Implications of decadal changes in precipitation and land use policy to soil erosion in Basilicata, Italy

M. Piccarreta a, D. Capolongo a,*, F. Boenzi a, M. Bentivenga b

a Dipartimento di Geologia e Geofisica, Università di Bari, via Orabona 4, Bari, Italy
b Dipartimento di Scienze Geologiche, Università della Basilicata, Contrada Macchia Romana, Potenza, Italy

Abstract

This paper examines the implications of changes in precipitation and land use to soil erosion from 1955 to 2002 in Basilicata, a hilly portion of southern Italy. Analysis of daily precipitation records reveals statistically significant trends using both non-parametric and parametric approaches. The inter-annual variability of precipitation increases in intensity; primarily between October and January. From 1955 to 2000, the length of dry spells greatly increased, while wet days decreased. A land use change map was produced for the three study areas using aerial photos (1955) and orthophotos (1997 and 2002), integrated with field surveys. Results show that land use is highly dynamic in Basilicata, especially due to the application of the European Union’s Common Agricultural Policy (CAP) measures. The EU policies resulted in reclamation of badlands and degraded grasslands for agriculture, principally the cultivation of durum wheat. This farming practice and the abandonment of some of the remodeled areas have increased the risk of soil erosion and desertification processes, and is manifest in land degradation by rill networks and gullying.

Keywords: Soil erosion risk; Land degradation; Rainfall pattern; Land use change; Mediterranean; Southern Italy

1. Introduction

Land degradation, initiated by natural and human processes, is responsible for environmental and socio-economic problems and has long been of great concern to the Mediterranean region. Changes in rainfall patterns (annual precipitation, intensity and inter-annual variability) and in land use have frequently been found as the mechanisms responsible for triggering land degradation. Many studies in the Mediterranean region (Kosmas et al., 1997; Renschler et al., 1999; Torri et al., 1999; Faulkner et al., 2003) have shown that extreme events, severe drought, high wind and farming practices are powerful causes of erosion in bare or poorly vegetated areas (soils), and influence the development of geomorphic features. Lately some authors (Dumansky and Pieri, 2000) have focused their attention on the relationships between human activity and soil quality (loss in biodiversity, percentage in organic matter and nutrients). Technological development and commercial strategies, as well as the European and national policies, have led to production based on soil intensive exploitation and monoculture in the Italian countryside. Moreover, the improper use of production means intense agricultural systems and improper forest management have initiated land degradation in many regions (INEA, 1999), including Basilicata.

Agricultural soils in Basilicata underwent continuous degradation during the last century, with acceleration in the last 30 years due to the introduction of Common Agricultural Policy (CAP) measures (Rendell, 1986; Sonnino et al., 1998), such as Reg. CEE 1765/92 concerning the subsidies to cultivate durum wheat (first on production and then on cultivated areas) and Reg. CEE 2078/92 regarding the F measure (20 years – set-aside).

In Basilicata the first CAP measure favoured the reclamation of bushy lands and badlands for durum wheat cultivation owing to the great economical advantages. 

* Corresponding author. Fax: +39 080 5442471.
E-mail addresses: marcopiccarreta@geo.uniba.it (M. Piccarreta), capolongo@geo.uniba.it (D. Capolongo), boenzi@geo.uniba.it (F. Boenzi), bentivenga@uniba.it (M. Bentivenga).

0341-8162/S - see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.catena.2005.11.005
Reclamation of badlands is known as “remodelling” and implies the flattening of the landforms, reduction of slope angles (~20°) and breaking up of the soil surface. The exposed larger surface area results in more rapid wetting, increased slaking and an increased tendency for soils to chemically disperse (Phillips, 1998).

Subsequently the second measure has determined the abandonment of several remodeled areas, especially of badlands, which are characterized by low productivity. The seasonal cultivation of durum wheat and cereals and the frequent abandonment of some of these areas, deeply increased the erosion effectiveness of natural processes over these lands, causing degradation conditions, as in other Mediterranean areas (Kosmas et al., 2000; Dunjó et al., 2003). Rills, gullies, debris flows, mudflows, soil creep and occasionally small landslides are the main features of what was once a remodeled area. Previous studies relative to Basilicata have dealt with this topic in a qualitative way, showing in which way recent land use changes have contributed to exacerbate the soil erosion processes.

Thus, the aim of this paper is to make predictions of the impacts of changes in rainfall regime and land use on land degradation in Basilicata across a range of temporal and spatial scales, through analysis of precipitation and land-use dynamics in three selected areas from 1955 to 2002.

2. Study area

The study areas are located within the hydrographical basins of Agri and Salsandrella–Cavone river catchments between 40°16’ and 40°23’N and 16°12’ and 16°35’E (Fig. 1). The Aliano area (1) covers a surface of about 45.24 km², the Craco area (2) is 13.10 km² and the Pisticci area (3) 16.35 km².

The climate is typically Mediterranean, characterized by hot dry summers and mild wet winters. The yearly average rainfall ranges between 737.83 mm and 580.73 mm, and is concentrated from November to January; the yearly average temperature ranges from 16° to 17.5°, with an average maximum between 24° and 25.5° during summer and an average minimum ranging between 8° and 9.5° during winter.

The Plio-Pleistocene clays, with a thickness from 500 m to 900 m (Lentini and Vezzani, 1974; Clarke and Rendell, 2000), are the most widespread lithology in the studied areas. They consist of marly and silty clays with middle–high plasticity (Pieri et al., 1994; Clarke and Rendell, 2000). They include illite, kaolinite and montmorillonite. The high Na-contents of these deposits imply a great tendency to disperse rapidly when wetted. The calculated ESP (exchangeable sodium percentage) ranges from 36% to 45% (Alexander, 1982; Rendell, 1986; Del Prete et al., 1994; Phillips, 1998; Farifteh and Soeters, 1999). It is worth noting that ESP ≥15% induces deflocculation favouring piping and tunnel erosion (Alexander, 1982; Faulkner et al., 2000). The seasonal rainfall distribution, high relative relief, and dispersive nature of clays have contributed to create high drainage densities in both areas, resulting in a typical badland landscape.

3. Materials and methods

3.1. Data collection

Pluviometric data from 1955 to 2000 relative to the stations of Aliano and Pisticci were obtained from the National Hydrographic Service (SI). Time series were homogenized with single and multiple linear regression performed to fill data gaps. More details on pluviometric trends in Basilicata as well as on the methods of data management are supplied in Piccarreta et al., 2004. Land use changes have been deduced using aerial photography taken in 1955, 1997 and 2002. Field work was supplementary to the mapping of land use change.

3.1.1. Pluviometric data

Total annual and monthly precipitation data have been computed to evaluate the inter-annual variability of rainfall and its concentration during the year. To define pluviometric thresholds responsible for the main erosive processes on the slopes, the authors have verified directly to what extent pluviometric events having different intensity have affected the soil. Moreover, a detailed bibliographic analysis has been carried out on the dates when alluvional and landsliding events occurred in the investigated areas during the last century. Accordingly, three classes of pluviometric events have been considered: number of rainy events >2.0, >10.0 and <30.0 mm, and >30.0 mm. In this paper, events >2.0 mm, are considered as rainy days.

Several authors (Mannaerts and Gabriels, 2000, Boardman et al., 2003) consider that an amount of daily rainfall >10.0 mm to be an approximate threshold at which runoff commences in semi-arid environments, while Canton et al. (2001) have found that in the semi-arid region of Almeria (Southern Spain) the threshold rainfall required to produce runoff ranges between 3.5 mm and 14.2 mm. Based on field surveys, the authors have concluded that erosion occurs when daily rainfall exceeds 10.0 mm.

The literature relative to the alluvional and landsliding events (Caloiero and Mercuri, 1982; AVI project) has shown that 30.0 mm might be considered as a threshold after which the geomorphic work effected by precipitation on slopes in Basilicata clays produces both severe rill erosion and mass movements.

Then, rainfall intensity, max number of consecutive dry days, max number of consecutive wet days, mean dry spell lengths (days) and mean wet spell lengths (days), have been computed for the two pluviometric stations. For all
Fig. 1. Lithology of the Aliano (a), Craco (b) and Pisticci (c) areas.
parameters, the Mann–Kendall non-parametric test, as described by Sneyers (1990) and Sneyers et al. (1997), was applied to detect possible trends in the time-series data (Table 1).

3.1.2. Land use dynamics

Land use change is examined using multitemporal analyses of aerial photos of 1955 (scale of 1:33,000) and orthophotos of 1997 and 2002. Six typologies of land use/cover have been mapped: (a) built up areas, (b) arboreal cultivation, (c) sown ground, (d) woodland, (e) pasture, grassland and bushy grassland, and (f) degraded areas (badlands, rills, gullies). Therefore, through the comparison of the maps relative to different years, it has been possible to quantify the remodeled and abandoned areas. The geocoding and orthorectification processes of 1955 aerial photos were carried out through the PCI Geomatica Orthoengine™, using all available camera parameters and at least 25 ground control points; the maps have been drawn using ArcGis software from ESRI.

4. Changes in rainfall patterns: implications

The general consensus is that the principal climatic agent on erosive processes is precipitation, since it is the major determinant of the vegetation cover and of overland flow (Mulligan, 1998; Soil and Water Conservation Society, 2003). In particular, the erosive power depends on precipitation regimes, expressed as total annual precipitation, intensity, and inter-annual variability.

The total annual rainfall was analyzed for the pluviometric stations of Aliano and Pisticci; the results are reported in Table 1 and in Fig. 2a. The annual mean precipitation from 1955 to 2000 was 737.83 mm and of 580.73 mm at Aliano and Pisticci, respectively. The minimum and maximum values for a 46-year record are: 1) 367.10 mm and 1090.00 mm for Aliano, with a standard deviation about the mean annual precipitation of 173.97 mm and 2) 266.90 and 1239.70 mm for Pisticci, with a standard deviation about the mean annual precipitation of 206.71 mm. For both stations precipitation is mainly concentrated from October through January (Fig. 2b).

![Fig. 2](image-url)
The trend analyses of events >2.0 mm, >10.0 mm and <30.0 mm, and >30.0 mm are reported in Table 1 and in Fig. 3 a. From the graphical analysis it emerges that a statistically significant decrease in pluviometric events >2.0 mm has occurred at Aliano and Pisticci. The trends of pluviometric events >10.0 mm and <30.0 mm, and >30.0 mm for Pisticci reflect the general pattern, while no statistically significant trend is recorded for Aliano. This tendency depends on the rainfall intensity (Fig. 3 b). At Aliano, an increase in rainfall intensity occurred in spite of a net decrease in total annual precipitation, while at Pisticci a general decrease of rainfall intensity also occurred. Nevertheless, the decrease in intensity is less than the decrease of total annual precipitation. This reveals for both stations an increase in rainfall intensity in respect to annual precipitation, which has been noted in other parts of the Mediterranean basin (Brunetti et al., 2001; Goodess and Jones, 2002).

The pluviometric analysis has been completed by taking into account the duration of dry and wet periods in order to evaluate the role of dry/wet cycles (Table 1). Thus the maximum numbers of dry (rainfall <1.0 mm) and wet (rainfall >2.0 mm) consecutive daily events as well as of the mean length of dry and wet spells have been calculated for
each year. The analysis of these data shows an increase of dry consecutive days, with a mean length of dry spells of 6.95 days for Aliano and of 8.14 days for Pisticci (Fig. 4a,b). As regards the wet consecutive days, a negative statistically significant tendency occurs for both stations: a mean of 5.54 wet consecutive days with a mean length of wet spells of 1.68 days is recorded at Aliano, while a mean of 4.74 wet consecutive days with a mean length of wet spells of 1.59 days is recorded at Pisticci. Calvo-Cases and Harvey (1996) and Canton et al. (2001) examined the impact of precipitation changes in southern Spain areas, and documented that the dry/wet cycle frequency, characterized by long dry periods separated by short but violent storms, strongly controls the distribution of rilling.

A substantial increase in rainfall frequency would increase the effectiveness of rilling, while a decrease in rainfall would reduce the effectiveness of rilling and increase the effectiveness of cracking and desiccation related processes. In particular, long dry periods with low-frequency heavy rains cause rill destruction, leading to more uniform percolation of water favoring mass movements such as slope creep. The magnitude and frequency of rainfall events is associated with several rapid erosive events. For example, over a 2-day period November 24 and 25 1959, there was 375.0 mm of rainfall, with 314.7 mm on 25th November, greater than half of the annual average. This event generated significant soil erosion and produced gullies greater than 2 m in depth (Fig. 5), contributing to the evolution of badlands.

5. Land use dynamics

It is important to emphasize that, over the 46-year period examined in this study, soil conservation and land management underwent significant change within the three areas (Fig. 6). The land use change data is summarized in Table 2. Examination of the aerial photos and orthophotos, along with the field survey, reveals varying patterns in land use change for the three study areas between 1955 and 2002 (Table 3). The greatest amount of change occurred in the Aliano area, which had 602 ha remodeled and 137 ha abandoned. The Craco area had 171 ha remodeled and 15 ha abandoned, while the Pisticci area had 97 ha remodeled and 17 ha abandoned.

5.1. Arboreal cultivation

The arboreal cultivation area increased at Aliano by 95 ha from 1955 to 1997, but decreased from 1997 to 2002 (38 ha). Arboreal cultivation continuously decreased from 1955 to 2002 at Craco (40 ha) and Pisticci (25.6 ha). Olive cultivation is concentrated on hilly areas, and thus is important to rainfall interception and reducing runoff. In particular at Aliano, olive cultivation continues to be an important component of modern land use due to the presence of oil-mills. The decrease in olive cultivation between 1997 and 2002, however, is due to the conversion of olive groves into sown ground (Table 2). At Craco and Pisticci, the transformation of olive culture into sown ground is widespread.

5.2. Sown ground

The change in sown ground cultivation between 1955 and 2002 is certainly the most important agent of land mismanagement occurring within the study area. The summary data shows a marked increase in sown ground areas, occupying 1607 ha (35.3% of total surface) at Aliano, 781.6 ha (57.0% of total surface) at Craco, and 483.6 ha (29.6% of total surface) at Pisticci. The prevalent form of sown ground cultivation is durum wheat, a monoculture. This practice is mainly concentrated along valley bottoms and terraced surfaces where water supplies...
Fig. 6. Land use dynamics maps (a) and graphics (b) during the period 1955–2002 for Aliano (i), Craco (ii) and Pisticci (iii).
is more available. It must be emphasized that ploughing and sowing occur in October and November, while major plant growth occurs from March to May, followed by harvest from June to August. As a consequence, the soil is deprived of vegetation cover from September to February and is vulnerable to extreme winter precipitation events.

5.3. Woodland

Woodland areas increased from 1955 to 2002 in all areas due to reforestation policy, after the 1950s, resulting in reforestation with *Pinus pinea* and *Pinus halepensis*. Fig. 7 shows the spatial distribution of remodeled, reforested, and abandoned areas for the three study areas. Reforestation occurred throughout the study area, but was greatest within the hilly northeastern portions of Pisticci (Fig. 7). During the 47 years of study, the increase in woodlands for Aliano, Craco, and Pisticci was 120 ha, 27.4 ha, and 153.2 ha, respectively.

5.4. Pasture, grassland and bushy grassland

The Mediterranean ‘macchia’ characterizes the bushy grassland areas, while *Pistacia lentiscus* and *Lygeum Spartum* steppe are dominant on badlands. Because of CAP measures a decrease of these typologies occurred, primarily due to reclamation for cereal production. Over the 47-year period, the reduction in this land use type at Aliano, Craco, and Pisticci was 230 ha, 31 ha, and 24 ha, respectively.

5.5. Degraded areas

In this paper areas characterized by such erosive features as badlands, gully, rills, shallow debris flow, small landslides are considered degraded areas. A conspicuous decrease of degraded areas occurred over the 47-year study period due to the reclamation of badlands (*calanchi* and *biancane*) for the monoculture of durum wheat. Aliano underwent the greatest amount of change, with 426.8 ha being converted. The amount of change at Craco and Pisticci was 153.1 ha and 176.1 ha, respectively.

It must be emphasized that the practice of remodeling land for cultivation of durum wheat does not stabilize hillslopes, as extreme rain events have transformed remodeled areas back to their original condition. Moreover, in many cases, field surveys have found that along the same hillslope, contiguous remodeled and vegetated (*macchia*) areas behave distinctly, with remodeled areas experiencing intense erosion manifest as rills and gullies while vegetated (spontaneous) areas generally undergo less erosion (Fig. 8).

6. Analysis and discussion

The analysis of the pluviometric data reveals that, notwithstanding a decrease in total annual precipitation, and an increase in rainfall intensity occurs, especially between October and February. Moreover, a great increase in the number of days without rainfall is recorded, with a progressive increase in the mean length of dry spells, and

Table 2
Summary of land use for the three watersheds in area (ha) and percentage (%) for 1955, 1997, and 2002

<table>
<thead>
<tr>
<th></th>
<th>1995</th>
<th>1997</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aliano</td>
<td>Craco</td>
<td>Pisticci</td>
</tr>
<tr>
<td>Arboreal cultivation (ha)</td>
<td>260.6</td>
<td>99.1</td>
<td>108.3</td>
</tr>
<tr>
<td></td>
<td>(5.8%)</td>
<td>(7.2%)</td>
<td>(6.6%)</td>
</tr>
<tr>
<td>Sown ground (ha)</td>
<td>1146.5</td>
<td>592.3</td>
<td>434.0</td>
</tr>
<tr>
<td></td>
<td>(25.3%)</td>
<td>(43.1%)</td>
<td>(26.6%)</td>
</tr>
<tr>
<td>Woodland (ha)</td>
<td>191.9</td>
<td>28.4</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>(4.2%)</td>
<td>(2.1%)</td>
<td>(0.4%)</td>
</tr>
<tr>
<td>Pasture, grassland and bushy grassland (ha)</td>
<td>1331.0</td>
<td>183.0</td>
<td>122.9</td>
</tr>
<tr>
<td></td>
<td>(29.4%)</td>
<td>(13.4%)</td>
<td>(7.5%)</td>
</tr>
<tr>
<td>Degraded areas (ha)</td>
<td>1585.9</td>
<td>397.5</td>
<td>928.9</td>
</tr>
<tr>
<td></td>
<td>(35.1%)</td>
<td>(29.0%)</td>
<td>(56.8%)</td>
</tr>
</tbody>
</table>

Table 3
Summary of abandoned, remodeled, and reforested areas summary from 1955 to 2002

<table>
<thead>
<tr>
<th></th>
<th>Aliano</th>
<th>Craco</th>
<th>Pisticci</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remodelled sites from 1955 to 1997</td>
<td>565.82</td>
<td>12.51</td>
<td>108.3</td>
</tr>
<tr>
<td>Remodelled sites from 1997 to 2002</td>
<td>36.26</td>
<td>0.80</td>
<td>6.0</td>
</tr>
<tr>
<td>Abandoned areas from 1955 to 1997</td>
<td>133.68</td>
<td>2.95</td>
<td>6.0</td>
</tr>
<tr>
<td>Abandoned areas from 1997 to 2002</td>
<td>2.87</td>
<td>0.06</td>
<td>6.0</td>
</tr>
<tr>
<td>Reforestation</td>
<td>153.19</td>
<td>9.37</td>
<td>6.0</td>
</tr>
</tbody>
</table>
Fig. 7. Maps of abandoned, remodeled and reforested areas from 1955 to 2002 for Aliano (i), Craco (ii) and Pisticci (iii).
especially in the consecutive number of days without rainfall. Thus, the trends in the precipitation data fall within a larger trend of Mediterranean precipitation; characterized by an increase in dry periods but with an increase in the number of large events (Geeson and Thornes, 1996).

Analysis of land use change data has shown that the degraded areas decreased between 1955 to 2002 by almost 27% at Aliano (427 ha), 39% at Craco (153 ha) and about 19% (176 ha) at Pisticci. During the same period, the sown ground areas increased by 40% at Aliano (461 ha), by 32% (190 ha) at Craco and by 11% (50 ha) at Pisticci. In all sites, the reduction in degraded areas is mainly due to an increase in sown areas, except for the northeastern hillslopes within the Pisticci study area because of a reforestation policy after the 1950s. Furthermore, during the same period, mainly along valley bottoms and river terraces, many badlands were remodeled for cultivation of durum wheat, resulting in a landscape characterized by continuous slopes having fewer erosive forms.

In a study on the dispersive nature of soils in Tuscany (Central Italy) and Basilicata, Robinson and Phillips (2001) documented that reclamation with modern heavy earthmoving equipment enables tillage and cultivation of badland areas, but does not stabilize the dispersive character of soil aggregates. The use of remodeled areas for cereal cultivation makes soil aggregates vulnerable to rainfall impact, promoting the development of soil surface crusts. The occurrence of soil surface crusts has been shown to reduce infiltration, thereby increasing runoff and the potential for a rainfall event to produce erosion. Such scenarios promote the development of non-productive badlands. Other authors (Kosmas et al., 1997) have found that in cereal fields, total annual runoff is positively related to the annual rainfall, and the amount of runoff produced from a single rainfall event is relatively minor (<1.5%) if the annual rainfall does not exceed 280.00 mm. Conversely, a higher proportion of rainfall is converted to runoff if the average annual rainfall exceeds 700.00 mm, with up to 24% of the total precipitation occurring as runoff.

While the thresholds required for runoff and soil erosion are regionally unique, the concepts supported by these data (e.g., Kosmas et al., 1997) are of importance in this study because, for the three areas, the annual precipitation often approaches or exceeds 700.00 mm. Moreover, the vegetative phase in cereal fields occurs from March to June, when the cropping starts. Thus, the lands are deprived of vegetation cover from September to February and experienced degradation due to large winter storm events. It is during these months that critical pluviometric events have increased, and appear to generate slope erosion.

As has been found in many other semi-arid regions (e.g., Vandeaele et al., 1996; Garcia-Ruiz et al., 1997; Vandekerckhove et al., 1998; Poesen et al., 2003), the change in land use within Basilicata is associated with a rapid geomorphic response. Within many remodeled and abandoned sites, this included formation of rills (Fig. 9), gullies, shallow debris flows, and small landslides (Fig. 10). Thus, the observed changes in precipitation characteristics together with specific types of land use change resulted in an increase in the sensitivity of this landscape to degradation.

7. Conclusions

Land degradation and soil erosion features in Basilicata (southern Italy) have been shown to be associated with regional changes in precipitation and with specific types of land use change, which were promoted by agricultural policy. In Basilicata, the risk of land degradation is intimately linked to several factors, including the timing (e.g., seasonality) of rainfall events in relation to agricultural practice (e.g., planting). The clayey nature of the soils is also associated with erosion, particularly after being
Fig. 9. Rills cobwebs, ephemeral gullies and a small landslide occurred on a remodeled site of Craco, after 5 consecutive rainy days (8–12/12/2003) with an amount greater than 96 mm.
Fig. 10. Different erosion forms developed in remodelled sites of Basilicata. (a) (1) Shallow debris flow at Craco (March 2003) and (2) present situation (December 2003) without any erosive features due to human impact. (b) Combination of two gullies in a remodelled site of Craco. (c) Rills developed in a remodelled site at Pisticci. (d) Small landslide in clayey soil of Aliano. (e) Shallow debris flows occurred in a remodelled site of Pisticci (3 January 2004) after the rainy months of December 2003 (161 mm).
disturbed by the process of land remodeling. Within the region of southern Italy examined in this study, humans assume an increasingly effective agent in land degradation and soil erosion due to the inappropriate application of specific CAP measures. These policies were designed primarily for agricultural purposes, and allowed reclamation of bushy lands and badlands for durum wheat cultivation and. Subsequently, much of this land has been abandoned.

The amount of land remodeled over the period of study, 1955 to 2002, varied for the three sub-regions within the study area. In Aliano, 602 ha of land was remodeled, while in Craco and Pisticci, there were 171 ha and 97 ha of land remodeled, respectively. Consequently, land use typologies mainly involved sown ground areas and degraded areas. In particular the sown ground areas increased by 40% at Aliano (461 ha), 32% (190 ha) at Craco, and 11% (50 ha) at Pisticci. Degraded areas decreased by almost 27% at Aliano (427 ha), 39% at Craco (153 ha) and about 19% (176 ha) at Pisticci.

Results from this study have implications related to understanding different land use types and geomorphic response, and should be used as a guide in the implementation of new land use policies, particularly in Mediterranean regions where agriculture is a large component of the landscape. The application of the F measure of Reg. CEE 2078/92, which implies a 20-year period of set-aside for remodeled areas, is likely to cause an increase of soil loss and soil degradation. Field surveys have documented that gullies and shallow mass movements occurred on abandoned remodeled slopes within only a short period after land conversion occurs. As a consequence, the predictable increase of erosive processes will invert the present trend and increase the risk of soil erosion in Basilicata. The application of new land use policies, such as CAP, should do so by considering the type of land use changes in accordance with an analysis of changes in the magnitude and frequency of precipitation events.

Acknowledgements

This research was financed by the European Union funding for PhD Courses in Geomorphology and Environmental Dynamics granted to M. P. We are grateful to Dr. Carlos E. Cordova and Dr. Mike Slattery for having critically reviewed the manuscript. We are indebted to Dr. Paul Hudson, the editor of this special issue, for his constructive criticism and his kind support.

References


