Mediterranean agriculture under climate change: adaptive capacity, adaptation, and ethics

Article

Supplemental Material

Appendix – Effects of climate change on agriculture in the Mediterranean region

Table 5 – Estimates for agricultural impacts (modified from Cline 2007) by 2080 (reference year 2003)

Country	Impact without carbon fertilization effect (% yield)	Impact with carbon fertilization effect (% yield)
Algeria	-36	-26.4
Egypt	11.3	28
France	-6.7	7.3
Greece	-7.8	6
Italy	-7.4	6.5
Morocco	-39	-29.9
Portugal	-9.6	4
Southeast Europe	-8.6	5.1
Spain	-8.9	4.8
Syrian Arab Republic	-27	-16
Turkey	-16.2	-3.6

Adaptive capacity index

Table 6 – Determinants of adaptive capacity in agriculture and their rationale (from Smit et al 2001)

Determinant	Rationale
Economic resources	Greater economic resources increase adaptive capacity
	Lack of financial resources limits adaptation options
Technology	Lack of technology limits range of potential adaptation options
	Less technologically advanced regions are less likely to develop and/or implement technological adaptations
Information and skills	Lack of informed, skilled and trained personnel reduces adaptive capacity
	Greater access to information increases likelihood of timely and appropriate adaptation
Infrastructure	Greater variety of infrastructure can enhance adaptive capacity, since it provides more options
	Characteristics and location of infrastructure also affect adaptive capacity
Institutions	Well-developed social institutions help to reduce impacts of climate-related risks, and therefore increase adaptive capacity
	Policies and regulations may constrain or enhance adaptive capacity
Equity	Equitable distribution of resources increases adaptive capacity
	Both availability of, and entitlement to, resources is important

Sensitivity analysis

In the sensitivity analysis 5 different weighting systems were tested by comparing the resulting rankings of the adaptive capacity index (ACI) (Table 3 in the Article):

- A baseline giving equal weight to the determinants.
- A weighting system giving a weight of 1,2 points to determinants a, b and d, and 0,8 to the remaining determinants (weighting system 1). Determinants a, b and d are composed by agriculture-specific indicators and therefore potentially deserving a higher weight than the remaining indicators, which refer to society at large.
- A weighting system giving a weight of 1,5 points to determinants a, b and d, and 0,5 to the remaining determinants (weighting system 2). This weighting system is analogous, but more extreme, than the previous one.
- A weighting system giving a weight of 1,2 points to indicators b2 and d1, and 0,8 to the remaining determinants (weighting system 3). Indicators b2 and d1 are related to water issues and therefore potentially deserve a higher weight, being water scarcity one of the most serious expected effects of climate change in the Mediterranean region.
- A weighting system giving a weight of 1,5 points to indicators b2 and d1, and 0,5 to the remaining determinants (weighting system 4). This weighting system is analogous, but more extreme, than the previous one.

Table 7 – Results of the sensitivity analysis

Country	Total ACI equal weight	Rank total ACI - equal weight	Total ACI weighting 1	Rank total ACI - weighting 1	Total ACI weighting 2	Rank total ACI - weighting 2	Total ACI weighting 3	Rank total ACI - weighting 3	Total ACI weighting 4	Rank total ACI - weighting 4
Albania	0.315	7	0.307	7	0.295	7	0.322	6	0.329	6
Algeria	0.276	10	0.276	9	0.277	9	0.263	11	0.250	11
Egypt	0.282	8	0.277	8	0.270	10	0.304	7	0.327	7
France	0.721	1	0.698	1	0.665	1	0.702	1	0.684	1
Greece	0.559	4	0.533	3	0.494	3	0.530	3	0.501	3
Italy	0.620	2	0.610	2	0.596	2	0.603	2	0.586	2
Jordan	0.273	11	0.247	12	0.207	12	0.276	9	0.278	9
Lebanon	0.259	12	0.275	10	0.298	6	0.266	10	0.272	10
Morocco	0.197	13	0.199	13	0.202	13	0.183	13	0.168	13
Portugal	0.484	5	0.452	5	0.404	5	0.456	5	0.429	5
Spain	0.562	3	0.533	4	0.491	4	0.526	4	0.490	4
Tunisia	0.276	9	0.267	11	0.253	11	0.253	12	0.229	12
Turkey	0.318	6	0.308	6	0.293	8	0.302	8	0.286	8

Table 8 – Detailed data for the indicators

Countries	Values – Indicators											
	Agriculture value added per worker	Agricultural value added pro capita * 1000	Agricultural machinery	Area equipped for irrigation/ Cultivated area	Students in tertiary education/ 100000 inhabitants	Internet users/Total population	Annual freshwater withdrawals for agriculture/ Total freshwater withdrawals	Agricultural area	Government effectiveness index	Mobile phones subscriptions/100 population	GINI index	Per capita total expenditure on health at average exchange rate
Albania	1800.00 [a]	330.81	142.85	48.64 [b]	2505.61 [e]	15.04	61.99	0.36	-0.20	99.90	33.00	187.00
Algeria	2304.55	210.49	140.40	6.94 [b]	2739.33 [c]	10.34	64.91	1.22	-0.59	92.70	35.30	148.00
Bosnia and Herzegovina	11646.98	175.70	283.76	0.27 [b]	3042.02 [c]	27.92	-	0.57	-0.65	84.30	36.30	296.00
Croatia	16123.43	378.01	2228.72	0.32 [b]	3274.20	44.70	-	0.27	0.64	132.70	29.00	790.00
Cyprus	9947.76	302.62	1017.39	31.51	3261.16	38.12	-	0.18	1.32	117.90	29.00 [g]	1459.00
Egypt	2839.20	244.70	339.91	99.94 [b]	3125.79	14.76	86.38	0.04	-0.30	50.60	32.10	92.00
France	48983.20	531.31	615.74	13.68	3532.02	63.54	9.81	0.48	1.44	93.10	32.70	3937.00
Greece	7411.19	514.99	1017.66	47.92	5477.82 [d]	30.20	80.44	0.74	0.61	122.80	34.30	2280.00
Israel	-	-	-	58.89	4705.15	48.13	57.78	0.07	1.09	122.90	39.20	1675.00
Italy	27636.67	444.23	2667.69	40.71	3412.84	38.28	45.10	0.23	0.52	151.00	36.00	2813.00
Jordan	2558.48	53.67	384.89	35.63	4260.32	20.00	64.96	0.17	0.28	91.40	37.70	238.00
Lebanon	31834.26	263.08	575.59	33.21 [b]	4762.35	18.74	59.54	0.17	-0.67	34.00	45.00 [f]	494.00
Libyan Arab Jamahiriya	-	-	-	21.86 [b]	-	4.72	82.85	2.53	-1.12	76.70	36.00 [f]	219.00
Macedonia, FYR	4643.94	177.82	1243.76	27.37	3244.04	36.30	-	0.53	-0.14	122.60	42.80	249.00
Malta	-	-	-	34.41	2345.36	45.33	-	0.02	1.11	93.60	26.00 [h]	1308.00
Montenegro	2196.39	155.76	1828.91	-	-	45.09	-	0.83	-0.03	118.10	36.90	348.00
Morocco	2147.98	218.20	53.60	16.57	1295.14	21.40	87.38	0.97	-0.11	72.20	40.90	113.00
Portugal	6187.74	335.10	1629.73	34.91	3564.78	39.62	78.24	0.33	1.21	140.40	38.50	1864.00
Serbia	-	-	-	-	3269.88	29.87	-	0.68	-0.15	130.90	28.20	336.00
Slovenia	62779.35	279.97	5762.71	2.02	5784.87	53.30	-	0.25	1.16	101.70	31.20	1607.00
Spain	19140.97	510.62	800.03	21.10	4048.71	52.02	68.03	0.64	0.94	109.00	34.70	2328.00
Syrian Arab Republic	4394.25	297.68	228.94	25.32	-	16.92	87.89	0.68	-0.61	34.30	42.00 [f]	66.00
Tunisia	3496.96	269.14	143.82	8.03 [b]	3506.30	17.10	82.01	0.96	0.41	83.30	40.80	156.00
Turkey	3145.86	376.88	473.86	20.02	3489.10	30.10	73.82	0.54	0.35	89.10	41.20	352.00

[a] Estimate of the authors based on historical trend 1998-2005; [b] Data for 2000, 2001 or 2002; [c] Estimate of the authors based on historical trend 2000-2009; [d] Value for 2007; [e] elaborated from the Albanian Statistical Office; [f] Data refer to 2008; [g] Data for 2005; [h] Data for 2007.

Table 8 – Detailed data for the indicators (continued)

Countries	Normalized values – Indicators											
	Agriculture value added per worker	Agricultural value added pro capita * 1000	Agricultural machinery	Area equipped for irrigation/ Cultivated area	Students in tertiary education/ 100000 inhabitants	Internet users/Total population	Annual freshwater withdrawals for agriculture/ Total freshwater withdrawals	Agricultural area	Government effectiveness index	Mobile phones subscriptions/100 population	GINI index	Per capita total expenditure on health at average exchange rate
Albania	0.00	0.58	0.02	0.49	0.27	0.18	0.33	0.13	0.36	0.56	0.63	0.03
Algeria	0.01	0.33	0.02	0.07	0.32	0.10	0.29	0.48	0.21	0.50	0.51	0.02
Bosnia and Herzegovina	0.16	0.26	0.04	0.00	0.39	0.39	-	0.22	0.18	0.43	0.46	0.06
Croatia	0.23	0.68	0.38	0.00	0.44	0.68	-	0.10	0.69	0.84	0.84	0.19
Cyprus	0.13	0.52	0.17	0.31	0.44	0.57	-	0.06	0.95	0.72	0.84	0.36
Egypt	0.02	0.40	0.05	1.00	0.41	0.17	0.02	0.01	0.32	0.14	0.68	0.01
France	0.77	1.00	0.10	0.13	0.50	1.00	1.00	0.18	1.00	0.51	0.65	1.00
Greece	0.09	0.97	0.17	0.48	0.93	0.43	0.10	0.29	0.67	0.76	0.56	0.57
Israel	-	-	-	0.59	0.76	0.74	0.39	0.02	0.86	0.76	0.31	0.42
Italy	0.42	0.82	0.46	0.41	0.47	0.57	0.55	0.08	0.64	1.00	0.47	0.71
Jordan	0.01	0.00	0.06	0.35	0.66	0.26	0.29	0.06	0.55	0.49	0.38	0.04
Lebanon	0.49	0.44	0.09	0.33	0.77	0.24	0.36	0.06	0.17	0.00	0.00	0.11
Libyan Arab Jamahiriya	-	-	-	0.22	-	0.00	0.06	1.00	0.00	0.36	0.47	0.04
Macedonia, FYR	0.05	0.26	0.21	0.27	0.43	0.54	-	0.20	0.38	0.76	0.12	0.05
Malta	-	-	-	0.34	0.23	0.69	-	0.00	0.87	0.51	1.00	0.32
Montenegro	0.01	0.21	0.31	-	-	0.69	-	0.32	0.42	0.72	0.43	0.07
Morocco	0.01	0.34	0.00	0.16	0.00	0.28	0.01	0.38	0.39	0.33	0.22	0.01
Portugal	0.07	0.59	0.28	0.35	0.51	0.59	0.12	0.12	0.91	0.91	0.34	0.46
Serbia	-	-	-	-	0.44	0.43	-	0.26	0.38	0.83	0.88	0.07
Slovenia	1.00	0.47	1.00	0.02	1.00	0.83	-	0.09	0.89	0.58	0.73	0.40
Spain	0.28	0.96	0.13	0.21	0.61	0.80	0.25	0.25	0.80	0.64	0.54	0.58
Syrian Arab Republic	0.04	0.51	0.03	0.25	-	0.21	0.00	0.26	0.20	0.00	0.16	0.00
Tunisia	0.03	0.45	0.02	0.08	0.49	0.21	0.08	0.37	0.60	0.42	0.22	0.02
Turkey	0.02	0.68	0.07	0.20	0.49	0.43	0.18	0.21	0.57	0.47	0.20	0.07