polynomial degree	Adjusted R-squared	P-value
Mean agricultural yield (agricultural)	Political stability	1	0.09881	0.213
	Producer prices	3	0.9842	0.009486
	Crop production	5	0.8357	0.1133
	Food production economic variability	5	0.7662	0.0813
	Food production	5	0.37	0.3911
	Infant mortality rate	5	0.2928	0.3585
	Child mortality rate	5	-0.07234	0.5763
	Consumer inflation	4	0.7876	0.03145
Food production economic variability	Political stability	1	0.3291	0.06195
	Infant mortality rate	4	0.6855	0.06639
	Child mortality rate	5	0.7922	0.06876
	Consumer inflation	5	0.986	0.001288
Crop production index	Political stability	1	0.2844	0.09981
	Infant mortality rate	1	0.4873	0.03257
	Child mortality rate	3	0.4156	0.1841
	Consumer inflation	5	0.7603	0.1625

Table 24. Table of correlations (Namibia)

Index	Polynomial degree	Adjusted R-squared	P-value
Food production economic variability	1	-0.08981	0.5777
Arable land used per person	3	0.001146	0.4534
Mean agricultural yield (cereals per used land area)	1	0.0498	0.2867
Ratio of agricultural, forestry and fishery in GDP	1	-0.04966	0.4863
Producer prices index	1	-0.06659	0.4535
Crop production index	1	0.1165	0.2149
Food production index	2	-0.06082	0.4998
Consumer inflation	1	-0.09001	0.6861
Employment in agricultural sector	1	0.08455	0.1988
Unemployment fraction	1	-0.04232	0.4741
Human development index	5	0.03706	0.4686
Homicide rate	1	0.1363	0.197
Infant mortality rate	1	0.007412	0.3269
Mortality rate (among children under age of 5)	1	0.01136	0.3185
Political stability index	5	0.2397	0.3024

Table 25. Table of correlations between indices vs SPEI (Nicaragua).

Influencing parameter:	Dependent indice:	Polynomial degree	Adjusted R-squared	P-value
Mean agricultural yield (agricultural)	Political stability	4	0.8457	0.04082
	Producer prices	3	0.9441	0.03336
	Crop production	2	0.6931	0.0225
	Food production economic variability	2	0.393	0.1238
	Food production	4	0.8982	0.02218
	Infant mortality rate	4	0.8355	0.04483
	Child mortality rate	4	0.8457	0.04084
	Consumer inflation	4	0.7572	0.07866
Food production economic variability	Political stability	5	0.97	0.004012
	Infant mortality rate	4	0.8242	0.02183
	Child mortality rate	4	0.8155	0.02396
	Consumer inflation	3	0.1042	0.3684
Crop production index	Political stability	5	0.515	0.3113
	Infant mortality rate	5	0.6714	0.2185
	Child mortality rate	5	0.689	0.2075
	Consumer inflation	5	-0.1508	0.6309

Table 26. Table of correlations (Nicaragua)

Index	Polynomial degree	Adjusted R-squared	P-value
Food production economic variability	2	0.07964	0.3289
Arable land used per person	4	0.07498	0.4194
Mean agricultural yield (cereals per used land area)	5	0.8255	0.05351
Ratio of agricultural, forestry and fishery in GDP	1	-0.1008	0.7777
Producer prices index	2	-0.3055	0.6933
Crop production index	3	-0.06719	0.5333
Food production index	3	-0.08403	0.5471
Consumer inflation	1	-0.01158	0.3713
Employment in agricultural sector	2	-0.1166	0.6367
Unemployment fraction	2	-0.02361	0.4502
Human development index	2	-0.09304	0.5847
Homicide rate	N/A	N/A	N/A
Infant mortality rate	1	-0.07861	0.6151
Mortality rate (among children under age of 5)	1	-0.07978	0.6216
Political stability index	1	-0.06656	0.555

Table 27. Table of correlations between indices vs SPEI (Nigeria).

Influencing parameter:	Dependent indice:	Polynomial degree	Adjusted R-squared	P-value
Mean agricultural yield (agricultural)	Political stability	5	0.04435	0.5093
	Producer prices	1	0.1733	0.2256
	Crop production	3	-0.01398	0.4902
	Food production economic variability	3	0.06844	0.4006
	Food production	5	0.1386	0.5065
	Infant mortality rate	5	0.04462	0.5091
	Child mortality rate	5	0.03107	0.5171
	Consumer inflation	1	0.2455	0.09949
Food production economic variability	Political stability	1	-0.02709	0.4039
	Infant mortality rate	5	0.9619	0.005722
	Child mortality rate	5	0.9625	0.005593
	Consumer inflation	4	0.3348	0.2583
Crop production index	Political stability	2	0.1118	0.3206
	Infant mortality rate	1	0.7781	0.002323
	Child mortality rate	1	0.7761	0.002389
	Consumer inflation	1	-0.1467	0.7576

Table 28. Table of correlations (Nigeria)

Index	Polynomial degree	Adjusted R-squared	P-value
Food production economic variability	5	0.6838	0.1241
Arable land used per person	4	0.8876	0.003258
Mean agricultural yield (cereals per used land area)	5	0.4731	0.1863
Ratio of agricultural, forestry and fishery in GDP	1	-0.08435	0.712
Producer prices index	4	0.9892	0.06979
Crop production index	5	0.6582	0.08609
Food production index	5	0.6789	0.07676
Consumer inflation	5	0.3666	0.1731
Employment in agricultural sector	5	0.7063	0.03802
Unemployment fraction	2	0.4461	0.0284
Human development index	5	0.7546	0.02498
Homicide rate	5	0.6029	0.113
Infant mortality rate	5	0.5787	0.08673
Mortality rate (among children under age of 5)	5	0.5992	0.07753
Political stability index	4	0.586	0.04987

Table 29. Table of correlations between indices vs SPEI (Paraguay).

Influencing parameter:	Dependent indice:	Polynomial degree	Adjusted R-squared	P-value
Mean agricultural yield (agricultural)	Political stability	2	0.5854	0.01904
	Producer prices	3	0.2273	0.4257
	Crop production	1	0.7666	0.0005546
	Food production economic variability	3	0.326	0.1292
	Food production	1	0.7538	0.0006907
	Infant mortality rate	4	0.7293	0.0274
	Child mortality rate	4	0.7136	0.03133
	Consumer inflation	2	0.01919	0.3877
Food production economic variability	Political stability	1	0.1566	0.1589
	Infant mortality rate	1	0.3462	0.05594
	Child mortality rate	1	0.3607	0.05124
	Consumer inflation	3	0.06718	0.4497
Crop production index	Political stability	5	0.7451	0.04993
	Infant mortality rate	4	0.971	0.0001137
	Child mortality rate	4	0.9757	7.306e-05
	Consumer inflation	2	0.07981	0.3101

Table 30. Table of correlations (Paraguay)

Index	Polynomial degree	Adjusted R-squared	P-value
Food production economic variability	1	-0.1421	0.9463
Arable land used per person	1	0.1542	0.1428
Mean agricultural yield (cereals per used land area)	1	-0.1033	0.6317
Ratio of agricultural, forestry and fishery in GDP	1	0.2791	0.05471
Producer prices index	3	0.7584	0.1414
Crop production index	5	0.7498	0.1693
Food production index	5	0.8001	0.1367
Consumer inflation	1	0.2921	0.04985
Employment in agricultural sector	1	0.1459	0.1342
Unemployment fraction	1	0.1273	0.1377
Human development index	1	0.196	0.0967
Homicide rate	1	-0.07941	0.577
Infant mortality rate	1	0.1571	0.1249
Mortality rate (among children under age of 5)	1	0.1582	0.1239
Political stability index	5	0.6064	0.07445

Table 31. Table of correlations between indices vs SPEI (Philippines).

Influencing parameter:	Dependent indice:	Polynomial degree	Adjusted R-squared	P-value
Mean agricultural yield (agricultural)	Political stability	4	0.7937	0.02971
	Producer prices	3	0.7751	0.1319
	Crop production	1	-0.04072	0.4268
	Food production economic variability	2	0.3071	0.1403
	Food production	2	0.3588	0.142
	Infant mortality rate	1	0.7706	0.00115
	Child mortality rate	1	0.757	0.001414
	Consumer inflation	3	0.402	0.1487
Food production economic variability	Political stability	3	0.08981	0.3812
	Infant mortality rate	2	0.1662	0.2445
	Child mortality rate	2	0.1763	0.2358
	Consumer inflation	1	-0.12	0.7168
Crop production index	Political stability	1	0.02129	0.3243
	Infant mortality rate	1	-0.1529	0.798
	Child mortality rate	1	-0.149	0.7714
	Consumer inflation	1	-0.1238	0.6491

Table 32. Table of correlations (Philippines)

Index:	Projection on last comparable year in database (best model fit):	Real value:	Resulting deviation:	Absolute value of residual standard error for best model fit:
Food production economic variability	8.953245	7.8	1.15325	2.014
Arable land used per person	0.1451733	0.14	0.0051733	0.007091
Mean agricultural yield (cereals per used land area)	22422.34	22780	-357.66	89.96
Ratio of agricultural, forestry and fishery in GDP	22.28902	20.7	1.58902	2.254
Producer prices index	178.9038	178.9	0.0038	3.655
Crop production index	96.58616	109.8	-13.2138	14.06
Food production index	96.76703	109.1	-12.333	13.12
Consumer inflation	1.473028	2.43	-0.956972	1.493
Employment in agricultural sector	44.63203	40.2	4.43203	2.811
Unemployment fraction	8.467028	9.03	-0.562972	0.2559
Human development index	0.5024521	0.538	-0.0355479	0.02753
Homicide rate	N/A	N/A	N/A	N/A
Infant mortality rate	66.76007	58.6	8.16007	6.018
Mortality rate (among children under age of 5)	93.05962	79.3	13.7596	10.21
Political stability index	-1.169655	-0.96	-0.209655	0.241

Table 33. Table of deviation analysis (Côte d'Ivoire).

Index:	Projection on last comparable year in database (best model fit):	Real value:	Resulting deviation:	Absolute value of residual standard error for best model fit:
Food production economic variability	8.566301	2.4	6.1663	4.502
Arable land used per person	0.3438575	0.33	0.0138575	0.01543
Mean agricultural yield (cereals per used land area)	3979.788	4359	-379.212	743.9
Ratio of agricultural, forestry and fishery in GDP	6.535607	6.61	-0.074393	0.459
Producer prices index	184.8128	185.1	-0.2872	5.062
Crop production index	116.4393	121.4	-4.9607	5.898
Food production index	91.62096	92.6	-0.97904	0.9755
Consumer inflation	3.724983	3.72	0.004983	1.016
Employment in agricultural sector	22.19892	21.9	0.29892	3.348
Unemployment fraction	20.41345	20.4	0.01345	1.895
Human development index	0.6473363	0.646	0.0013363	0.0166
Homicide rate	16.87799	17.7	-0.82201	2.433
Infant mortality rate	30.92782	30.7	0.22782	1.848
Mortality rate (among children under age of 5)	43.72209	42.4	1.32209	2.526
Political stability index	0.6044665	0.53	0.0744665	0.1282

Table 34. Table of deviation analysis (Namibia).

Index:	Projection on last comparable year in database (best model fit):	Real value:	Resulting deviation:	Absolute value of residual standard error for best model fit:
Food production economic variability	6.096592	7.5	-1.40341	1.561
Arable land used per person	0.243092	0.23	0.013092	0.01699
Mean agricultural yield (cereals per used land area)	19332.06	17680	1652.06	1195
Ratio of agricultural, forestry and fishery in GDP	15.94636	15.4	0.54636	1.241
Producer prices index	188.5239	223.7	-35.1761	27.84
Crop production index	123.9858	137.7	-13.7142	9.546
Food production index	126.9449	128.5	-1.5551	4.911
Consumer inflation	5.107376	5.38	-0.272624	1.646
Employment in agricultural sector	30.7264	30.6	0.1264	0.7132
Unemployment fraction	6.122612	5.82	0.302612	1.471
Human development index	0.6605278	0.66	0.0005278	0.01594
Homicide rate	10.69355	7.19	3.50355	2.363
Infant mortality rate	16.4974	14.3	2.1974	2.237
Mortality rate (among children under age of 5)	19.27338	16.6	2.67338	2.731
Political stability index	-1.068924	-1.03	-0.038924	0.2985

Table 35. Table of deviation analysis (Nicaragua).

Index:	Projection on last comparable year in database (best model fit):	Real value:	Resulting deviation:	Absolute value of residual standard error for best model fit:
Food production economic variability	10.09796	6.9	3.19796	3.012
Arable land used per person	0.1737197	0.17	0.0037197	0.01452
Mean agricultural yield (cereals per used land area)	15031	14620	411	418.8
Ratio of agricultural, forestry and fishery in GDP	21.9757	21.9	0.0757	2.015
Producer prices index	96.6541	120	-23.3459	25.22
Crop production index	111.5001	118.9	-7.3999	11.33
Food production index	116.218	124.6	-8.382	12.57
Consumer inflation	12.08326	11.4	0.68326	2.767
Employment in agricultural sector	37.56749	35	2.56749	2.596
Unemployment fraction	5.433402	9.01	-3.5766	2.321
Human development index	0.5197521	0.539	-0.0192479	0.02086
Homicide rate	N/A	34.5	N/A	N/A
Infant mortality rate	80.1075	74.2	5.9075	3.841
Mortality rate (among children under age of 5)	127.9158	117.2	10.7158	6.949
Political stability index	-2.028826	-1.93	-0.098826	0.1025

Table 36. Table of deviation analysis (Nigeria).

Index:	Projection on last comparable year in database (best model fit):	Real value:	Resulting deviation:	Absolute value of residual standard error for best model fit:
Food production economic variability	89.03394	76.6	12.4339	11.78
Arable land used per person	0.6914824	0.68	0.0114824	0.01034
Mean agricultural yield (cereals per used land area)	43793.6	42260	1533.6	4883
Ratio of agricultural, forestry and fishery in GDP	10.83717	10.80	0.03717	1.535
Producer prices index	184.5842	184.6	-0.0158	2.287
Crop production index	107.0502	111.5	-4.4498	11.64
Food production index	104.8901	109.2	-4.3099	9.871
Consumer inflation	1.7696	1.77	-0.0004	1.326
Employment in agricultural sector	20.37068	18.7	1.67068	1.681
Unemployment fraction	7.572622	7.61	-0.037378	0.7547
Human development index	0.7222733	0.728	-0.0057267	0.007555
Homicide rate	8.580117	7.14	1.440117	1.142
Infant mortality rate	18.04412	16.6	1.44412	1.278
Mortality rate (among children under age of 5)	21.11661	19.4	1.71661	1.547
Political stability index	-0.2464215	0.00	-0.2464215	0.2753

Table 37. Table of deviation analysis (Paraguay).

Index:	Projection on last comparable year in database (best model fit):	Real value:	Resulting deviation:	Absolute value of residual standard error for best model fit:
Food production economic variability	5.087181	8.3	-3.21282	1.611
Arable land used per person	0.05519943	0.05	0.00519943	0.004749
Mean agricultural yield (cereals per used land area)	34524.96	36920	-2395.04	1757
Ratio of agricultural, forestry and fishery in GDP	10.28636	8.82	1.46636	1.661
Producer prices index	165.6995	165.3	0.3995	5.846
Crop production index	110.0953	109.6	0.4953	1.784
Food production index	113.3437	114	-0.6563	1.585
Consumer inflation	2.01602	2.48	-0.46398	1.163
Employment in agricultural sector	26.81365	22.9	3.91365	3.514
Unemployment fraction	3.36	3.065979	0.294021	0.5241
Human development index	0.7152136	0.718	-0.0027864	0.01782
Homicide rate	9.164326	6.46	2.70433	1.216
Infant mortality rate	22.86686	21.6	1.26686	1.014
Mortality rate (among children under age of 5)	28.98395	27.3	1.68395	1.418
Political stability index	-0.9306796	-0.88	-0.0506796	0.2022

Table 38. Table of deviation analysis (Philippines).

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