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Factors of land abandonment in mountainous Mediterranean areas: the case of Montenegrin settlements

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Abstract

Land use changes have been investigated in the surroundings of 14 rural Montenegrin settlements in order to get specific information about trends in land abandonment since around 1950. Permanently, seasonally and less inhabited settlements with different geographic conditions were studied. This was done by interviewing local inhabitants, which enabled a holistic approach to reveal the underlying processes of land abandonment. According to the observed patterns of land use change, the study sites can be categorized into intensified, urbanized, extensified, overgrown and forested cases. The category of extensified settlements is characterized by a highly reduced agricultural management intensity, resulting in an increase in grasslands and fruit trees at the expense of cropland. This land use change is mainly related to emigrating and aging inhabitants, having less livestock. Such extensive land use is found in both permanently inhabited and abandoned villages. Only some studied settlements became largely overgrown by bushes and forest. The steep average slope gradients and a large distance to the nearest city are explanatory factors of such land abandonment. Land use intensification takes place in low-lying areas located nearby towns.

Keywords: Montenegro, Land use changes, Marginal farmlands, Oral history, Qualitative research, Urbanization

Background

A dominant trend of abandonment, reforestation and extensification has been found in the mountainous European areas since 1950, in line with predominant socio-economic changes through the continent (Mottet et al. 2006; Jepsen et al. 2015). The combination of environmental, economic and social aspects act as a driver for migration in rural contexts and it influences the land use changes (Kranjc 2008). More specifically, industrialization and urbanization have altered the landscape patterns since the Second World War, due to shifts in lifestyles, resulting in extensification of remote and physically disadvantaged rural areas and intensification and agricultural modernization of more urban areas (Antrop 2005; Klijn and Vos 2000). Especially rural, mountainous landscapes are determined as vulnerable to land abandonment (Baldock et al. 1996). Decrease or abandonment

of ancient farming systems has caused an overgrowth of traditional farmlands by shrubs and trees (MacDonald et al. 2000). Such patterns have been registered in the mountainous regions of Southern Slovenia, where the traditional agricultural landscape was overgrown by forest by 1980. Relations of this trend to socio-economic factors have already been revealed: the emigration of rural inhabitants during the twentieth century and the accessibility of suitable lands to dwellings was detected as a driver of local agricultural intensification. Afterwards, some villages near access roads increased in terms of inhabitants but—as their activities are not related to agriculture anymore—this did not result in recent land use changes (Pausic and Carni 2012).

Traditional landscapes have been evolving gradually over time and were characterized by appropriate land use according to the local physical circumstances (Antrop 2000; Renes 2015). Initial settlements have often been established, taking into account land qualities and natural resources (LaGro 2001) as these provide inhabitants with ecosystem services on which they could rely for survival

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57 and welfare. According to Fagerholm et al. (2012), ecosys-
 58 tem services can be both materialistic (proper conditions
 59 for various crops or livestock, firewood, construction
 60 wood, wild fruits, herbs, etc.) as non-materialistic (places
 61 for enjoying nature, recreation, etc.). Inhabitants often
 62 possessed patches of land at different locations to have
 63 various physical circumstances (Antrop 2000) and a sys-
 64 tem of transhumance, where people seasonally migrated
 65 with their livestock in order to use grasslands in the
 66 mountains (Dodgshon and Olsson 2007). The human
 67 impact on the landscape visually occurs as lynchets, cre-
 68 ated by soil accumulated at the edges of parcels due to
 69 the long-lasting ploughing of croplands on slopes (Char-
 70 tin et al. 2011), and forest cutting and picking of stones
 71 caused land to become sensitive to soil erosion, espe-
 72 cially on hill slopes. When such human impacts diminish,
 73 the erosion degree reduces as forested, bushy and even
 74 grassy areas fix the soil and land resilience might take
 75 place (Nyssen et al. 2014). However, karst zones prove to
 76 be vulnerable to land degradation because they recover
 77 badly from degradation (Calo and Parise 2006).

78 Little scientific research has been performed concern-
 79 ing land abandonment factors within Montenegro. As
 80 this mountainous region is characterized by a variety
 81 of physical environmental settings and recently went
 82 through some turbulent socio-economic developments,
 83 it is able to indicate an interesting pattern of recent
 84 changes in land use and cover. Local-scale sites compris-
 85 ing different physical and demographic characteristics
 86 have been studied to obtain specific information about
 87 land abandonment. A holistic approach has been adopted
 88 as nowadays, many study methodologies are based on
 89 the integration of biophysical, environmental factors and
 90 socio-economic evolution to increase the understanding
 91 of landscape dynamics (Mottet et al. 2006).

92 Methods

93 Study area

94 Physical environment

95 Montenegro is situated in Southeast Europe along the
 96 Adriatic Sea and within the Dinaric Alps, a Western Bal-
 97 kan mountain range comprising mainly NW–SE oriented
 98 ridges (Kranjc 2008). The small (13,812 km²) country can
 99 be divided in seven geomorphological regions (Frankl
 100 et al. 2015; Fig. 1). The narrow *coastal zone* mainly con-
 101 tains small beaches with steep limestone slopes rising to
 102 average heights of 800 m, a ria coast centered on Boka
 103 Kotorska and a large debris cone near Albania on which
 104 sand beaches developed (Nyssen et al. 2014). NE of this
 105 zone lies the *high karst zone*: a dry Cretaceous limestone
 106 plateau characterized by karst phenomena, where the
 107 only fertile lands occur in poljes. This region is incised
 108 by the *inland depression*, which extends about 60 km in

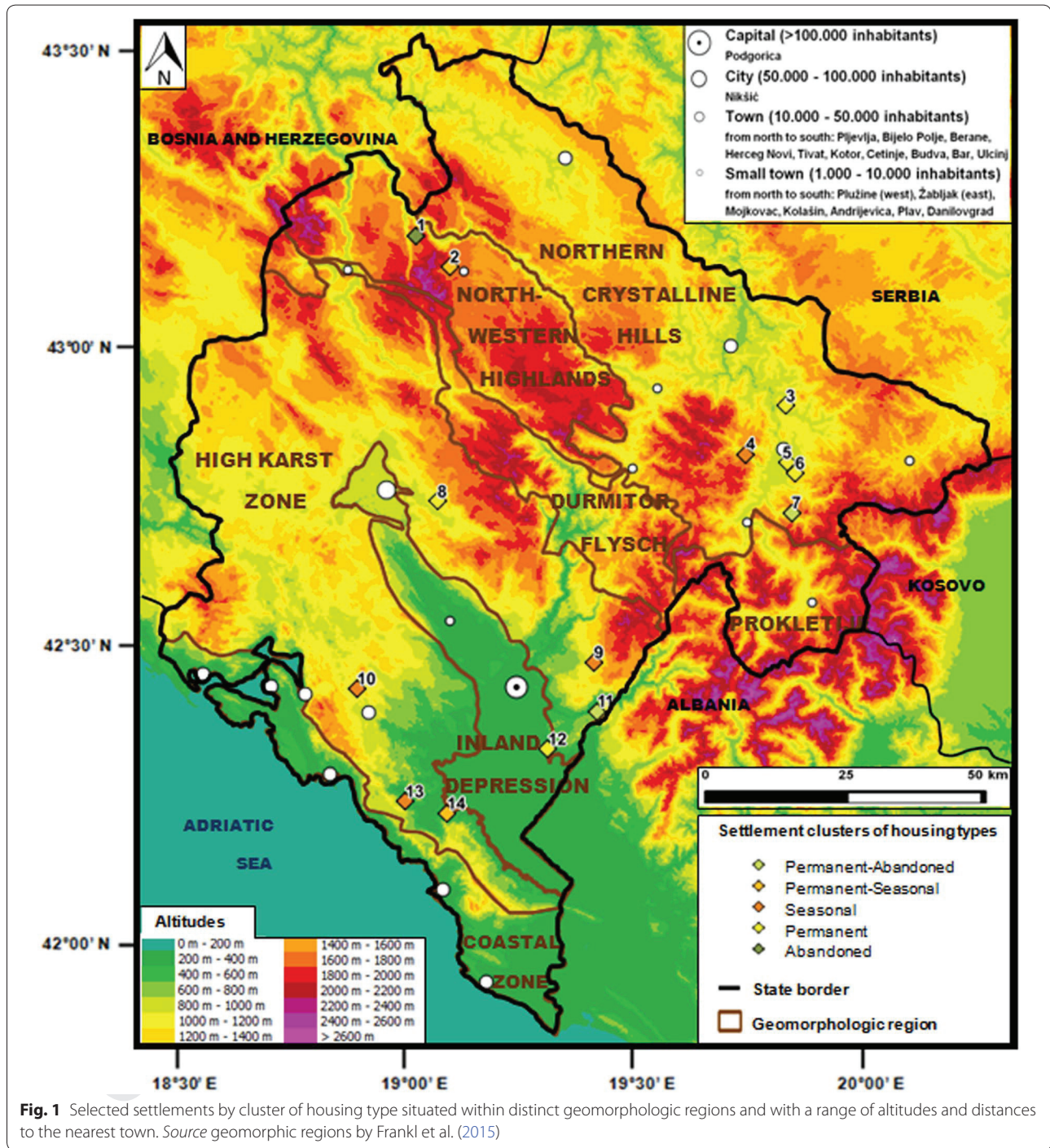
109 NW–SE direction (Mugoša 2008). It is mainly filled with
 110 Quaternary materials and comprises the polje of Nikšić,
 111 the area around the meandering river Zeta, the capital
 112 Podgorica, the lowland of Zeta Plain and Skadar Lake.
 113 Parallel with this zone the elevated *Durmitor Flysch*
 114 region is situated (often higher than 2000 m) with a rela-
 115 tively soft lithology dominated by sandstones, siltstones,
 116 marls and conglomerates. Furthermore, the *Prokletije*
 117 contains a varied geology (of schists, sand- and lime-
 118 stone, dolomites, volcanic outcrops, ...) with glacial geo-
 119 morphic features. The highest parts of this mountainous
 120 region extend to Kosovo and especially Albania. Within
 121 Montenegro, the *Northwestern Highlands* contain most
 122 peaks (with Bobotov Kuk being the highest: 2523 m a.s.l.)
 123 and plateaus. This region mainly contains limestone, its
 124 geomorphology is determined by a combination of glacial
 125 and karst processes (Annys et al. 2014). In the north, the
 126 Tara canyon marks the border with the *Northern crystal-
 127 line hills*, which covers a large part of the country along
 128 the NE border and it mainly comprises flysch and sand-
 129 stone sediments: softer materials forming an undulating
 130 landscape.

131 The climate of the coastal and high karst zone is Medi-
 132 terranean with hot, dry summers and mild, wet winters
 133 (Nyssen et al. 2014) but precipitation is also affected by
 134 the mountain massifs (Kranjc 2008). The limestone hin-
 135 terland is covered with typical bushy Mediterranean
 136 vegetation as maquis, garrigue and degraded evergreen
 137 woodland (Foster-Turley et al. 2010). The inland depres-
 138 sion contains large rectangular vineyards (Zeta Plain)
 139 and some swampy areas (around Skadar Lake) and can
 140 be extremely hot during summer. The northern regions
 141 have a continental climate with rainfall, which is more
 142 equally distributed over the year, cold winters and warm
 143 summers. Forests and pastures cover large parts of these
 144 regions (Nyssen et al. 2014).

145 History and demography

146 Montenegro is characterized by a turbulent history. After
 147 hard times during the Second World War, the Socialist
 148 Federal Republic of Yugoslavia (SFRY) was reorganized in
 149 six republics: Bosnia and Herzegovina, Croatia, Macedo-
 150 nia, Montenegro, Serbia and Slovenia (Pittaway 2004).
 151 Industrialization occurred, causing migration to towns,
 152 urbanization and abandonment of mountain farm-
 153 ing practices (MacDonald et al. 2000). After 1953, the
 154 short-lived Yugoslav agricultural collectivization faded
 155 away and gradually, farmers shifted from subsistence-
 156 to market-based production during the 1960s (Pittaway
 157 2004). Then, industries of aluminum, steel and energy
 158 also became highly important as the transport infra-
 159 structure was growing (Miller 2005). In the early 1990s,
 160 the economic reformation towards an open market failed





161 and as a result, a large decline in the Yugoslav economy
 162 took place (Lazic and Sekelj 1997). Then, the SFRY disintegrated (but Serbia and Montenegro temporarily stayed
 163 the last two members in the Federal Republic of Yugoslavia), defining the 1990s as the decade of Yugoslav wars
 164 (Miller 2005). Although Montenegro was located outside of the war zone, its general development suffered a lot.

In 2006, the country became independent after a referendum that was narrowly won due to the Albanian minority (Pond 2006), but Montenegro (especially the north(east) ern part) remained strongly linked to Serbia (MONSTAT 2011a, b).
 A strong population growth marked the twentieth century in Montenegro: from 311,000 inhabitants in 1921

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Author Proof

175 to 620,000 at the beginning of the twenty-first century
 176 (MONSTAT 2011a, b). However, many internal migra-
 177 tions took place since around 1950, with a continuous
 178 emigration trend from the northern regions. The ratio of
 179 46 % of the urban Montenegrins living in the northern
 180 regions in 1961 declined to about 30 % in 2000 (Mugoša
 181 2008). Urbanization occurred in all 21 municipalities
 182 (due to migration, to their central settlement and mainly
 183 to Podgorica) (MONSTAT 2011a, b). Montenegro has
 184 1256 settlements, 40 of which are urban. The coastal
 185 municipalities have the densest network of settlements,
 186 which have been analyzed for the presence of cultural
 187 and historical elements and forms of agricultural patterns
 188 (Curovic and Popovic 2014); especially the central area is
 189 economically important and highly urbanized, as the two
 190 largest cities (Podgorica and Nikšić, containing about one
 191 third of the population) are located there (MONSTAT
 192 2011a, b).

193 *Land use changes*

194 Around 1900, Montenegro mainly consisted of bare
 195 land (Kranjc 2008), as only about 35 % of its landscape
 196 was densely vegetated. The coastal and central zones
 197 were especially barren (for about half of their area),
 198 while not even one tenth of the northern zone was bar-
 199 ren wasteland, as it had more forests, meadows (respec-
 200 tively almost 30 and 40 %) and farmland (as opposed to
 201 small poljes and dry fields in the other areas). During the
 202 twentieth century, especially between 1950 and 1980,
 203 the Montenegrin landscape showed an overall increase
 204 in vegetation. The share of barren lands in the coastal
 205 and central zones strongly decreased in favor of shrub-
 206 land and forests, while there was less vegetation growth
 207 in the northern zone, where forests grew at the expense
 208 of farmland, which halved at least (Nyssen et al. 2014).
 209 This evolution runs parallel with large sectorial shifts in
 210 employment, as the Montenegrins working in agriculture
 211 (about 75 % in 1948) fell back to 5 % in 1981 (Radović
 212 1981). Restitution of lands to owners has also been play-
 213 ing a role in the decline of agriculture since the end of
 214 the 1980s (Mugoša 2008). However, due to the economic
 215 crisis in the 1990s, some marginal lands have been tem-
 216 porarily cultivated again (Grimes et al. 2005). Since 2000,
 217 areas occupied by infrastructure—often related to tour-
 218 ism—have rapidly increased in all Montenegrin regions
 219 (Nyssen et al. 2014) and regrowth of vegetation has accel-
 220 erated. In 2008, dense forests covered 45 % of the coun-
 221 try and another 9 % was under other woody vegetation
 222 types (including bushes, brushwood, maquis and stone
 223 steppes). By 2012, this had increased to respectively
 224 about 60 and 10 %, making Montenegro one of the most
 225 forested countries in Europe (Andelić et al. 2012).

226 *Selection of local-scale study sites*

227 A variety of settlements in terms of demographic and
 228 physical characteristics has been selected to investi-
 229 gate land abandonment in relation to human lifestyles
 230 and their environment. Therefore, data about housing
 231 types per settlement (MONSTAT 2011a, b) were used;
 232 all dwellings have been categorized as permanently/
 233 seasonally occupied or abandoned. The share of hous-
 234 ing types within a settlement defines it as permanent,
 235 permanent-seasonal, seasonal, abandoned or permanent-
 236 abandoned. A cluster analysis was carried out in SPSS
 237 so as to categorize 941 of all 1305 Montenegrin settle-
 238 ments in these five distinctive clusters. Settlements with
 239 more than 1000 houses, less than 10 houses and more
 240 than 25 % undetermined utilization types were excluded
 241 from the analysis. Besides representing a variety of set-
 242 tlement types, the selected settlements should be located
 243 in several of the geomorphological regions described by
 244 Frankl et al. (2015). Eventually, 14 settlements were cho-
 245 sen as study sites (Fig. 1; Table 1) representing all settle-
 246 ment types and four geomorphological regions (mainly
 247 the high karst zone and northern crystalline hills and—to
 248 a lesser extent—the northwestern highlands and inland
 249 depression).

250 *Conducting and processing interviews*

251 Semi-structured interviews have been conducted to
 252 gather first-hand information about land use/cover
 253 changes and thus land abandonment over time. The
 254 used questionnaire comprised six main topics: the basic
 255 characteristics of interviewees, agricultural situation
 256 and ecosystem services (both nowadays as in the past),
 257 aspects of land cover/use change (including matters as
 258 vegetation overgrowth and changes in the agricultural
 259 system, landscape and infrastructure), some physical
 260 geographical processes (like climate change and ero-
 261 sion), personal view and migration. Specific defined
 262 questions such as “How much livestock do you have
 263 now?” were not aimed at obtaining exact quantitative
 264 data but at facilitating answers and getting an idea about
 265 magnitudes. The questions ranged from completely
 266 open-ended to more narrow (although still open-ended).
 267 Participants were not forced to stick to the sequence
 268 of questions to prevent interruptions of their narra-
 269 tives. The used approach offers space to both theoretic-
 270 al ideas and empirical findings: the structure ensures
 271 the discussion of preconceived topics, while interview-
 272 ees still have latitude to bring new aspects to the study
 273 (Galletta 2013). Interviewees were considered experts of
 274 their environment (Fagerholm et al. 2012) and the way
 275 of interviewing them provoked ‘oral histories’ (stories
 276 about specific memories related to the landscape), which



Table 1 Overview of the locational and demographic features of the 14 selected settlements along with their cluster membership in the settlement typology

Settlement No.	Settlement name	Geographical position			Demographic characteristics			Settlement type/cluster				
		Municipality	Coordinates (lat. °N; lon. °E)	Altitude (m)	Geomorphologic region	Number of permanent residents	Number of dwellings					
							Total		Permanent (%)	Seasonal (%)	Abandoned (%)	Other (%)
1	Mala Crna Gora	Žabljak	43.207; 19.007	1450	NW highlands	53	84	28 (33)	10 (12)	44 (53)	2 (2)	Abandoned
2	Bosača	Žabljak	43.161; 19.087	1550	NW highlands	20	18	11 (61)	5 (28)	2 (11)	0 (0)	Perm.-Seas.
3	Trubina	Bijelo Polje	42.935; 19.879	940	N crystalline hills	175	50	44 (88)	3 (6)	0 (0)	3 (6)	Permanent
4	Pračevac	Berane	42.850; 19.786	1100	N crystalline hills	31	50	14 (28)	33 (66)	0 (0)	3 (6)	Seasonal
5	Luge	Berane	42.836; 19.883	690	N crystalline hills	1841	683	515 (75)	68 (10)	5 (1)	95 (14)	Permanent
6	Zagorje	Berane	42.818; 19.904	840	N crystalline hills	243	101	72 (71)	22 (22)	6 (6)	1 (1)	Permanent
7	Orah	Berane	42.746; 19.896	1100	N crystalline hills	47	31	12 (39)	9 (29)	10 (32)	0 (0)	Perm.-Aban.
8	Oblatno	Niškić	42.758; 19.072	860	High karst zone	96	28	23 (82)	4 (14)	0 (0)	1 (4)	Permanent
9	Orahovo	Podgorica	42.485; 19.442	900	High karst zone	81	723	44 (6)	671 (93)	1 (0)	7 (1)	Seasonal
10	Petrov Do	Cetinje	42.432; 18.892	870	High karst zone	9	38	5 (13)	23 (60)	9 (24)	1 (3)	Seasonal
11	Trabojin	Podgorica	42.399; 19.450	490	High karst zone	48	22	14 (64)	0 (0)	8 (36)	0 (0)	Perm.-Aban.
12	Vuksanlekići	Podgorica	42.336; 19.339	25	Inland depression	267	65	62 (95)	0 (0)	0 (0)	3 (5)	Permanent
13	Gornji Brčeli	Bar	42.240; 19.010	380	High karst zone	12	51	7 (14)	34 (67)	10 (19)	0 (0)	Seasonal
14	Godinje	Bar	42.221; 19.111	80	High karst zone	49	61	23 (38)	27 (44)	10 (16)	1 (2)	Perm.-Seas.



277 helped to notice key periods of change, motivations,
 278 meanings and lifestyles (Galletta 2013). When possi-
 279 ble, walks with informants were carried out to let them
 280 show interesting phenomena on the field (Fig. 2). Two
 281 to five interviews have been executed per settlement, until
 282 major study questions were answered (Neuman 2003).
 283 In total, 40 different (individual or group) interviews
 284 have been undertaken. As knowledge about landscape
 285 changes through recent history was required, mainly
 286 elderly people have been interviewed; approximately
 287 70 % was older than 60 years.

288 All interviews were recorded, transcribed and loaded
 289 into the qualitative data analysis program NVivo to
 290 structure all data and to implement a constant compari-
 291 son. This was done by using an open coding approach as
 292 included in the grounded theory procedures (Strauss and
 293 Corbin 1998). This means that relevant interview quotes
 294 were marked with codes of themes derived from litera-
 295 ture as having a relation with land abandonment (Lech
 296 and Onwuegbuzie 2007). Afterwards, relations between
 297 coded quotes were explored by bringing them together

per category and settlement in order to investigate the
 indicators of land abandonment.

Quantification of the environmental characteristics

To examine the impact of the altitude, slope gradient,
 previous woody vegetation cover and distance to the
 nearest town, these environmental features were quanti-
 fied. For the altitude, the elevation of the residential core
 of the village was taken. The slope gradient was meas-
 ured by the creation of paths with height profiles on four
 transects (in N–S, NE–SW, E–W and NW–SE direc-
 tions) through each study site (until the surrounding hill
 slopes) on recent satellite images of Google Earth. Sub-
 sequently, the sum of the absolute height differences in
 each transect was divided by its length to calculate the
 average slope gradient. Next, the woody vegetation cover
 was quantified using a point-counting method (Bellhouse
 1981). This included the placement of a (10 × 10) regu-
 lar grid (with 100 m between neighboring intersections)
 over Yugoslav topographic maps of the 1970s (on a scale
 of 1:25,000) of the settlement areas. For all intersections,



Fig. 2 Participants as key informants of their own settlement area. **a** Interviewee showing a karst phenomenon on his property, Orahovo, 10/08/2013. **b** Interviewee showing her earlier cultivated area, Oblatno, 13/08/2013. **c** Interviewee showing the forest around his house, Petrov Do, 14/08/2013. **d** The typical informal setting for the conduction of interviews, Petrov Do, 14/08/2013



318 it was recorded whether they corresponded with woody
319 vegetation or not. Eventually, a percentage of woody veg-
320 etation cover was obtained for each study site. Lastly, the
321 shortest distance to the nearest city (mostly the munic-
322 ipal capital) by road was measured in Google Earth.

323 Rating the evolution of landscape elements and statistical 324 analysis

325 From all collected data, quantitative values could be
326 determined for the evolution of several landscape ele-
327 ments during the last few decades. These landscape
328 elements have been classified into six categories: con-
329 structions (houses, barns, roads, etc.), cultivation (crop-
330 land, vineyards, gardens, etc.), grasslands (meadows and
331 pastures), areas covered by fruit trees, bushy areas and
332 forests. Measures for these parameters were scored on a
333 bilateral scale, with -2.5 and 2.5 as respectively a large
334 decrease and increase in the concerned factor and 0 ,
335 meaning no change. This expert rating was done for each
336 settlement using the interview transcripts, maps, satel-
337 lite images and field observations. Afterwards, these val-
338 ues were used to create clusters with a similar change in
339 land use/cover—settlement profiles—by cluster analysis.
340 Finally, Pearson correlations between the quantified envi-
341 ronmental factors and the measures of landscape changes
342 (including trends of intensive and extensive land use and
343 natural vegetation, comprising the summed scores of
344 respectively the categories constructions and cultivation,
345 grasslands, fruit trees and bushy area and forest), were
346 calculated to explore their relations. Also, coefficients
347 between these environmental factors were taken so as to
348 check their mutual relations. Regression analyses have
349 been carried out when conditions were met.

350 Results

351 Environmental characteristics and agricultural 352 components

353 The selected settlements show a variety in altitude, slope
354 gradient, previous woody vegetation cover and distance
355 to the nearest town (Table 2). Furthermore, some con-
356 cepts typical for rural Montenegrin areas emerged from
357 the interviews. Firstly, the *katun* was mentioned, a com-
358 plex of mountain pastures with extensive common mead-
359 ows (and often cottages), where inhabitants lived during
360 summertime with their livestock. Some settlements had
361 several *katuns*, located at different altitudes, which were
362 used in sequence. Nowadays, many of them are not used
363 anymore and became (partly) abandoned. Also, *lynchets*,
364 nowadays mainly under grassland, prove the previous
365 existence of croplands on slopes (Fig. 3). Cultivation in
366 *dolines* was encountered in study sites on limestone but
367 nowadays, these only subsist as small gardens. The pro-
368 duction of *lime* and *charcoal* was traditionally performed
369 in calcareous regions with a degraded forest but has
370 almost been abandoned.

371 Trends in the settlement areas

372 While comparing all interview transcripts, several pre-
373 dominant aspects have been detected. About 80 % of the
374 interviewees mentioned farming as a (former) secondary
375 job and 10 % as their main employment. Most of them
376 are still cultivating vegetables and fruits for personal
377 use. The number of livestock has strongly decreased (for
378 almost everyone) since 50 or even 2 years earlier; now-
379 days most inhabitants have none to three cows, some
380 have about 10–30 sheep but almost no one still owns a
381 horse or ox. About 70 % of the interviewees stated a large

Table 2 Geographic parameters altitude, average slope gradient, woody vegetation cover in the 1970s and distance to nearest town for each settlement

No.	Settlement name	Altitude (m)	Average slope gradient (%)	Woody vegetation cover in the 1970s (%)	Distance to nearest town (km)
1	Mala Crna Gora	1450	10.0	5	18
2	Bosača	1550	13.5	56	5
3	Trubina	940	13.0	64	16
4	Pračevac	1100	27.5	56	12
5	Luge	690	8.0	25	2
6	Zagorje	840	16.5	45	7
7	Orah	1100	26.0	43	17
8	Oblatno	860	12.0	57	12
9	Orahovo	900	14.5	26	21
10	Petrov Do	870	8.5	27	14
11	Trabojin	490	21.5	62	25
12	Vuksanlekići	25	8.0	7	12
13	Gornji Brčeli	380	22.5	55	25
14	Godinje	80	22.0	43	25





Fig. 3 *Sklads* or lynchets on the grasslands of the settlement Trubina. Several *sklads* are marked by an arrow. 01/09/2013

382 difference in territorial use: a more extensive instead of
 383 intensive land use with less cropland, more (maintained)
 384 grasslands and fruit trees or more overgrown bushy
 385 areas. Most interviewees go to town less than five times
 386 a month to visit shops, banks and doctors, as their settle-
 387 ments do not have these facilities. Almost all interview-
 388 ees mentioned getting a (small) pension from the state
 389 or from the country where they had worked temporarily.
 390 More than 90 % of the children of the interviewees had
 391 migrated to an urban area; about half of them moved
 392 abroad and the other half to the Montenegrin cities.
 393 Almost all participants told they preferred living in their
 394 settlement over an urban lifestyle. Besides, many of them
 395 said that it is easier to farm and live rurally than before
 396 but less people (especially youngsters) want this. Further-
 397 more, in all studied villages, inhabitants own lands with
 398 different kinds of land cover; (almost) each one has a gar-
 399 den around the house, meadows on different altitudes
 400 and one or more plots of forest. A diminished soil quality
 401 (due to a decrease in livestock) has also frequently been
 402 mentioned. Furthermore, many interviewees stated that
 403 the summers became hotter and drier than before. Also,
 404 the inflations of the 1990s caused no large changes or
 405 problems in rural settlements, as inhabitants were rela-
 406 tively self-sufficient. Specific features and trends for set-
 407 tlements are given in Table 3.

408 Land abandonment factors and processes

409 Location

410 The distance to urban areas influences the land use
 411 change. Large cities (as Podgorica) have a larger sphere
 412 of influence than smaller towns (as Žabljak). Urban–rural

gradients of study sites include Luge, Zagorje (both 413
 permanent), Pračevac (seasonal) and Orah (perma- 414
 nent-abandoned) to the city Berane, Bosača (perma- 415
 nent-seasonal) and Mala Crna Gora (abandoned) to the 416
 town Žabljak and Vusanlekići (permanent) and Trabojin 417
 (permanent-abandoned) to Podgorica. Generally, the 418
 closer a village is situated to a town, the less abandoned 419
 it became. Within permanent(-seasonal) inhabited study 420
 sites (as Trubina and Bosača), abandoned and over- 421
 grown grasslands are generally situated at the edges of 422
 the village, because parts of the land had been exchanged 423
 between staying and migrating family members. How- 424
 ever, when settlements became more abandoned (as 425
 Mala Crna Gora), overgrown areas appear on their ter- 426
 ritories everywhere. 427

Physical geography 428

The altitude determines the presence of *katuns* and 429
 thereby land abandonment, as these elevated areas 430
 often were abandoned first. For example, the *katuns* of 431
 Pračevac are at the first level partially (Fig. 4) and at the 432
 second level, totally abandoned and overgrown. Fur- 433
 thermore, the often mentioned hotter, dryer and longer 434
 summers cause more dry soils nowadays. In parts of the 435
 Montenegrin karst region, water has always been the 436
 main restriction for agriculture as cultivable soil is very 437
 scarce and thus all small fertile grounds (dolines) were 438
 (and still are) well maintained (as in Petrov Do, Fig. 5). 439
 Other areas (as Godinje and Gornji Brčeli) have springs 440
 and more fertile soils, which became quickly overgrown 441
 due to bad maintenance and abandonment. Usually, the 442
 best grounds are being kept, while less fertile lands had 443



Table 3 Statements emerged from the interviews about several situations in the studied settlement areas, with + as confirmation, – as negation, / as not determined or relevant and the numbers 1–14 representing the settlements (see Tables 1, 2)

Statement	Settlement number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Land is mainly used for grass cutting instead of crops	/	+	+	+	+	+	+	+	+	/	+	-	-	-
Most fields are abandoned and overgrown by bushes	+	-	-	+	-	-	+	-	-	-	-	-	+	+
The <i>katuns</i> in the mountains are still used nowadays	+	/	+	-	+	+	-	-	-	/	-	/	-	-
Now there are more forested areas around the village	+	+	+	-	+	+	+	-	-	+	-	-	+	+
... because people cut less trees now	+	+	-	-	+	+	+	+	-	+	+	+	+	+
There is more forest but of less quality now than before	/	-	+	+	-	+	-	+	+	/	/	-	-	-
There is more degraded forest now due to forest fires	-	-	-	+	-	-	-	+	+	+	+	+	-	-
There are high quality trees for construction wood	+	+	-	+	+	+	+	-	-	-	-	-	-	-
Residents still collect mushrooms or berries in the forest	+	+	+	+	+	+	+	+	-	-	-	-	+	+
Residents made <i>kreč</i> or charcoal with degraded wood	-	-	-	-	+	-	-	+	+	+	+	+	+	+
Now there are more (fruit) trees in the village	/	/	+	+	+	+	+	+	+	/	+	-	+	+
There are erosion processes	-	-	-	-	+	-	+	+	+	+	+	+	+	-
There are karst phenomena	+	+	-	-	-	-	-	-	+	+	+	-	+	-
People cleaned farmlands of stones and made walls of it	+	-	-	-	-	-	-	+	+	+	+	-	+	+
There are terraces	-	-	-	-	-	-	-	-	+	+	+	-	+	+
There are lynchets	-	-	+	+	+	+	+	+	-	-	-	-	-	-
It is still difficult to survive due to the lack of water	+	-	+	-	-	-	-	-	-	+	+	-	-	-
Residents built (a part of) their roads or electricity	+	-	/	/	-	-	+	-	-	+	/	-	+	-
Residents still burn their garbage or throw it in the river	+	+	+	+	-	-	+	+	-	+	+	-	-	-
There is a pro-Serbian mentality in the settlement	-	-	-	+	+	+	+	+	+	/	-	-	-	-
The main emigrations were in the 1970s	-	+	-	+	/	+	+	+	+	+	+	+	+	+
The main emigrations were in the 1990s	+	-	+	-	/	-	+	+	-	-	-	+	-	-
Now only the elderly people remain to live here	+	-	-	+	-	-	+	+	+	+	+	-	+	+
Only a few families live here during the winter	+	-	-	+	-	+	-	-	-	+	-	-	+	+

444 been abandoned or exchanged. In Bosača, the latter was
 445 done with lands in Pitomine (a neighbouring village),
 446 which have a lower soil quality. Also, the slope gradient
 447 influences the land abandonment. In several villages,
 448 interviewees told that abandoned and overgrown lands
 449 are mainly situated on steep slopes, while these areas
 450 were traditionally meant for grasslands (rather than
 451 croplands).

452 **Vegetation and ecosystem services**

453 Several study sites have forests with high quality trees
 454 (mainly pines) which have value as timber and therefore,
 455 inhabitants do not ruin them by making charcoal or lime,
 456 which was done in regions with a degraded, bushy veg-
 457 etation. Some interviewees own separate forest patches
 458 with trees for firewood (lower situated) and high quality
 459 trees (located higher). People always need permission and
 460 tax payment for logging. Generally, all settlements are
 461 more vegetated now; mainly the areas around the houses
 462 became greener because of an increase in fruit trees,
 463 grasslands and bushy areas at the expense of croplands.

Therefore, most settlements gained a more closed land-
 scape without attributing this to abandonment alone. In
 Zagorje, the central plain traditionally comprised open
 space but during the 1980s, new houses appeared with
 an increase in gardens and plum trees. The study sites
 Gornji Brčeli and Godinje show many new bushes and
 trees due to the abandonment of croplands on cultivation
 terraces, leading to an almost inaccessible vegetated area.
 A result of the emerging forest is the increased amount of
 mushrooms, berries and herbs in these settlements, ena-
 bling more inhabitants to collect and sell them.

Agriculture

Nowadays, physical circumstances of territories are
 less determinative than before, as agricultural tools and
 inputs have drastically improved and local inhabitants
 do not need much space for farming anymore. Some
 interviewees mentioned people respected their land
 more in the past by using the unfertile areas for building
 and keeping fertile grounds for cultivation. For exam-
 ple, the settlement structure of Zagorje evolved from

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Fig. 4 Phases in the process of overgrowth of grasslands to natural vegetation in the katun Ravni, as not all lands become abandoned at the same time, Pračevac, 02/09/2013



Fig. 5 Half cultivated garden in a doline (*foreground*). Livestock is still kept in this landscape, as evidenced by the presence of tracks and a pen (*arrows*). Petrov Do, 14/08/2013

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484 houses only being located at the surrounding hill slopes
 485 to the scattered habitat over the territory; also after the
 486 devastating earthquake of 1979 in Godinje, a part of its
 487 traditional houses on the hill slopes have been rebuilt
 488 on the lower, flatter area used for vineyards earlier on.
 489 Furthermore, in the past, almost every house had one or
 490 two oxen for land cultivation. Herds of sheep, goats or
 491 cows were taken to meadows around the village or the
 492 *katuns*. Also, interviewees in Godinje mentioned the
 493 former occurrence of stubble grazing on the residues
 494 of the harvested croplands. Nowadays, mainly gardens
 495 around houses remain areas of intensive land use. Crop-
 496 lands for fodder are no longer necessary, as inhabitants
 497 do not have much livestock anymore. A transition from
 498 croplands to grasslands, bushy areas and eventually for-
 499 ests is generally observed. However, not all grasslands
 500 became overgrown, as several inhabitants were able to
 501 maintain them.

502 **Demography**

503 Demographic changes due to emigration and aging
 504 appeared to be the major driving forces for land use
 505 change. Most family sizes reduced as many people in
 506 their twenties migrated to the cities (mainly their munic-
 507 ipal capital, Podgorica or a coastal city) or abroad (often
 508 Serbia and some to another ex-Yugoslav country), while
 509 the old, remaining family members were passing away.
 510 Usually, these remaining persons only cultivate accord-
 511 ing to their needs and thus, as a result, gardens became
 512 smaller. Their old age and the absence of helpers also
 513 determine the declining amounts in livestock and crops.
 514 One of the reasons for emigration nowadays is that
 515 young people cannot find a partner if they stay in their
 516 village, as many traditional settlements only house few
 517 different families. Furthermore, it was frequently heard
 518 that inhabitants temporarily migrated to other nearby
 519 countries (mainly Germany, Austria or Italy) to work
 520 some time for a higher salary. With less people, less land
 521 is cultivated or maintained, more areas become over-
 522 grown and less trees are cut for firewood in the forests
 523 surrounding the villages. Large variations occur between
 524 properties of seasonal inhabitants. Owners are often
 525 there during summers, weekends or vacations and they
 526 maintain their lands well, while others almost never
 527 come, have much overgrown land or let neighbours
 528 maintain it.

529 **Society**

530 Lastly, policy and laws have an impact on the land use
 531 change. The establishment of national parks largely
 532 influenced the forest policy in the concerned areas.
 533 For example, due to the more strict laws of the Durmi-
 534 tor National Park since the 1980s, the surroundings of

Mala Crna Gora became more forested. In several areas
 535 which are unprotected as a national park, the laws on
 536 tree cutting also became stricter according to inter-
 537 viewees. Since the last 20 years, the authorities have
 538 been acting stricter and did not allow firewood cutting
 539 for sale; permissions to cut trees in private forests are
 540 harder to obtain and there is much forest owned by the
 541 state. However, interviewees of some settlements (like
 542 Orahovo, near Podgorica) mentioned that nowadays,
 543 authorities are tolerating the illegal cutting of good qual-
 544 ity forest (facilitated by better machinery, including sec-
 545 ond-hand military vehicles), which did not happen until
 546 1990. Furthermore, war periods and economic crises had
 547 an impact on the environment. The inflation during the
 548 1990s, coupled with weakness of authority, caused more
 549 mushroom picking in forests and tree cutting as peo-
 550 ple needed to be more self-sufficient. Then, there were
 551 -about one third- less trees in Bosača, due to the uncon-
 552 trolled cutting. The collective agricultural system of the
 553 early 1950s, when people had to give away their lands,
 554 is partly responsible for the many overgrown terrains in
 555 Godinje, as these unclaimed lands remain state prop-
 556 erty until the hypothetical previous owners are claiming
 557 them back.
 558

559 **Settlement profiles of landscape changes**

560 The evolution in land use change of all 14 study sites
 561 can be clustered into five distinctive groups of land use
 562 change (Fig. 6; Table 4). The first two settlement profile
 563 types—urbanized and intensified—both contain only one
 564 settlement—respectively Luge and Vuksanlekići. Luge is
 565 characterized by an obvious increase in construction but
 566 not in cultivation, while Vuksanlekići largely increased
 567 in cultivation and -to a much smaller extent- in con-
 568 struction. All other settlements are characterized by a
 569 decrease in intensive land use, while most of them show
 570 an increase in extensive land use. Seven settlements—
 571 Bosača, Trubina, Pračevac, Zagorje, Oblatno, Orahovo
 572 and Trbojin—are categorized as extensified and char-
 573 acterized by a significant decrease in intensive land use
 574 (mainly in terms of croplands) on the one hand and a
 575 strong increase in extensive land use (as grasslands and
 576 fruit trees) on the other hand. Moreover, they contain
 577 recently grown shrubs, bushes and trees. The overgrown
 578 settlement profile includes Mala Crna Gora, Orah and
 579 Petrov Do and their territories, where intensive land use
 580 has strongly decreased but also (slightly) extensive land
 581 use (fruit trees and mainly meadows). Furthermore, some
 582 surfaces have recently become overgrown by natural
 583 vegetation. Finally, Gornji Brčeli and Godinje were heav-
 584 ily forested during the last decades. These settlements
 585 have a decreased area of intensively used land, as well as
 586 grasslands.



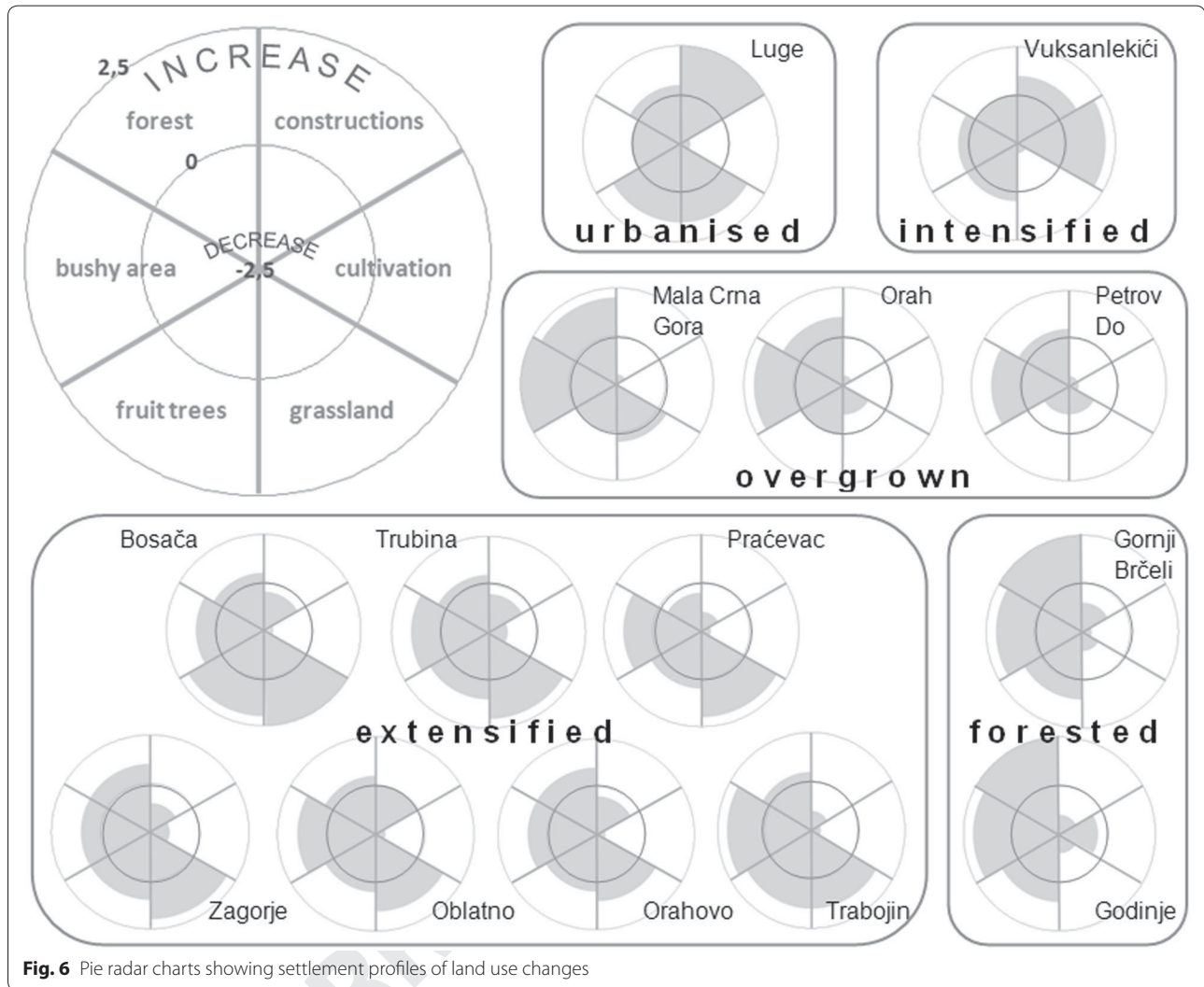


Fig. 6 Pie radar charts showing settlement profiles of land use changes

Table 4 Settlement profiles with a short description of the most important trends

Cluster name	Settlements	Description
Urbanised	Luge	Much more houses, more small gardens and fruit trees, much less cropland
Intensified	Vuksanlekići	Much more vineyards, some more houses, much less grassland
Extensified	Bosača—Trubina—Pračevac—Zagorje—Oblatno—Orahovo—Trabojin	Little less number of houses, often with smaller gardens, much less cropland, more meadows and fruit trees
Overgrown	Mala Crna Gora—Orah—Petrov Do	Much less houses and cultivation, more bushy areas, some more forest
Forested	Gornji Brčeli—Godinje	Less houses and cultivation, less grass land, much more bushy area and especially recent forest

587 **Comparison of the variables**

588 According to the calculated Pearson correlation coef-
 589 ficients, the average slope gradient is moderately related
 590 to the previous woody vegetation cover ($r = + 0.57$) and
 591 weakly to the distance to the nearest town ($r = + 0.47$).
 592 The factor 'altitude' is weakly related to the distance to

town ($r = -0.38$). Furthermore, correlations between
 the geographic features and land use changes are inves-
 tigated, where the former aspects are expected to explain
 some values of the latter (Table 5). The strongest correla-
 tions are detected between the altitude and changes
 in the cultivated area ($r = -0.73$), slope gradient and

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Table 5 Matrix comprising Pearson correlation coefficients of possible determining geographical variables (rows) and influenced variables of land use changes (columns)

Independent variables: geo-graphic aspects	Dependent variables: land use changes								
	Construction	Cultivation	Intensive land use	Grassland	Fruit trees	Extensive land use	Bushy area	Forest	Natural vegetation
Altitude (m)	-0.28	-0.73***	-0.60**	<i>0.40</i>	-0.19	<i>0.24</i>	<i>0.18</i>	-0.08	<i>0.04</i>
Slope gradient (%)	-0.50*	-0.26	-0.47*	<i>0.11</i>	<i>0.25</i>	<i>0.17</i>	<i>0.71***</i>	<i>0.42</i>	<i>0.62**</i>
Vegetation (%)	-0.27	-0.35	-0.37	<i>0.54**</i>	<i>0.37</i>	<i>0.55**</i>	<i>0.23</i>	<i>0.13</i>	<i>0.20</i>
Distance (km)	-0.55**	<i>0.04</i>	-0.32	-0.36	-0.28	-0.38	<i>0.69***</i>	<i>0.34</i>	<i>0.56**</i>

A underline font shows that conditions for linear regression analysis are satisfied, while an italic font shows that this is not the case. The asterisks show the significances of the executed linear regression analyses, with * $p < 0.10$; ** $p < 0.05$, *** $p < 0.01$

changes in the bushy area ($r = + 0.71$) and distance to the nearest town and changes in the bushy area ($r = + 0.69$). The change in the constructed area is significantly correlated with the distance to town ($r = -0.55$), as well as the slope gradient ($r = -0.50$). The changes in forest and extensive land use appear to be rather unrelated to the studied geographical aspects, with only a moderate correlation ($r = + 0.54$) between the previous vegetation cover and the change into grassland.

Lastly, when combining all settlement clusters and profiles, a large variation in housing type (settlement clusters) exists for the extensified settlement profiles, having mainly permanent and seasonal settlements. The overgrown settlements are mainly (partly) abandoned and the two forested settlements are seasonal and permanent-seasonal.

Discussion

Land use changes

The studied areas show similar trends, as well as variations concerning the land use change. All rural inhabitants still own differently located territories, but while in the past the purpose was to enable several types of land use (Antrop 2000), now less strong relations between land use and soil qualities exist due to the declining cultivation activities. However, cultivating in dolines and maintaining them in the limestone areas (i.e. using their ecosystem services) is still occurring when there is a need for it. In Montenegro, firewood remains the dominant type of fuel for heating, especially in (northern) rural settlements and about 14 % of the households get firewood from their own forest (Glavonjic and Krajnc 2013). Furthermore, lynchets situated in the meadows and terraces overgrown by bushes indicate the decrease of former agricultural practices and the shift in land cover. The land use changes were found to be highly related to the shifts in lifestyles as mentioned by Fry (2000) with social, economic and political driving forces. However, ambiguities exist about the role of the authorities in logging. Some interviewees mentioned more logging in the forests

around their village in the early 2000s than before, due to the better machinery and a lack of control. Conversely, in other settlements, interviewees talked about the current stricter laws to cut trees in their own forests and thus the (forced) decrease of it. A possible explanation for this are the stricter laws in the private forests—which significantly increased during the last decades to about 33 % in 2008 (Andelić et al. 2012)—against the inefficient forest management of the state forests (Grimes et al. 2005). However, the forest management became more efficient in controlling the illegally obtained timber wood through clear cuts and wildfires since 2000 according to Foster-Turley et al. (2010). Furthermore, the conclusion of Nyssen et al. (2014) about the general increase of the forest in Montenegro throughout the twentieth century can be more nuanced according to this research. In some sites, it was said that—although there is more vegetation now—the quality of the forest has decreased. Also, many interviewees mentioned that—mainly inside their settlement—the vegetation increased at locations where they cultivated the land before, creating a more closed local landscape. Research in other topographically complex areas (such as the Alps) found that the cultivated land in particular is affected by large socio-economic changes (Schirpke et al. 2012).

Land abandonment versus extensification

The most frequently observed phenomenon was the decrease of (intensively) cultivated areas and the increase of (extensively) maintained grasslands and fruit trees. Since most inhabitants have less livestock now, they do not need crops for fodder anymore to feed them efficiently. Therefore, a less intensive method is achieved by giving hay through grass cutting on former croplands. As two cows need lots of hay, large meadows have to be maintained. Also, several inhabitants maintain their grasslands only in order to keep their property tidy. Because of the aging of the remaining rural inhabitants, it is not evident for them to do intensive labour anymore. Therefore, fruit trees became popular too, as this

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represents also a more extensive way of gardening. These findings are comparable with the dominant trend of extensification in the mountainous rural European areas since about 1950 (Mottet et al. 2006). The single significant relation between the increasing grasslands and the woody vegetation cover in the 1970s can be partially explained through the good soil characteristics for vegetation and the intermediate effect of the slope gradient. Land abandonment in terms of an enormous increase in natural, wild vegetation was found to a lesser extent, although in all extensified villages several parcels became so. The overgrown territories turned out to be mainly influenced by their location (far from a city), slope gradient (steep) and altitude (elevated) and have the most abandoned houses. The forested territories are influenced by the same geographical factors but are situated not so high and house more inhabitants that are seasonal.

Interview methods

Interviewing local inhabitants provided us with useful, detailed data about their lifestyles and habits in particular. However, sometimes contradictory comments were given, so interviews had to be analyzed critically. Indications for reliability were the recurring similar answers by several interviewees of the same settlement. It was easier to ask interviewees detailed questions about their personal experiences than about general landscape evolutions. Also, it was more interesting to interview men, since married women had migrated to the village of their husband and they did not know the area since childhood as a result.

Conclusion

The evolution of land abandonment in rural Montenegro since about 1950 at 14 local study sites and their underlying processes has been examined. Certain trends can be partially explained through geographical conditions. Settlements with steep slope gradients and large distances to cities show an increase in overgrown, bushy lands, while the cultivated area decreased for villages at high altitudes, and small distances to cities led to more house construction. Also, demographic and social circumstances demonstrated their impact on the landscape. Villages where lands were extensively maintained turned out to be mainly characterized by emigration and aging of their inhabitants; such extensification was also significantly correlated with the woody vegetation cover in the 1970s. Five settlement profiles could be distinguished: urbanized, intensified (both comprising only one settlement), extensified, overgrown and forested types of settlements. Most study sites displayed a trend of extensification, with maintained grasslands and fruit trees instead of traditional croplands and much livestock. Also, often areas became overgrown by bushes and vegetation, mainly at

edges and on mountain areas of settlement territories, but also centrally within villages overgrown grasslands occur. These processes -along with the increase of fruit trees- caused a shift from rather open to more closed landscapes within settlements.

Public attitudes towards such “rewilding” processes (sensu Bauer et al. 2009) and social-ecological benefits (Navarro and Pereira 2012) should be studied in order to develop policies to cope with the phenomenon of overgrown village territories that occurs in many mountainous regions in Mediterranean Europe.

Authors’ contributions

The first author, AK, designed the research setup and conducted this research. She visited the research area, collected relevant data and she analyzed and interpreted the data. She also drafted the manuscript for this research. She has constantly worked in the research area for 2 months. The second author, VS, permanently lives in the research area, participated in the data collection and shared his scientific knowledge of the research area. The last author, JN, planned the research and together with the third author, VVE, supervised the first author. They also contributed towards developing, editing and finalizing of the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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References

Andelić M, Dees M, Pantić D, Borota D, Šljukić B, Čurović M (2012) Status of forest resources of Montenegro. *Agricult For* 57:39–52
 Annys K, Frankl A, Spalević V, Čurović M, Borota D, Nyssen J (2014) Geomorphology of the Durmitor Mountains and surrounding plateau Jezerska Ploča (Montenegro). *J Maps* 10(4):600–611
 Antrop M (2000) Background concepts for integrated landscape analysis. *Agric Ecosyst Environ* 77:17–28
 Antrop M (2005) Why landscapes of the past are important for the future. *Landscape Urban Plan* 70(1–2):21–34
 Baldock D, Beaufoy G, Brouwer F, Godeschalk F (1996) Farming at the margins. Abandonment or redeployment of agricultural land in Europe. Institute for European Environmental Policy/Agricultural Economics Research Institute, London/The Hague
 Bauer N, Wallner A, Hunziker M (2009) The change of European landscapes: human-nature relationships, public attitudes towards rewilding, and the implications for landscape management in Switzerland. *J Environ Manag* 90(9):2910–2920
 Bellhouse DR (1981) Area estimation by point-counting techniques. *Biometrics* 37:303–312
 Calo F, Parise M (2006) Evaluating the human disturbance to karst environments in Southern Italy. *Acta Carsologica* 35:47–56

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- 786 Chartin C, Bourennane H, Salvador-Blanes S, Hirschberger F, Macaire JJ (2011)
787 Classification and mapping of anthropogenic landforms on cultivated hill
788 slopes using DEMs and soil thickness data: example from the SW Parisian
789 Basin, France. *Geomorphology* 135:8–20
- 790 Čurović Z, Popović S (2014) Typological classification of settlements in the
791 rural hinterland of the bay of Boka Kotorska. *Agric Cult For* 60(4):275–289
- 792 Dodgshon RA, Olsson EGA (2007) Seasonality in European mountain areas:
793 a study in human ecology. In: Palang H, Printsmann A, Soovali H (eds)
794 Seasonal landscapes. Springer, Dordrecht, pp 85–102
- 795 Fagerholm N, Käyhkö N, Ndumbaro F, Khamis M (2012) Community stakehold-
796 ers' knowledge in landscape assessments—mapping indicators for
797 landscape services. *Ecol Ind* 18:421–433
- 798 Foster-Turley P, Grimes A, Sedej M (2010) Biodiversity analysis update for Mon-
799 tenegro, May 2010. USAID Serbia, Belgrade
- 800 Frankl A, Lenaerts T, Radusinović S, Spalević V, Nyssen J (2015) The regional
801 geomorphology of Montenegro mapped using land surface parameters.
802 *Zeitschrift für Geomorphologie* (submitted)
- 803 Fry G (2000) The landscape character of Norway—landscape values today and
804 tomorrow. In: Pedrolí B (ed) *Landscape, our home. Essays on the culture
805 of the European landscape as a task*. Christofoor, Zeist, pp 93–99
- 806 Galletta A (2013) Mastering the semi-structured interview and beyond: from
807 research design to analysis and publication. New York University Press,
808 New York
- 809 Glavonjić BD, Krajnc N (2013) Wood fuels consumption in households in
810 Montenegro. *Therm Sci* 17:323–332
- 811 Grimes AP, Latif MA, Vujadinovic-Colic J, Buskovic V (2005) Biodiversity assess-
812 ment update for Serbia and Montenegro. USAID Serbia-Montenegro,
813 Belgrade
- 814 Jepsen MR, Kuemmerle T, Erb K, Verburge PH, Müller D, Reenberg A, Haberl H,
815 Vesterager JP, Zhllima E, Krausmann F, Van Eetvelde V, Antrop M, Chromý
816 P, Jančáki V, Pärnj J, Mander U, Björn I, Terkenli TS, Schistou D, Konkoly-
817 Gyuró E, Bondeau A, McDonagh J, Niedertscheider M, Olj Nikodemus
818 O, Daugirdas V, Ribokas G, Schmit G, Caspar G, Cassar LF, Conrad E, Aus-
819 trheim G, Tretvik AM, Ostapowicz K, Trzepacz P, Kozak J, Pinto-Correia
820 T, Vadineanu A, Izakovicova A, Kladnik D, Andrič M, Elena-Rosselló R,
821 Pérez-Soba M, Jansson U, Gimmi U, Walz A, Bürgi M, Bryson J, Rounsevell
822 M (2015) Transitions in European land management regimes between
823 1800 and 2010. *Land Use Policy* 49:53–64
- 824 Klijn J, Vos W (eds) (2000) *From landscape ecology to landscape science*.
825 Kluwer, London
- 826 Kranjc A (2008) History of deforestation and reforestation in the Dinaric Karst.
827 *Geogr Res* 47:15–23
- 828 LaGro JA (2001) site analysis. Linking program and concept in land planning
829 and design. Wiley, New York
- Lazic M, Sekelj L (1997) Privatisation in Yugoslavia (Serbia and Montenegro).
830 *Eur-Asia Stud* 49:1057–1070
- 831 Leech NL, Onwuegbuzie AJ (2007) An array of qualitative data analysis tools: a
832 call for data analysis triangulation. *Sch Psychol Q* 22:557–584
- 833 MacDonald D, Crabtree JR, Wiesinger G, Dax T, Stamou T, Fleury P, Gutierrez
834 Lazpita J, Gibon A (2000) Agricultural abandonment in mountain areas
835 of Europe: environmental consequences and policy response. *J Environ
836 Manag* 59:47–69
- 837 Miller NJ (2005) Serbia and Montenegro. In: Frucht R (ed) *Eastern Europe. An
838 introduction to the people, lands, and culture*. ABC-CLIO, Santa Barbara,
839 pp 529–581
- 840 MONSTAT Statistical Office of Montenegro (2011) Table N4: population
841 by age and sex by settlement. [http://www.monstat.org/eng/page.
842 php?id=395&pageid=57](http://www.monstat.org/eng/page.php?id=395&pageid=57). Accessed 24 Jun 2013
- 843 MONSTAT Statistical Office of Montenegro (2011) Table SN1: dwellings by
844 use, i.e. by purpose by settlement. [http://www.monstat.org/eng/page.
845 php?id=452&pageid=57](http://www.monstat.org/eng/page.php?id=452&pageid=57). Accessed 24 Jun 2013
- 846 Mottet A, Ladet S, Coqué N, Gibon A (2006) Agricultural land-use change and
847 its drivers in mountain landscapes: a case study in the Pyrenees. *Agric
848 Ecosyst Environ* 114:296–310
- 849 Mugoša R (2008) Spatial plan of Montenegro until 2020. Ministry of Economic
850 Development, Podgorica
- 851 Navarro LM, Pereira HM (2012) Rewilding abandoned landscapes in Europe.
852 *Ecosystems* 15(6):900–912
- 853 Neuman WL (2003) *Social research methods: qualitative and quantitative
854 approaches*. Allyn and Bacon, Boston
- 855 Nyssen J, Van den Branden J, Spalević V, Frankl A, Van de Velde L, Čurović M,
856 Billi P (2014) Twentieth century land resilience in Montenegro and conse-
857 quent hydrological response. *Land Degrad Dev* 25:336–349
- 858 Pausic A, Carni A (2012) Landscape transformation in the low karst plain of
859 Bela krajina (SE Slovenia) over the last 220 years. *Acta Geogr Slov-Geogr
860 Zb* 52:35–51
- 861 Pittaway M (2004) *Eastern Europe 1939–2000*. Arnold, London
- 862 Pond E (2006) *Endgame in the Balkans. Regime change, European style*. Brook-
863 ings Institution Press, Washington
- 864 Radović M (1981) Savremene društveno-ekonomske promjene u SR Crnoj
865 Gori. In: Ivanović Z (ed) *XI Congress of Yugoslav Geographers in Montene-
866 gro. Geografsko Društvo SR Crne Gore, Titograd*, pp 32–33
- 867 Renes H (2015) Historic landscapes without history? A reconsideration of the
868 concept of traditional landscapes. *Rural Landsc Soc Environ Hist* 2(1):1–11
- 869 Schirpke U, Leitinger G, Tappeiner U, Tasser E (2012) SPA-LUCC: developing
870 land-use/cover scenarios in mountain landscapes. *Ecol Inform* 12:68–76
- 871 Strauss A, Corbin J (1998) *Basics of qualitative research: Grounded theory
872 procedures and techniques*. Sage, Thousand Oaks
- 873

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