

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

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7 **Abstract** In the coming decades, the Mediterranean
8 region is expected to experience various climate impacts
9 with negative consequences on agricultural systems and
10 which will cause uneven reductions in agricultural pro-
11 duction. By and large, the impacts of climate change on
12 Mediterranean agriculture will be heavier for southern areas
13 of the region. This unbalanced distribution of negative
14 impacts underscores the significance and role of ethics in
15 such a context of analysis. Consequently, the aim of this
16 article is to justify and develop an ethical approach to
17 agricultural adaptation in the Mediterranean and to derive
18 the consequent implications for adaptation policy in the
19 region. In particular, we define an index of adaptive
20 capacity for the agricultural systems of the Mediterranean
21 region on whose basis it is possible to group its different
22 sub-regions, and we provide an overview of the suitable
23 adaptation actions and policies for the sub-regions identi-
24 fied. We then vindicate and put forward an ethical approach
25 to agricultural adaptation, highlighting the implications for
26 the Mediterranean region and the limitations of such an
27 ethical framework. Finally, we emphasize the broader
28 potential of ethics for agricultural adaptation policy.
29

Keywords Adaptation · Adaptive capacity · Agriculture · 30
Climate change · Ethics · Mediterranean region 31

Introduction 32

The harmful effects of global climate change on agriculture 33
are unevenly distributed across regions, countries, and areas 34
within countries because they depend on local physical and 35
environmental conditions (Ferrara et al. 2009; Giorgi and 36
Lionello 2008; Giorgi et al. 2004), and on the sensitivity, 37
vulnerability, and adaptive capacity of different natural and 38
social systems (Brooks et al. 2005; Smit and Skinner 2002). 39
Climate change will significantly influence agricultural 40
production in the coming decades (Cline 2007; Olesen and 41
Bindi 2002), and, possibly, current climatic patterns are 42
already impacting on specific agroecosystems and crops 43
(Ben Mohamed et al. 2002; Nicholls and Hoozemans 1996). 44

Existing scientific research clearly indicates that climate 45
change, besides having strong negative impacts on agricul- 46
ture in developing countries (Cline 2007), will largely affect 47
Southern Europe (Olesen and Bindi 2002). Specifically, this 48
region is expected to experience severe negative effects on 49
yield for many crop species (Iglesias et al. 2009; Magnan 50
et al. 2009; Giannakopoulos et al. 2005; Maracchi et al. 51
2005). Despite the high variability in effects expected in 52
different sub-regions and for different crop species, countries 53
in Southern Europe are deemed to have more in common 54
with other non-European countries in the Mediterranean 55
region than with countries in Northern Europe (Giannako- 56
poulos et al. 2005, 2009). In short, agriculture in the entire 57
Mediterranean basin is going to suffer severely from climate 58
change (Iglesias et al. 2011; Giannakopoulos et al. 2009). 59

Between 2031 and 2090, the Mediterranean region 60
is expected to experience various climate impacts with 61

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62 negative consequences on agricultural systems (Giorgi and
63 Lionello 2008). An increase in water stress would be par-
64 ticularly serious, as the region is already experiencing
65 water shortages due to climatic conditions and to an often
66 inefficient water management system (Iglesias et al. 2011;
67 Rodríguez-Díaz and Topcu 2010; Magnan et al. 2009).
68 Other expected effects include the increased frequency of
69 extreme meteorological events (Giannakopoulos et al.
70 2005; Maracchi et al. 2005), increased interannual climatic
71 variability (Maracchi et al. 2005), reduction of suitable
72 areas for traditional crops (Maracchi et al. 2005), sea level
73 rise, increased soil salinity, and coastal erosion (Iglesias
74 et al. 2011; Sánchez-Arcilla et al. 2011).

75 Furthermore, these climatic impacts are expected to cause a
76 substantially uneven reduction in agricultural production.
77 Iglesias et al. (2009) used crop yield functions to estimate a
78 yield variation, in the time frame between 2071 and 2100, in
79 the range of -22 to 0% for the Mediterranean North. In the
80 Mediterranean South, the estimated range is between -27 and
81 5% , depending on the climate scenario considered.¹ Import-
82 antly, the reduction in agricultural production is expected to
83 differ across sub-regions (e.g., Mediterranean North or
84 South), crops, and seasons (Giannakopoulos et al. 2009; Cline
85 2007) as shown by Table 5 in the supplementary Appendix.

86 It therefore seems likely that the impacts of climate
87 change and variability on Mediterranean agriculture will be
88 heavier in southern areas. This unbalanced distribution of
89 negative effects makes Mediterranean agriculture a partic-
90 ular sensitive and controversial context. Hence, in our
91 view, it emphasizes the role and potential of ethical anal-
92 ysis, which is still infrequent in the current literature.
93 Ethical considerations, in fact, imply greater legitimacy
94 and can persuade parties with conflicting interests to
95 cooperate more closely on collective actions.

96 This article, therefore, aims to investigate the fundamental
97 ethical issues raised by adaptation to climate change in
98 Mediterranean agriculture. In particular, we intend clearly to
99 identify (1) the subjects of justice in the context of the con-
100 sidered agricultural systems, (2) the principles of distribution
101 that justify the moral duties and rights of subjects of justice,
102 and (3) the types of adaptation-related burdens and benefits
103 that should be shared fairly among subjects of justice.

104 To this end, we argue that a regional perspective is more
105 likely to account for the ethical traits, characteristics, and
106 needs of Mediterranean agriculture because of its greater
107 ability, as compared to a global perspective, to include local
108 specificities and the consequent plurality of interests
109 and objectives of the subjects involved. This standpoint,

110 moreover, would reduce the complexity of adaptation poli-
111 cies due to the more limited number of parties involved, and
112 the consequent less cumbersome bureaucratic and adminis-
113 trative requirements, and it would ultimately have a higher
114 chance of success (Liverman and Ingram 2010). States, in
115 fact, are expected to have more incentives to enter into a
116 regional agreement rather than a global one, because the
117 former can reflect local exigencies more closely, reduce risks
118 of non-cooperation, and lower transaction costs (Asheim
119 et al. 2003). We are nonetheless aware of the limitations of
120 our investigation, which for a comprehensive grasp should
121 take account of institutional considerations, precluded here
122 by space constraints. Nevertheless, our study indicates that an
123 ethical focus, i.e., the scrutiny of the three constituents of
124 distributive justice mentioned above, on Mediterranean
125 agricultural systems makes it possible to develop fresh, wide-
126 ranging, and more acceptable and feasible approaches to
127 agricultural adaptation policy in the region.

128 In particular, the second section of the article defines an
129 index of adaptive capacity for the agricultural systems of
130 the Mediterranean region on whose basis it is possible to
131 group its different sub-regions. The third section provides
132 an overview of the suitable adaptation actions and policies
133 for the sub-regions identified in the second section. The
134 fourth section explores and vindicates the constituents of
135 distributive justice in relation to adaptation, and it develops
136 an ethical framework in which to analyze and contextualize
137 Mediterranean agricultural adaptation. The fifth section
138 discusses the implications of such an ethical framework on
139 Mediterranean agricultural adaptation and sets out its main
140 limitations. The concluding section emphasizes the broader
141 potential of ethics for agricultural adaptation policy.

142 The adaptive capacity index

143 Methodology

144 Although some indicator sets and indices have been pro-
145 posed to assess adaptive capacity in agriculture (e.g.,
146 Iglesias et al. 2009, 2011; Tubiello and Rosenzweig 2008;
147 Swanson et al. 2007), there are no agreed-upon and
148 uncontroversial measures of adaptive capacity in agricul-
149 ture (Reidsma et al. 2009).

150 The present study is largely based on the adaptive capacity
151 index (ACI) approach proposed by Swanson et al. (2007),
152 which in its turn is based on the index of Smit et al. (2001). We
153 have privileged this approach for a number of reasons: (1) it
154 proposes a comprehensive and theoretically based framework
155 for analysis; (2) it specifically targets adaptive capacity in
156 agricultural systems; (3) it can be operationalized through
157 secondary data sources and thus does not need direct data
158 collection; and (4) its main strength lies in the relative

1FL01 ¹ These estimates already include the direct positive effects of carbon
1FL02 dioxide (CO₂) on crops, the rain-fed and irrigated simulations in each
1FL03 district, changes in crop distribution in the scenario due to modified
1FL04 crop suitability under the warmer climate, and endogenous adaptation.

159 comparison of geographical units with respect to widely
160 agreed-upon determinants of adaptive capacity, thus provid-
161 ing basic information for the prioritizing of adaptation options.

162 The ACI is defined by the performance of the agricul-
163 tural system in relation to six determinants named,
164 according to the original work of Smit et al. (2001): eco-
165 nomic resources, technology, information and skills,
166 infrastructure, institutions, and equity (see also Table 6 in
167 the supplementary Appendix). To our knowledge, this is
168 the first study attempting to measure adaptive capacity in
169 agriculture for the entire Mediterranean region.

170 These six determinants are operationalized through
171 twelve indicators, and each determinant is associated with
172 two indicators. The selection of the attributes is based on
173 the literature (Iglesias et al. 2011; Swanson et al. 2007;
174 Smit et al. 2001) and on data availability (Table 1).

175 The main objectives of the ACI are identification of the
176 adaptive capacities of national agricultural systems (NAS)
177 and comparative exploration of their determinants. This
178 index therefore does not give an absolute measure of adaptive
179 capacity but rather compares and ranks the NAS considered,
180 thereby pointing out which countries might warrant further
181 and more detailed analysis on the determinants or aspects
182 considered.

183 The ACI index is calculated by normalizing the values
184 of the indicators according to the following formulas:

$$\text{Normalized value (higher is better)} = \frac{\left(\text{value for the NAS to be normalized} - \text{minimum value for all NASs}\right)}{\left(\text{maximum value for all NASs} - \text{minimum value for all NASs}\right)} \quad (1)$$

$$\text{Normalized value (lower is better)} = 1 - \left[\frac{\left(\text{value for the NAS to be normalized} - \text{minimum value for all NASs}\right)}{\left(\text{maximum value for all NASs} - \text{minimum value for all NASs}\right)} \right] \quad (2)$$

185 The normalized values for each indicator are first
186 aggregated by determinant, and then in the total ACI, as the
187 average of the normalized values (Swanson et al. 2007).
188 This progressive aggregation procedure makes it possible
189 to define an overall index. At the same time, it guarantees
190 transparency by making the rankings of each determinant
191 visible. Furthermore, we carried out a sensitivity analysis
192 to test the robustness of the rankings under five different
193 weighting systems (see supplementary Appendix). Because
194 no significant differences were observed, the results pre-
195 sented here refer to the baseline case, in which equal
196 weight is adopted for each indicator and determinant.

The ACI index is calculated for four groups of Medi- 197
terranean countries: (1) North Mediterranean countries 198
belonging to the European Union (NM-EU: Cyprus, 199
France, Greece, Italy, Malta, Portugal, Slovenia, and 200
Spain); (2) North Mediterranean countries not belonging to 201
the European Union (NM: Albania, Bosnia and Herzego- 202
vina, Croatia, Macedonia FYR, Montenegro, Serbia, and 203
Turkey); (3) Middle Eastern countries (ME: Israel, Jordan, 204
Lebanon, and Syrian Arab Republic); and (4) North Afri- 205
can countries (NA: Algeria, Egypt, Libyan Arab Jama- 206
hiriya, Morocco, and Tunisia). 207

Results 208

The ranking for the total ACI shows a clear divide between 209
the North Mediterranean countries belonging to the EU and 210
the Middle Eastern and North African countries (Table 2). 211
France and Portugal stand out among the North Mediter- 212
ranean countries, the former being the country with the 213
highest index, and the latter with the lowest index, within 214
this sub-region. Among the remaining countries, some 215
minor differences can be observed between North Medi- 216
terranean countries not belonging to the EU and the North 217
African and Middle Eastern ones, although only Morocco 218
stands out at a significant level (negatively) from this 219
group. 220

The analysis of the rankings of the ACI individual 221
determinants allows us to identify those that most influence 222
the ranking of the total ACI: namely economic resources, 223
information and skills, institutions and networks, and 224
equity. The rankings of these determinants are both more 225
skewed than the remaining ones and show a high tendency 226
to cluster by sub-regions. Specifically, NM-EU countries 227
consistently rank higher than almost all other countries. In 228
other words, NM-EU countries perform better than other 229
countries in regard to: (1) value added produced (per 230
worker and per capita unit), with the partial exception of 231
Portugal and Cyprus, which show very low levels of 232

Table 1 Indicators of the ACI

Determinant	Attribute	Indicator	Unit	Better	Data source*	Reference period
Economic resources	Income generation	Agriculture value added per worker	Constant 2000 USD	High	WB, FAO	2007
		Agricultural value added per capita * 1,000	Constant 2000 USD	High	WB, OECD	2007
Technology	Technological exposure	Agricultural machinery	Tractors per 100 km ² of arable land	High	FAO	2007
	Water access technology	Area equipped for irrigation/cultivated area	%	High	FAO	2007
Information and skills	Education	Students in tertiary education/100,000 inhabitants	Number	High	UN	2008
	Access to information	Internet users/total population	%	High	UN	2007
Infrastructure	Water resources	Annual freshwater withdrawals for agriculture/total freshwater withdrawals	%	Low	FAO	2007
	Soil resources	Agricultural area	Ha per person	High	FAO, UN	2007
Institutions and networks	Effective governance	Government effectiveness index	Dimensionless	High	WB	2009
	Social networks	Mobile phones subscriptions/100 population	%	High	ITU, WB	2008
Equity	Inequality	GINI index	Dimensionless	Low	WB	2010
	Availability of health care resources	Per capita total expenditure on health at average exchange rate	USD	High	WHO	2006

* WB World Bank, FAO Food and Agriculture Organization, UN United Nations, ITU International Telecommunication Union, WHO World Health Organization, OECD Organisation for Economic Co-operation and Development

233 productivity per worker unit; (2) educational level and
 234 access to information, where also Israel, Croatia, Lebanon,
 235 and Jordan perform relatively well, especially the latter two
 236 because of relatively high levels of tertiary education; (3)
 237 government effectiveness and social networks, where again
 238 also Israel and Croatia perform relatively well; and (4) Gini
 239 index and health expenditure, where Croatia and Serbia
 240 also perform relatively well, and Turkey performs rela-
 241 tively poorly, mainly because of a low per capita health
 242 expenditure. These *soft* determinants, i.e., those related to
 243 social components such as information and skills, institu-
 244 tions and networks, and equity, in many cases facilitate or
 245 serve as prerequisites for *hard* ones such as technical
 246 exposure.

247 The rankings of the ACI values of two determinants,
 248 technology and infrastructure, are partly inconsistent with
 249 the total ACI ranking. As far as technology is concerned,
 250 this mirrors the fact that some countries have a small
 251 agricultural area and high technological levels in terms of
 252 machinery (e.g., Slovenia) or of irrigation equipment (e.g.,
 253 Egypt). On the other hand, countries such as France, which
 254 if taken in their entirety make less use of irrigation
 255 equipment, perform relatively poorly. In regard to infra-
 256 structure, Greece and Portugal perform relatively poorly
 257 due to relatively high levels of water withdrawal and low

Table 2 Ranking of the total ACI

Country	Sub-region	Total ACI
France	NM-EU	0.721
Italy	NM-EU	0.620
Spain	NM-EU	0.562
Greece	NM-EU	0.559
Portugal	NM-EU	0.484
Turkey	NM	0.318
Albania	NM	0.315
Egypt	NA	0.282
Tunisia	NA	0.276
Algeria	NA	0.276
Jordan	ME	0.273
Lebanon	ME	0.259
Morocco	NA	0.197

The total ACI could be calculated only for a limited number of countries, i.e., those for which no data were missing for any determinant (see also Table 3)

258 levels of agricultural area *per capita*. Consequently, these
 259 two countries' rankings resemble that of NA and ME ones,
 260 more than that of NM ones.

261 Agricultural adaptation to climate change 262 in the Mediterranean region

263 The ACI suggests that, in general terms, there is a marked
264 North–South divide in the Mediterranean region, where
265 North African and Middle Eastern countries seem to be
266 rather similar to each other. These results confirm those of
267 previous studies. Iglesias et al. (2011), for example, com-
268 pared six countries in the Mediterranean basin and esti-
269 mated that NA countries (Egypt, Tunisia, Morocco, and
270 Libya) have a significantly lower adaptive capacity than
271 NM ones (France, Spain). Our results, obtained with a
272 different index of adaptive capacity, suggest that this gap
273 characterizes the entire Mediterranean basin.

274 The ACI also suggests that the North–South divide
275 depends largely on *soft* determinants (information and
276 skills, institutions and networks, equity) and on economic
277 resources. From a technological and infrastructural per-
278 spective, the difference between North and South Medi-
279 terranean countries is less manifest. Therefore, the *soft*
280 determinants may represent key entry points for increasing
281 adaptive capacity in the NA and ME countries.

282 However, while a wide set of potentially applicable
283 adaptation policies exist, the task of identifying appropriate
284 adaptation options with respect to these determinants is
285 complicated by several factors. They include: (1) the
286 uncertainty of impacts and of adaptation capacity, which
287 makes planning and cost-benefit analysis difficult (e.g.,
288 Adger and Vincent 2005); (2) the different potential scales
289 of intervention (from local to global), which often have
290 unpredictable cross-level feedbacks (e.g., Ericksen 2008);
291 and (3) the existence of different stakeholders or subjects
292 with specific interests and needs to be negotiated and rec-
293 onciled within existing or potentially novel institutional
294 settings (e.g., Rodríguez-Díaz and Topcu 2010; Ericksen
295 2008).

296 Thus considered, adaptation initiatives for NA and ME
297 countries could ideally include a mix of different options
298 targeting the soft determinants, such as measures to stabi-
299 lize farm income through crop insurance, crop shares and
300 futures, and diversification of household activities (espe-
301 cially in the case of smallholders) (AEA Energy and
302 Environment and Universidad Politécnica de Madrid 2007;
303 Smit and Skinner 2002). The information and skills gap
304 could be targeted through services advising farmers on how
305 to adapt farming practices or use new crops and dissemi-
306 nating good practices and technical information (AEA
307 Energy and Environment and Universida Politécnica de
308 Madrid 2007). In addition, non-agriculture-related pro-
309 grams targeting ethical issues or education as a driver of
310 social development might also be expected to exert a
311 positive effect on adaptive capacity in rural communities
312 and among the smallholder farming households which

characterize many countries in the Southern Mediterranean 313
basin (Lutz 2009). 314

315 As noted above, from a technological and infrastructural
316 perspective (e.g., water availability), the difference
317 between North and South Mediterranean countries is less
318 apparent. This is especially true if the southernmost areas
319 of NM countries are considered, instead of the entire
320 country (e.g., Italy, France, and Spain). In this respect,
321 especially for issues such as water availability, it seems
322 impossible to identify geographical differences, and it is
323 instead more appropriate to talk of issues widespread at a
324 regional (i.e., Mediterranean) level.

325 However, this does not imply that the same adaptation
326 options might be equally appropriate in different countries
327 and sub-regions within each country. In fact, adaptation
328 measures should fit the diverse institutional settings and the
329 productive and socioeconomic characteristics that are
330 found in different contexts. For example, water manage-
331 ment is usually carried out at a local level (e.g., water
332 basin), and local variation in both pedoclimatic and pro-
333 ductive conditions can be significant.

334 Thus, for all countries in the Mediterranean region,
335 many adaptation options might be possible from a tech-
336 nological and infrastructural perspective. These options
337 include a shift in sowing dates, the planting of different
338 genotypes, a change in inputs, water conservation measures
339 (e.g., Olesen and Bindi 2002), the improvement of water
340 supply infrastructure, regional or basin water management
341 and drought management plans, an increase in irrigation or
342 substitute rain-fed with irrigation systems, an increase in
343 energy efficiency, and the improvement of weather forecast
344 and information systems (e.g., Bindi and Olesen 2011;
345 Iglesias et al. 2011; Howden et al. 2007; Maracchi et al.
346 2005; Olesen and Bindi 2002; Tubiello et al. 2000).

347 These examples of adaptations differ in several respects,
348 importantly including the role that different actors may
349 take in the different stages of promotion, funding, imple-
350 mentation, and assessment of the adaptation measure. For
351 instance, in the adoption of water conservation measures,
352 farmers, farmer organizations, governments, and interna-
353 tional organizations might all play a role, such as testing
354 and implementing technology (farmers), promoting
355 knowledge exchange (farmer organizations), funding and
356 incentives in new technologies (governments), and the
357 funding of research programs and knowledge exchange
358 (international organizations).

359 Ultimately, the different adaptation needs and adaptive
360 capacities of the areas to which these actors belong make
361 them, as pointed out in the ensuing section, subjects of
362 justice in agricultural adaptation. We therefore need to
363 understand how such subjects of justice should respond to
364 the important ethical issues entailed by the unequal impacts
365 of climate change and variability on Mediterranean

366 agriculture and eventually make clear the consequent
367 implications for adaptation initiatives in the region.

Table 3 Rankings of the ACI for single determinants

Country	Sub-region	Index-economic resources
France	NM-EU	0.887
Slovenia	NM-EU	0.737
Italy	NM-EU	0.621
Spain	NM-EU	0.621
Greece	NM-EU	0.529
Lebanon	ME	0.465
Croatia	NM	0.457
Turkey	NM	0.349
Portugal	NM-EU	0.331
Cyprus	NM-EU	0.327
Albania	NM	0.290
Syrian Arab Republic	ME	0.277
Tunisia	NA	0.239
Egypt	NA	0.208
Bosnia and Herzegovina	NM	0.208
Morocco	NA	0.175
Algeria	NA	0.168
Macedonia, FYR	NM	0.153
Montenegro	NM	0.110
Jordan	ME	0.006
Israel	ME	Missing data
Libyan Arab Jamahiriya	NA	Missing data
Malta	NM-EU	Missing data
Serbia	NM	Missing data
Country	Sub-region	Index-information and skills
Slovenia	NM-EU	0.913
France	NM-EU	0.749
Israel	ME	0.749
Spain	NM-EU	0.709
Greece	NM-EU	0.682
Croatia	NM	0.560
Portugal	NM-EU	0.549
Italy	NM-EU	0.521
Lebanon	ME	0.505
Cyprus	NM-EU	0.503
Macedonia, FYR	NM	0.485
Malta	NM-EU	0.462
Jordan	ME	0.460
Turkey	NM	0.460
Serbia	NM	0.434
Bosnia and Herzegovina	NM	0.392
Tunisia	NA	0.351
Egypt	NA	0.289

Table 3 continued

Country	Sub-region	Index-information and skills
Albania	NM	0.223
Algeria	NA	0.209
Morocco	NA	0.142
Libyan Arab Jamahiriya	NA	Missing data
Montenegro	NM	Missing data
Syrian Arab Republic	ME	Missing data
Country	Sub-region	Index-institutions and networks
Portugal	NM-EU	0.909
Cyprus	NM-EU	0.835
Italy	NM-EU	0.819
Israel	ME	0.812
Croatia	NM	0.765
France	NM-EU	0.753
Slovenia	NM-EU	0.735
Spain	NM-EU	0.722
Greece	NM-EU	0.717
Malta	NM-EU	0.690
Serbia	NM	0.602
Montenegro	NM	0.572
Macedonia, FYR	NM	0.570
Turkey	NM	0.523
Jordan	ME	0.519
Tunisia	NA	0.510
Albania	NM	0.460
Morocco	NA	0.360
Algeria	NA	0.354
Bosnia and Herzegovina	NM	0.307
Egypt	NA	0.231
Libyan Arab Jamahiriya	NA	0.182
Syrian Arab Republic	ME	0.101
Lebanon	ME	0.087
Country	Sub-region	Index-technology
Egypt	NA	0.525
Slovenia	NM-EU	0.509
Italy	NM-EU	0.432
Greece	NM-EU	0.323
Portugal	NM-EU	0.312
Albania	NM	0.250
Cyprus	NM-EU	0.241
Macedonia, FYR	NA	0.240
Lebanon	ME	0.211
Jordan	ME	0.206
Croatia	NA	0.191
Spain	NM-EU	0.170
Syrian Arab Republic	ME	0.141

Table 3 continued

Country	Sub-region	Index-technology
Turkey	NA	0.136
France	NM-EU	0.116
Morocco	NA	0.082
Tunisia	NA	0.047
Algeria	NA	0.041
Bosnia and Herzegovina	NM	0.020
Israel	ME	Missing data
Libyan Arab Jamahiriya	NA	Missing data
Malta	NM-EU	Missing data
Montenegro	NM	Missing data
Serbia	NM	Missing data
Country	Sub-region	Index-infrastructure
France	NM-EU	0.591
Libyan Arab Jamahiriya	NA	0.532
Algeria	NA	0.386
Italy	NM-EU	0.316
Spain	NM-EU	0.250
Albania	NM	0.233
Tunisia	NA	0.225
Lebanon	ME	0.210
Israel	ME	0.202
Turkey	NM	0.194
Morocco	NA	0.193
Greece	NM-EU	0.191
Jordan	ME	0.175
Syrian Arab Republic	ME	0.131
Portugal	NM-EU	0.123
Egypt	NA	0.014
Bosnia and Herzegovina	NM	Missing data
Croatia	NM	Missing data
Cyprus	NM-EU	Missing data
Macedonia, FYR	NM	Missing data
Malta	NM-EU	Missing data
Montenegro	NM	Missing data
Serbia	NM	Missing data
Slovenia	NM-EU	Missing data
Country	Sub-region	Index-equity
France	NM-EU	0.824
Malta	NM-EU	0.660
Cyprus	NM-EU	0.601
Italy	NM-EU	0.592
Greece	NM-EU	0.568
Spain	NM-EU	0.563
Slovenia	NM-EU	0.562
Croatia	NM	0.515
Serbia	NM	0.477

Table 3 continued

Country	Sub-region	Index-equity
Portugal	NM-EU	0.403
Israel	ME	0.360
Egypt	NA	0.343
Albania	NM	0.331
Algeria	NA	0.266
Bosnia and Herzegovina	NM	0.259
Libyan Arab Jamahiriya	NA	0.257
Montenegro	NM	0.250
Jordan	ME	0.214
Turkey	NM	0.137
Tunisia	NA	0.122
Morocco	NA	0.114
Macedonia, FYR	NM	0.082
Syrian Arab Republic	ME	0.079
Lebanon	ME	0.055

Ethical analysis of agricultural adaptation in the Mediterranean context

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As anticipated, an ethical analysis of agricultural adaptation has seldom been carried out and, to our knowledge, never conducted for the Mediterranean region. However, given the unbalanced distribution of climate impacts and the diversity of Mediterranean agricultural systems and of the relevant actors, an ethical analysis would be of great benefit to the understanding of the adaptations needed by the agricultural systems of the region, and of their eventual implications for the development of more effective policy initiatives.

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In order to carry out an ethical analysis of agricultural adaptation in the Mediterranean, it is convenient to organize our argument around the three constituents of distributive justice anticipated in the introduction—(1) subjects of justice; (2) principles of distribution; and (3) types of burdens and benefits—according to a liberal theoretical perspective. In fact, despite the controversies that such a standpoint may raise in relation to environmental issues (Mason 2008), we maintain, consistently with the most authoritative climate ethics literature (e.g., Shue 1993, 2011; Caney 2009, 2010; Gardiner 2004, 2010; Moellendorf 2009; Miller 2008; Jamieson 2005; Singer 2002), that liberalism, by claiming that its central moral tenet is that stronger subjects should support and assist weaker, vulnerable ones (Dworkin 1978), can authoritatively frame ethical approaches to global environmental issues (Miller 1999) and in particular to climate change (Calder and McKinnon 2011). Specifically, owing to the characteristics of Mediterranean agricultural systems, a liberal approach to the constituents of distributive justice

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399 is, in our opinion, extremely useful for grasping some of
400 the most urgent ethical implications entailed by agricultural
401 adaptation in the region, and eventually for deriving
402 arguments that are useful for policy-making.

403 Distributive justice by and large relates to the distribu-
404 tion of burdens and benefits in society, and it can be
405 articulated, as said, into three closely intertwined ques-
406 tions: (1) What are the subjects of justice? (2) What is/are
407 the principle/s of distribution?, and (3) What types of
408 burdens and benefits are to be justly shared? (Caney 2005).
409 In what follows, we analyze from a liberal standpoint each
410 of these constituents of distributive justice in relation to
411 Mediterranean agricultural systems and consistently with
412 the considerations put forward concerning their adaptive
413 capacities and consequent adaptation needs, with the ulti-
414 mate objective of improving the effectiveness of agricul-
415 tural adaptation policy in our context of analysis.

416 As far as the first constituent of distributive justice is
417 concerned (specification of subjects of justice) we deem
418 that—owing to the characteristics of adaptive capacities
419 and to the consequent nature of the required adaptations by
420 Mediterranean agricultural systems—two general claims of
421 liberalism must be defended and contextualized in order to
422 identify the relevant (groups of) subjects of justice:
423 (i) more advantaged subjects should bear the burden of
424 adaptation and (ii) less advantaged subjects should be
425 assured privileged access to adaptations (Grasso 2010b). It
426 is worth pointing out that vindication of these two claims
427 also concerns the second constituent of distributive justice
428 (the distributive principle), whereas the third one (the types
429 of burdens and benefits) requires close scrutiny of the
430 context of analysis and therefore will be addressed in
431 the ensuing section, when we discuss the implications of the
432 ethical analysis for Mediterranean agricultural adaptation.

433 The first claim [(i) more advantaged subjects should
434 bear the burden of adaptation] entails, in this context of
435 analysis, the *Ability to Pay* distribution principle. This is a
436 forward-looking principle grounded in no-fault forms of
437 prospective responsibility (Shue 1993) based on the
438 capacity (in terms of institutions, technology, infrastruc-
439 tures, skills) and the wealth (in terms of welfare levels) of
440 subjects, which ultimately justifies also remedial duties. In
441 practice, the *Ability to Pay* principle requires that the most
442 advantaged subjects bear the largest quota of adaptation
443 burdens because of their greater wealth and capacities. We
444 call these subjects *contributors*.

445 The second claim [(ii) privileging those who are most
446 in need of adaptation] refers instead to the *Lack of*
447 *Adaptive Capacity* principle of distribution. It identifies,
448 on the one hand, a minimum level of adaptive capacity.
449 This is a level below a moral threshold between those
450 who have enough and those who have not enough adap-
451 tive capacity to perform the basic adaptation activities

452 ensuring that agricultural systems provide a decent life.
453 On the other hand, the principle in question recognizes
454 adaptive capacity levels that extend beyond that moral
455 threshold. The objective of this principle is to allow those
456 subjects of justice below the moral threshold of adaptive
457 capacity to be supported in carrying out the agricultural
458 adaptations necessary to pursue a decent life. We call
459 these subjects *recipients*.

460 It is important to note that, despite the state-level per-
461 spective of the ACI, on empirical grounds, subjects of
462 justice are not only states. In fact, in order to frame our
463 ethical analysis, we attribute to national and sub-national
464 subjects of justice the level of the ACI index of the country
465 to which they belong. In other words, the possibility of an
466 ethical analysis requires that relevant subjects of justice be
467 considered as having the same degree of adaptive capacity
468 as their respective state, or, more precisely, as their NAS.

469 That said, we maintain that, in practical terms, the eth-
470 ically relevant subjects of justice in agricultural adaptation
471 are farmers (both family and industrial), producer organi-
472 zations, national governments, non-governmental organi-
473 zations (NGOs) and international institutions. Their ethical
474 status is substantiated by the principles of justice of *Ability*
475 *to Pay* and of *Lack of Adaptive Capacity* put forward and
476 which, respectively, specify their moral role as *contribu-*
477 *tors* or *recipients* of adaptation duties and rights (i.e., in
478 practice, a duty to support adaptation and a right to adap-
479 tation assistance).

480 In light of the ACI evaluation (Table 3), and in partic-
481 ular of the role and dynamics of soft determinants of
482 adaptive capacity that it emphasizes, it seems possible to
483 claim that the duties and rights of the above-specified
484 subjects of justice vary among the different areas of the
485 Mediterranean region. In our view, the subjects of justice
486 central for confronting the North–South disparities in terms
487 of soft determinants of adaptive capacity in the region
488 considered are family and industrial farmers, producer
489 organizations, and national governments, with the proviso
490 that farmers should not be considered contributors because
491 of their relative (i.e., in comparison with the other subjects
492 of justice) limited capacity and wealth, which exclude the
493 moral mandate of the *Ability to Pay* principle.

494 According to our moral argument, these subjects of
495 justice, when located in the southern Mediterranean region
496 (NA and ME countries), are ethically entitled to adaptation
497 assistance owing to their scant adaptive capacity as
498 demanded by the principle of *Lack of Adaptive Capacity*.
499 In particular, farmers should be primary recipients of
500 adaptation assistance, whereas producer organizations and
501 national governments have an indirect right to receive
502 assistance, meaning they are entitled to it only in virtue of
503 their capacity to target it more effectively on farmers, the
504 main subjects of justice. Producer organizations and

505 national governments of Northern countries, instead, owing
506 to their greater capacity and wealth, should be morally held
507 to be contributors, as required by the *Ability to Pay* prin-
508 ciple. At the same time, we believe that Northern NGOs
509 and international organizations might play a non-marginal
510 role in increasing adaptive capacity and promoting adap-
511 tation in the Mediterranean region. In this regard, we argue
512 that they have an indirect duty to contribute owing to their
513 capacity to represent and express the implicit obligations of
514 adaptation assistance incumbent on wealthier Northern
515 societies.

516 To summarize, the ethical framework envisioned, and
517 synthesized in Table 4, holds that farmers in Northern
518 countries are not morally entitled to adaptation assistance,
519 whereas those of the NA-ME countries are morally eligible
520 for it. North producer organizations and national govern-
521 ments are morally obliged to be contributors, while
522 Southern ones are recipients. Furthermore, adaptation
523 assistance is due to recipient subjects of justice also from
524 NGOs and international organizations in their representa-
525 tive role.

526 Discussion

527 Implications of ethical analysis for agricultural 528 adaptation

529 The ethical analysis carried out has a manifest normative
530 slant. As a consequence, it simply justifies the existence of
531 subjects of justice and the role that they ought to play in the
532 context of analysis consistently with their mutual status in
533 regard to the principles of justice specified. The analysis
534 therefore has no ambition to stipulate binding obligations,
535 whose exploration would need—as highlighted in the
536 introduction and emphasized below—an institutional
537 approach, which would in any case fall outside the scope of
538 this article. Nonetheless, the ethical framework outlined
539 provides valuable suggestions, as clearly shown, for
540 instance, by the consideration of adaptation measures on
541 the adaptive capacity determinants of economic resources
542 and information and skills, which are particularly weak in
543 Southern Mediterranean countries. In this regard, our
544 framework suggests, in fact, a possible effective strategy:
545 national governments and NGOs and international organi-
546 zations in NM countries would have a moral obligation to
547 support adaptation by Southern farmers and farmer orga-
548 nizations through measures such as educational programs
549 to enhance information and skills and crop insurance
550 schemes to support producer units economically in the case
551 of adverse weather events.

552 Furthermore, the categorization of subjects of justice
553 and the specification of their ethical duties and rights also

554 make it possible to stipulate the types of burdens and
555 benefits that should be distributed, this being the third
556 constituent of distributive justice highlighted in the previ-
557 ous section. In general, the elements to be distributed take
558 the form of *in-cash* or *in-kind* adaptation assistance. In
559 relation to our context of analysis, we maintain that
560 adaptation funding, namely *in-cash* assistance, is crucial
561 for implementing adaptation initiatives in Mediterranean
562 agriculture. At the same time, as pointed out in the third
563 section, also *in-kind* technology transfer and—especially
564 due to the *soft* nature of the main determinants of adaptive
565 capacity—scientific and knowledge transfer are crucial
566 elements of adaptive capacity. In this regard, our ethical
567 analysis yields a further, significant, insight. The *soft* nature
568 of the main determinants of adaptive capacity makes, in the
569 case of family farmers, *in-kind* transfer superior to *in-cash*
570 one. Adaptation assistance targeted on them should there-
571 fore take primarily the form of technology, scientific and
572 knowledge transfer, owing to the lower capacity of family
573 farmers to turn cash into proper adaptation activities. This
574 paternalistic recommendation is justified on the basis of
575 problems of preference interdependence of individuals
576 (i.e., the likely indulgence in the consumption of vices by
577 poorly educated individuals) and of the possibilities of
578 externalities (Currie and Gahvari 2008; Thurow 1974). On
579 the contrary, adaptation assistance targeted on industrial
580 farmers, producer organizations, and national governments
581 should preferably take the form of *in-cash* transfer, owing
582 to the expected superior capacity of these subjects to invest
583 in appropriate adaptations, and to their predominantly
584 funds-channeling role. For instance, in regard to water
585 availability (technological and infrastructural determinants
586 of adaptive capacity) for family farmers in Southern
587 Mediterranean countries, our analysis envisions a particular
588 set of priorities such as the provision of information about
589 the possibility of shifting sowing dates, about new geno-
590 types or enhanced weather forecasts, or the improvement of
591 water distribution infrastructure. These *in-kind* transfers are
592 preferable to a system of (*in-cash*) incentives for modifying
593 water usage patterns.

594 To briefly recap the entire argument, our ethical
595 framework holds that, in regard to the distribution of bur-
596 dens and benefits of Mediterranean agricultural adaptation
597 among farmers, producer organizations, national govern-
598 ments, and NGOs and international organizations, the most
599 suitable liberal principles of distributive justice are *Ability*
600 *to Pay* and *Lack of Adaptive Capacity*. The former prin-
601 ciple responds to the claim that more advantaged sub-
602 jects—namely Northern producer organizations,
603 governments, and NGOs and international organizations—
604 should provide adaptation assistance because they have the
605 possibility and the means to do so. The second requires that
606 weaker subjects of justice—Southern farmers, producer

Table 4 Subjects of justice, roles, and ethical principles: the ethical framework

Subjects of justice		Farmers		Producer organizations		National governments		NGOs and international organizations
		North	South	North	South	North	South	
Roles (Ethical principles)	Contributors (Ability to pay)	No	No	Yes	No	Yes	No	Yes (indirect duty)
	Recipients (Lack of adaptive capacity)	No	Yes	No	Yes (indirect right)	No	Yes (indirect right)	No

607 organizations, and governments—should be assisted
608 according to their level of adaptive capacity: the lower that
609 level, the larger the assistance morally owed, and that in
610 the case of Southern family farmers this assistance should
611 preferably be *in-kind*.

612 Limitations and future work

613 Despite the novel, in our opinion, insights into Mediterra-
614 nean agricultural adaptation and its policy afforded by our
615 ethical investigation, we are aware of its main limitations.
616 In fact, when considering the overall ethical picture, it
617 would also be necessary to bear in mind the procedural (or
618 formal, or abstract) notion of justice (Grasso and Sacchi
619 2011; Gardiner 2010; Grasso 2010b; Albin 2003). This
620 concerns the fairness of the process by which the distri-
621 bution of burdens and benefits is attainable and relates to
622 the participation and recognition of all actors involved in
623 decisional processes, as well as to the distribution of power
624 among them. However, this issue is not covered here so as
625 to maintain our argument within reasonable bounds.

626 More importantly, in a broader understanding, a fully
627 comprehensive specification of our ethical approach to
628 Mediterranean agriculture would also need an institutional
629 analysis, as underlined above. This is not dealt with here
630 because an institutional perspective would require attentive
631 scrutiny of regional structures and mechanisms governing
632 climate change and its policy, which has not been possible
633 in this article because of obvious space constraints. How-
634 ever, we believe that the current study can inform such
635 analysis, in that it discusses the founding elements that may
636 serve as a basis for a more specific policy debate among the
637 regional subjects concerned. We therefore maintain that the
638 institutional approach is definitely a relevant avenue for
639 future research.

640 A final limitation concerns the ACI itself. In particular,
641 the proposed index presents an aggregate picture of
642 national agricultural systems in the Mediterranean coun-
643 tries. This methodological approach was adopted because
644 of its functionality to the ethical analysis carried out, and in
645 particular to its regional approach, justified from the

environmental, cultural, and governance perspectives 646
(Liverman and Ingram 2010; Asheim et al. 2003). 647
Adoption of an aggregate measure of adaptive capacity 648
was also made necessary by the limited availability of 649
reliable and comparable data at a more disaggregated 650
level for the entire Mediterranean region. A drawback of 651
this approach, however, is that it does not appropriately 652
render the variability that exists among agricultural sys- 653
tems at sub-national and local level. An interesting pos- 654
sibility for future research is therefore more detailed 655
investigation of such local differences adopting a wider 656
spectrum of research tools, including qualitative research. 657
We envision that the ACI, appropriately applied at a lower 658
spatial scale, can function as an exploratory tool with 659
which, for example, to identify hotspots and thus inform a 660
more qualitative analysis of adaptive capacity at local 661
level. 662

663 Conclusions

664 What conclusions might be drawn from analysis of the 664
characteristics of Mediterranean agriculture adaptive 665
capacity and adaptation and from the ethical considerations 666
that have been consequently raised? How might these 667
reflections apply to adaptation policy in agriculture? 668

669 We have assumed that the unbalanced impacts of cli- 669
mate change on Mediterranean agriculture emphasize the 670
role and potential of ethical analysis. Hence, our main aim 671
has been to vindicate and develop an ethics-based frame- 672
work on agricultural adaptation in the region. In this 673
regard, we believe that, by and large, the article has shown 674
the critical, yet greatly neglected, relevance of ethical 675
considerations when dealing with adaptation in agriculture. 676
In fact, we have argued that framing agricultural adaptation 677
through reference to ethical considerations can greatly 678
improve the acceptability and political feasibility of its 679
dynamics, in regard to both contribution (i.e., duties) and 680
assistance (i.e., rights). In particular, the ethical analysis 681
carried out fundamentally makes it possible to argue that, 682
in the Mediterranean context, in regard to adaptation 683

684 assistance, Northern producer organizations, governments,
685 and NGOs and international organizations are duty-bearers,
686 whereas Southern farmers, producer organizations, and
687 governments are, respectively, morally entitled to *in-kind*
688 and *in-cash* assistance.

689 In short, inclusion of the ethical dimension may help
690 remedy the cleavages caused by the different perspectives
691 on the nature of adaptation in agriculture, and it may
692 mitigate the consequent conflicts among interests, so that
693 the harm inflicted by climate change on a sensitive sector
694 such as agriculture can be effectively addressed. Hence, in
695 the case of a difficult issue like this, it seems that reference
696 to the moral dimension would provide a useful underpin-
697 ning for international initiatives, especially in regard to the
698 necessary involvement of poorer countries in the broader
699 climate debate (Grasso 2010a). Eventually, we believe that,
700 in regions characterized by high degrees of inequalities
701 such as the Mediterranean basin, ethical considerations
702 might also provide reasoned elements for debate among
703 regional stakeholders with regard to the development of an
704 agreed-upon framework to confront agricultural adaptation
705 and devise coherent and unified regimes. Otherwise, the
706 emerging hectic system, in which the notion of adaptation
707 itself is fragmented and unclear, let alone its agricultural
708 specification, will lead to the ineffective use of resources
709 and to poor adaptation practices, which are detrimental to
710 agricultural systems.

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