Forest expansion in mountain ecosystems: "environmentalist's dream" or societal nightmare?

Driving forces, topics and impacts of one of the main 20th century's environmental, territorial and landscape transformations in Italy

Giorgio Conti, Laura Fagarazzi***

Abstract
Among the main threats that mountain areas in industrialised countries are nowadays facing, land abandonment is by far the most important. Land abandonment is mainly due to marginalisation trends and it is closely associated with other processes such as depopulation and decline of mountain farming. The most evident consequence of such a situation is the phenomenon of forest expansion, due to the process of natural succession causing shrub and tree encroachment into abandoned farmland, mainly pastures and other kinds of cultivated grassland. Such a process, which has been largely underestimated or even ignored within the Italian scientific and political debate, represents one of the main land use changes occurred during the last decades, as well as one of the most impacting and radical landscape transformations affecting the Italian territory.

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Mountain ecosystems; forest expansion; natural hazards; watershed ecosystem dynamics; decline of mountain farming activities; land abandonment; land cover changes; landscape transformation.

1 – Introduction

Throughout the world mountains are currently facing several threats, ranging from rapid demographic changes to the overexploitation of natural resources by exogenous agents tending to reap off most benefits without paying back local communities, from the loss of cultural identity to the closure, lack or diminishing quality of basic community services and infrastructures such as schools, health units, post offices, transportation, businesses and so on (Cristovão, 2002). Some of these problems typically affect uplands in developing countries, like deforestation and depredation of natural resources, while others mainly threat mountain areas in industrialised countries, such as tourism pressure on the environment, a general decline of agricultural activities – animal husbandry in particular – and over ageing trend.

Finally, other issues are common to mountains areas all around the world, such as the lack of employment opportunities, the growing socio-economic fragility and the increased risk of natural hazards. However, above all "*the major threat to most mountain areas is the very own nature of the dominant development paradigm, which tends to marginalize the less favoured territories, and leads the State to invest in those areas which seem more capable to reproduce the capital (more competitive) and which have more power in terms of population pressure*" (*ib.*).

As a matter of fact, nowadays European mountain areas do not include only economically weak regions, but also some very wealthy communities with highly industrialised and/or tourism-based economies (Nordregio, 2004), which constitute approximately □0% of the total area in the Alps (Stone, 1992). Tourism in particular is unevenly distributed throughout the Alpine arch, and benefits deriving from tourism are mostly concentrated in very limited areas, thus representing a spot or band formed phenomenon (Tappeiner *et al.*, 2003).

The dichotomy is due to the so-called *polarisation* process, which means that small villages on mountain slopes are largely abandoned, while people tend to concentrate in urban-like settlements along the main valley floors, where social, health and educational facilities, infrastructures and economic activities are mostly concentrated.

Such a polarisation trend usually follows urban development models, which have been shaping European lowlands, while being rarely compatible with mountain environments. Nevertheless, the implementation of "lowland-cities" development schemes in certain mountain areas has been enhanced by the dramatic growth of mass tourism and especially winter tourism, developed starting from the 19□0s and requiring distinctive infrastructures and settlements.

For their major evidence, the main focus is usually on the problems affecting these overdeveloped Alpine regions, while the problems of remote, economically weak regions are hardly recognised (Stone, 1992), despite their large extension. Furthermore, even when focusing on favourably located areas, the problems considered are usually related to overuse, in terms of land consumption, air and water pollution and overexploitation of natural resources. On the contrary under-use and abandonment of the land do not only occur in economically weak, marginal areas, but also in tourist and industrial centres, since here only selected areas are devoted to very intensive forms of use, while the remaining areas are virtually unused and deteriorate (*ib.*).

As a consequence of these marginalisation and land abandonment processes, mountain regions have been experiencing radical landscape changes, as once cultivated areas are turning to forests through the process of natural succession. The extent of this phenomenon is already well marked and evident throughout the Alps, to the point that *Newsweek International* recently published an article titled "*Into the woods*", depicting Europe as a land under renaturalisation where large parts are going back to their primeval state, with wolves and bears taking the place of people. All across the southern Alps in particular several villages have emptied out and forests have grown back in (Theil, 2005).

The author wonders whether this represents an eco-environmentalist's dream in terms of return of primitive wilderness into an anthropogenic landscape deeply modified by human activities, or – on the contrary – the problem is more complex than it might seem, since "*the scrub bush and forest that grows on abandoned land might be good for deer and wolves, but is vastly less species-rich than traditional farming, with its pastures, ponds and hedges […], whereas a new forest does not get diverse until it is a couple of hundred years old*" (*ib.*).

When focusing on Italy in particular, we should notice that at a national scale land abandonment and the consequent invasion of forests into farmlands represents, from a quantitative point of view, the most relevant change in land use which took place in Italy during the last □0 years (Piussi and Pettenella, 2000). In particular, Graph 3 shows that forests expanded as much as artificial surfaces during the last decade of the 20th century – a period characterised by impressive urbanisation processes –, while according to Table 4 more than 18 thousands of hectares of new transitional woodland shrub

developed from natural grassland in the same time frame, which is likely to further evolve to forest within a few decades (EEA, ETC/TE, 2004).

Despite its extent, no or little attention has been paid so far to such a phenomenon by the society as a whole, the academic environments not directly dealing with these issues, most of politicians and land planners. Yet, according to professor Lanaro, an historian from the University of Padua, in Italy it is not just the South to represent a problematic issue (the so-called "*questione meridionale*"), but what might be referred to as the "mountain issue" represents a larger, more serious and widely unknown topic (Pasqualetto, 2005).

Indeed, farmland abandonment and, more generally, desertion of mountain territories, create environmental, economic and social impacts affecting not only mountain districts, but the whole society, since mountains still contribute to provide a number of essential resources and services, namely watershed resources, soil protection, biodiversity maintenance, wood growth, open space for recreational activities, carbon sequestration, natural hazards prevention and maintenance of sediments' balance along the coasts (UNCED, 1992). Therefore, although mountains provide a direct life-support base for about one-tenth of humankind, they provide goods and services to more than half the world's population (Ives, 1992; Price *et al.*, 1998; Price, 2004). On the other hand, these environmental services and goods are potentially deeply compromised by land abandonment and uncontrolled forest expansion.

Mountain ecosystems thus hold a local and global significance, playing a pivotal role for downstream communities, who mainly depend on certain fundamental services provided by upstream territories, such as supply of reliable quantities of high-quality water resources and disaster prevention (Bieberstein □och-Weser and □ahlenborn, 2004). The mountains' greatest value, particularly at European scale, is probably as "water towers" (Nordregio, 2004), since water resources provided by mountains cover the most vital functions of both mountain and lowland people (EEA, 1999).

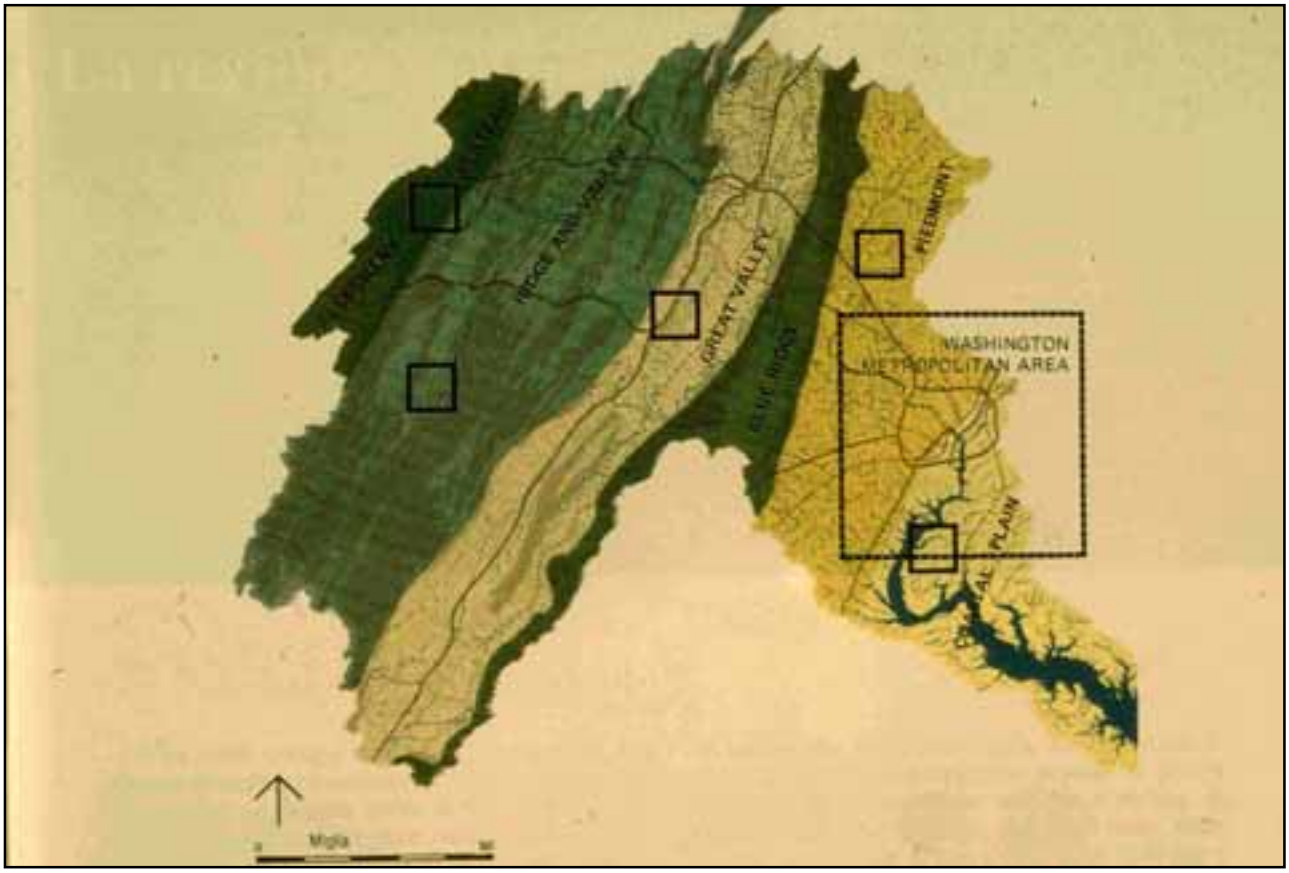


Figure 1 - Downstream - upstream relationships are properly described through this image published by Ian McHarg in 19□9

Although mountain areas represent a relatively small proportion of river basins, they provide the greater part of the river flows downstream. In humid climates, the proportion of water generated in the mountains can comprise as much as □0% of the total fresh water available in the watershed (the 32% mountain watershed of the River Po, for instance, contributes to 5□% to the lowland flow) (Mountain Agenda, 1992). It is actually mountain communities' management of natural resources on the mountain slopes which determines the manner in which water is available for development in the lowland communities (*ib.*).

According to a widespread, well-rooted belief, the strong increase in shrub and forest surface occurring in mountain areas of most of the industrialised countries represents a positive process, contributing to counteract deforestation trends in other parts of the globe and the loss of large tropical forest extensions, mainly taking place in developing countries.

On the contrary, the uncontrolled development of new forest areas represents a problem by itself, causing a number of social, environmental and economic impacts, including loss of cultural landscapes and habitat variety, bio and eco-diversity depletion, landscape homogenisation and closure, waste of economic and natural resources, loss of productive land, depletion of environmental services and increased risk of natural hazards such as floods, landslides and fires.

Furthermore, wood extension often is just the most evident effect of an otherwise less apparent and somehow silent marginalisation, depopulation and ageing trend affecting many mountain and high-hilly regions in industrialised countries throughout the world, finally leading to the breakdown of traditional, land-rooted civil societies.

2 – The state of the art: decline of mountain farming and farmland abandonment

Concerning the Alps as a whole, the data show a decrease in Utilised Agricultural Area (UAA) by 4.8% from 1980 to 1990, so that in 1990 UAA covered 13% of the total Alpine territory. In particular there has been a dramatic decline in the arable land, as largely self-sufficient rural societies have collapsed or contracted and abandoned subsistence cultivation. Similarly, also the number of Livestock Units has been facing a negative trend, decreasing by 8.9% during the same time period (Tappeiner *et al.*, 2003).

The increase in the extension of unused usable agricultural area is somehow associated with the decrease in Utilised Agricultural Area. The peculiarity of Italian situation within the Alpine context clearly appears from the following datum: while in the other Alpine countries the unused agricultural area has decreased (which means that a larger area is reversed back to cultivation in comparison with the area which is abandoned), this trend is opposite in Italian Alpine territories, where unused agricultural area is increasing (+4.5% from 1979 to 1997).

If we disentangle these data distinguishing by different land use typologies, we can make, for instance, an interesting comparison between the data concerning Italy and Austria. Indeed, while UAA as a whole is decreasing in both countries (-4.4% in Austria, -11.7% in Italian Alpine provinces from 1979 to 1997), data related to the different land uses are notably dissimilar. While arable land decreases in both countries to about the same extent (–17.5% in Austria, -1□% in Italian Alpine provinces), opposite is the situation as regards permanent grassland, which is diminishing in Italian Alpine provinces (–11.4% from 1979 to 1997) whereas it is dramatically increasing in Austria (+1□.2% in the same time period) (Tappeiner *et al.*, 2003).

Such a difference is also reflected by data related to pasture farming, revealing the marginal role played by pasturing activities in the Italian Alpine arch, particularly in comparison with other Alpine countries such as Switzerland, Germany and Austria. According to some estimates, about 800,000 hectares of grassland have been abandoned since 19□0 throughout the Italian Alpine arch, which means

that 45% of the surface covered by pastures and meadows at that time has disappeared (Chemini and Gianelle, 1999; Bovolenta, 2004).

In contrast with the relative great importance of pasturing farming and the increase in permanent grassland area characterising most of the Alpine countries, the total number of Livestock Units (L.U.) is decreasing almost everywhere, even though some species are more affected than others: in particular, pig livestock has significantly decreased in all of the Alpine countries, while sheep and goat livestock has dramatically raised in those countries where cattle livestock has only slightly decreased or even remained steady, such as Austria (+ 98.7% in sheep and goat livestock, +0.1% in cattle livestock from 1979 to 1997) and Switzerland (+ 45.5% in sheep and goat livestock, -0.1% in cattle livestock). As far as Italian Alpine provinces is concerned, all the trends are negative, no matter which kind of livestock is considered (-2.5% in sheep and goat livestock, -7.□% in cattle livestock) (Tappeiner *et al.*, 2003).

Some data specifically referring to Italian mountain areas[1] are reported in Table 1. According to the agrarian census run in the year 2000, more than 490,000 hectares included within working mountain farms are no longer utilised: most of them are likely to be abandoned pastures.

	1990	2000	Change □%) 1990-2000
Number of farms	□57,087	500,495	-23.83
Total Agricultural Area	7,744,810	□,483,□83	-1□.28
Utilised Agricultural Area	3,□39,159	3,112,770	-14.4□
Number of zootechnical farms	100,□22	58,973	-41.39
Number of cattle units	1,353,7□5	1,089,945	-19.49

Table 1 – Agricultural indicators referring to Italian mountain areas as classified by the National Statistical Bureau. Source: ISTAT, 1990 and 2000 agrarian censuses

An example at local scale, which is quite representative of the current trends affecting Italian Alps, is given by Veneto: the data reported in Table 2 refer to this North-eastern Italian region. While a general negative trend towards a reduction in the number of farms and cattle units is evident as regards the region as a whole, it is interesting to note that the data are even more worrying when focusing on mountain areas.

Indeed, Veneto comprises lowlands, hilly and mountain areas, highly intensive as well as traditional extensive forms of cattle breeding. Yet, when disentangling the average data referring to the whole regional territory, one might notice that the decreasing rates of both farms and cattle units are higher than the regional average as regards the Province of Belluno, the most mountainous province within Veneto, whose territory is located at various altitude, comprising high hilly, medium and high mountain areas. In particular, when focusing on the areas at the higher altitude (roughly corresponding to the Local Action Group named "Alto Bellunese"), the negative trend referring to the reduction of farms slightly decreases, while the value of the indicator describing the decrease in cattle units dramatically increases.

[1] Official definition of mountain areas according to the national legislation differs from the National Statistical Bureau (ISTAT) delimitation: while ISTAT classifies as "mountain" those areas located at an altitude higher than □00 m a.s.l. in the Alps and 700 m a.s.l. in the Apennines, Act □57 of 1957 considered as mountainous those municipalities having at least 80% of their area over □00 metres above sea level as well as all those municipalities which, although not meeting the altitude criteria, face similar agro-economic conditions. These classification criteria have been cancelled in 1990 without being repealed by any other criteria. Later on, Italian government decided to fix the number of municipalities already classified as mountainous indefinitely. Consequently, according to ISTAT only 35.2% of national territory is classified as mountain area, while according to UNCEM, the National Union of Mountain Municipalities and Communities, 54% of national territory can be considered as mountainous, both because of the different criteria applied and because the UNCEM classification also includes those municipalities whose territory, although not completely mountainous, is included within a "Comunità Montana", the consortia of mountain municipalities established by Act 1102 in 1971 (Villeneuve *et al.*, 2002).

This means that farm abandonment, although evident, is slightly less pronounced in mountain regions, while the decrease in the number of cattle units is by far much better marked than the average trend at regional level. Accordingly, the area covered by pastures and hay meadows decreased by 5.9% within the Province of Belluno between 1990 and 2000.

	1990		2000		Change □%) 1990 - 2000	
	Farms	Cattle units	Farms	Cattle units	Farms	Cattle units
Local Action Group "Alto Bellunese"	□39	3,394	294	2,202	-53.99	-33.95
Province of Belluno	2,5□2	27,1□1	1,137	20,□0□	-55.□2	-24.13
Veneto Region □as a whole)	42,459	1,1□1,992	21,575	931,337	-49.19	-19.85
Italy □mountain areas)	100,□22	1,353,7□5	58,973	1,089,945	-41.39	-19.49

Table 2 – Change in zootechnical farms and cattle units in Veneto as a whole and in the mountainous province of Belluno. Source: ISTAT, 1990 and 2000 agrarian censuses

It might be interesting to correlate the previous data with demographic trends affecting the same area, as reported in Table 3. Along with depopulation, another relevant phenomenon concerns the number of houses not permanently inhabited by residents, which dramatically increased from 39,079 in 1981 up to 4□,751 in 1991 and finally 48,115 in 2001 (ISTAT, 2001). Such an impressive increase is partly due to the numerous second homes built in the most renowned tourist resorts, but it is likely to be due to the abandonment of remote villages and isolated houses by local people as well.

	Population in 1991	Population in 2001	Change □%) 1991-2001	Population over 65 □%)
Local Action Group "Alto Bellunese"	74,382	70,4□□	-5.2□	20.72
Province of Belluno	212,085	209,033	-1.44	20.81
Veneto Region	4,379,930	4,490,58□	+2.53	17.72

Table 3 – Demographic trends in the mountainous areas of Veneto. Source: ISTAT, 1991 and 2001 general censuses

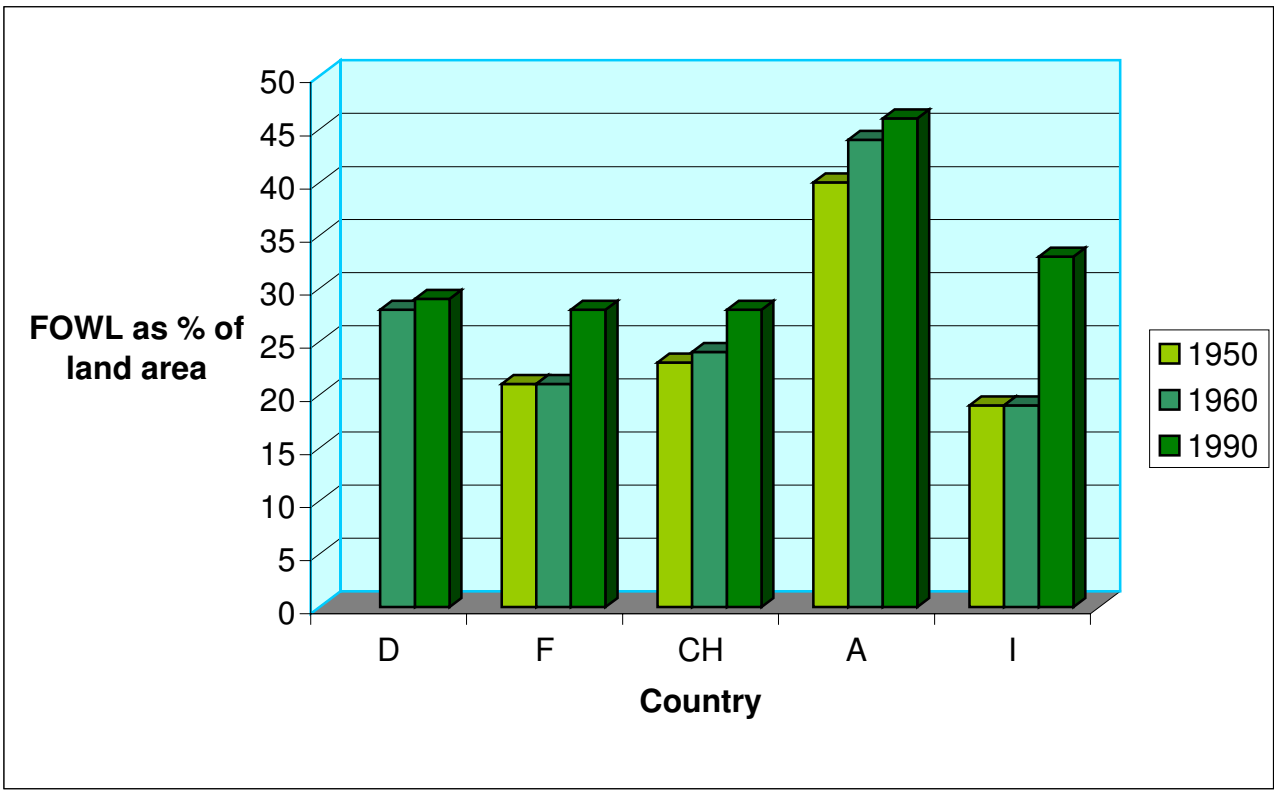
3 – The process: from land abandonment to forest expansion

Mowing and livestock grazing are primary factors inhibiting woody plant succession, which actually takes place after production disturbance ceases or decreases. The abandonment of semi-natural grasslands results especially in the expansion of forest and shrubby habitats in secondary grasslands, but also in an expansion of dwarf shrubs in the pastures above the timberline, i.e. primary grasslands[2] (Chemini and Rizzoli, 2003). Secondary pastures represent the outcome of a historical co-evolution between humans and environment, resulting from an initial deforestation, followed by continuous interventions aimed at containing forest encroachment (Ziliotto *et al.*, 2004), also hindered by summer animal grazing. Wherever abandonment of extensive zootechnical activities occur, heavy and often irreversible landscape changes take place, as once cultivated areas turn to forests through the process of natural succession and the invasion of shrubs and trees into farmland.

[2] While primary pastures are natural grasslands lying beyond the limit of tree vegetation, secondary pastures are somehow "artificial", in a sense that they result form the activities which men have been running over them.

Nowadays, about 3□% of Europe's land surface (excluding Russia) is covered by *Forest and Other Wooded Land* (FOWL)[3], although this share varies widely: the largest forest areas are in the Nordic countries and in mountainous regions (Eurostat, 2001; UNECE/FAO, 1999).

Forest expansion trend regarding Alpine countries in particular is displayed in Graph 1. Although the data do not specifically refer to the Alpine territory within each country, it is interesting to note how forest area strongly increased in all of these countries, and especially in Italy.



Graph 1 – Changes in forest extension in some Alpine countries from 1950 to 1990. Source: own elaboration from data provided by the FAO Temperate and Boreal Forest Resources Assessment, 2000

From the data provided in Graph 1 one can easily deduce that, although farmland abandonment and afforestation processes do occur in most of Alpine countries, the magnitude they reach is apparently maximum, both in absolute and relative terms, in Italy. Indeed, forest areas have been strongly increased in Italy during the past □0 years, to the extent that invasion of forests into farmlands represents, from a quantitative point of view, the most relevant change in land use which took place in Italy during this period (Piussi and Pettenella, 2000) (see Pictures from 2 to □ and Graph 3 as regards land cover changes during the last decade of the 20th century).

Although the process was already evident in the 1950s and 19□0s, a dramatic increase in the abandonment trend can be observed during the very last decades, following a further decline of mountain farming. The results of such a boost will be evident in the next future, posing serious problems to sustainability of mountain territories.

[3] *"Forest"* is defined as land with tree crown cover (or equivalent stocking level) of more than 10% and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity *in situ*. "O*ther Wooded Land"* is land with either a tree crown cover (or equivalent stocking level) of 5-10% of trees able to reach a height of 5 m at maturity *in situ*; or a crown cover (or equivalent stocking level) of more than 10% of trees not able to reach a height of 5 m at maturity *in situ* (e.g. dwarf or stunted trees) and shrub or bush cover (Eurostat, 2003).

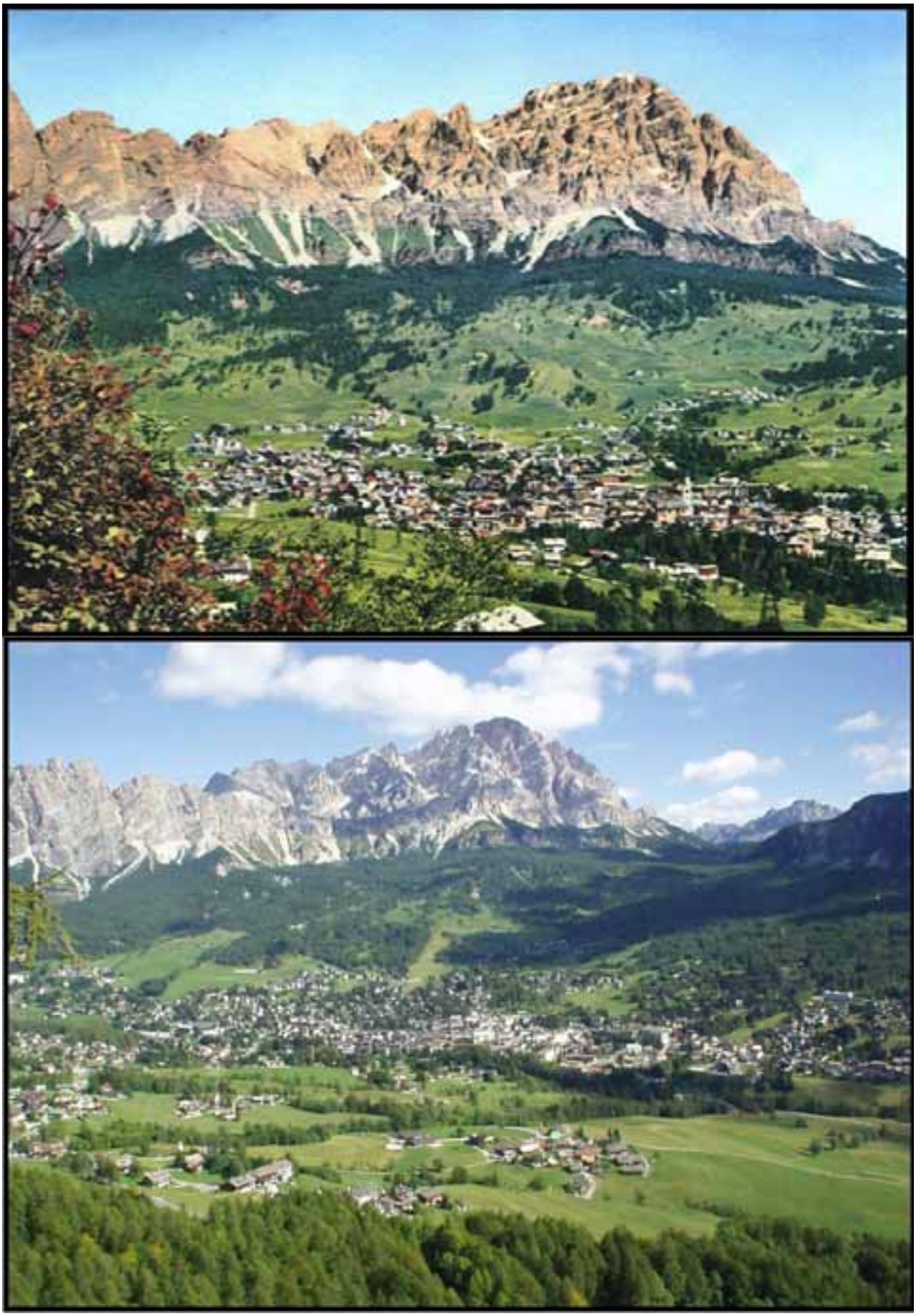
According to the *National Statistical Bureau* (ISTAT), during the second half of the 20th century forest areas increased by 14.9%, and the increment was of 7.0% only in the last decade of the century (Piussi and Pettenella, 2000) (see Graph 2).

Yet, it is important to underline that data provided by ISTAT do not take into account spontaneous afforestation processes, unless a targeted administrative act explicitly acknowledges the new land cover as wooded area, since ISTAT data are based on administrative rather than real land uses (Comitato Tecnico Interministeriale per la Montagna, 2003). This means that phenomena associated with natural succession and unplanned, spontaneous afforestation are not included, at least until they are expressly recognised through administrative acts acknowledging the new land use, which usually occur after a few decades.

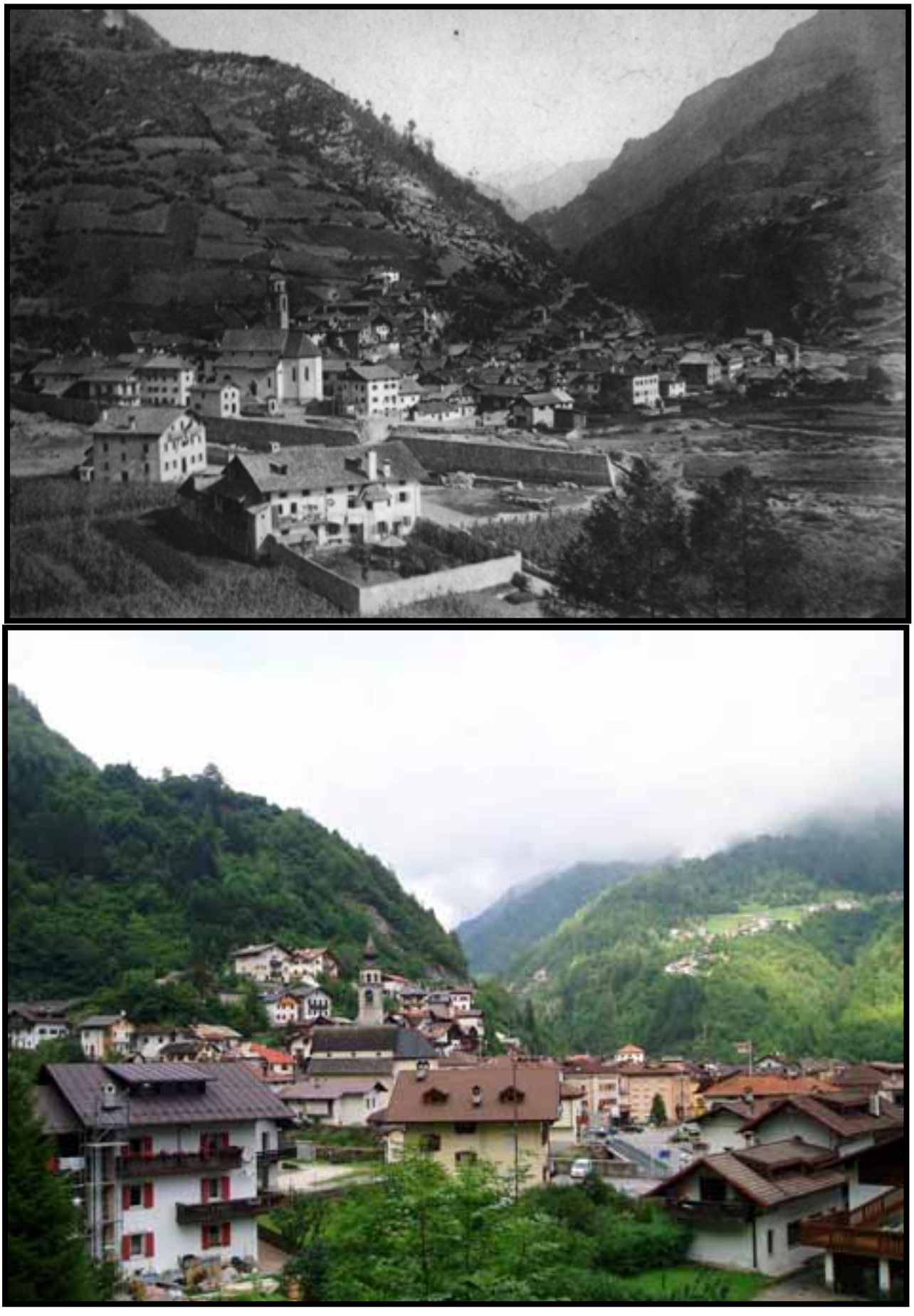
On the other hand, ISTAT is the only source of data for trends which need to be continuously and regularly monitored for a very long time period, although ISTAT data were collected using criteria that have been modified through time.

As regards the Italian territory, significant are also the results obtained by *IMAGE and CORINE Land Cover 2000* (I&CLC2000), a project launched by the European Environment Agency (EEA) and the Joint Research Centre (JRC), consisting in the update of the CORINE Land Cover 90 (CLC90) database. The aim of I&CLC2000 is to produce the CORINE Land Cover database for the year 2000, as well as to detect Land Cover Changes (LCC) in Europe occurred during the period from 1990 to 2000, based on the data provided by the first inventory (CLC90) and the satellite image coverage of IMAGE2000 (EEA, ETC/TE, 2004).

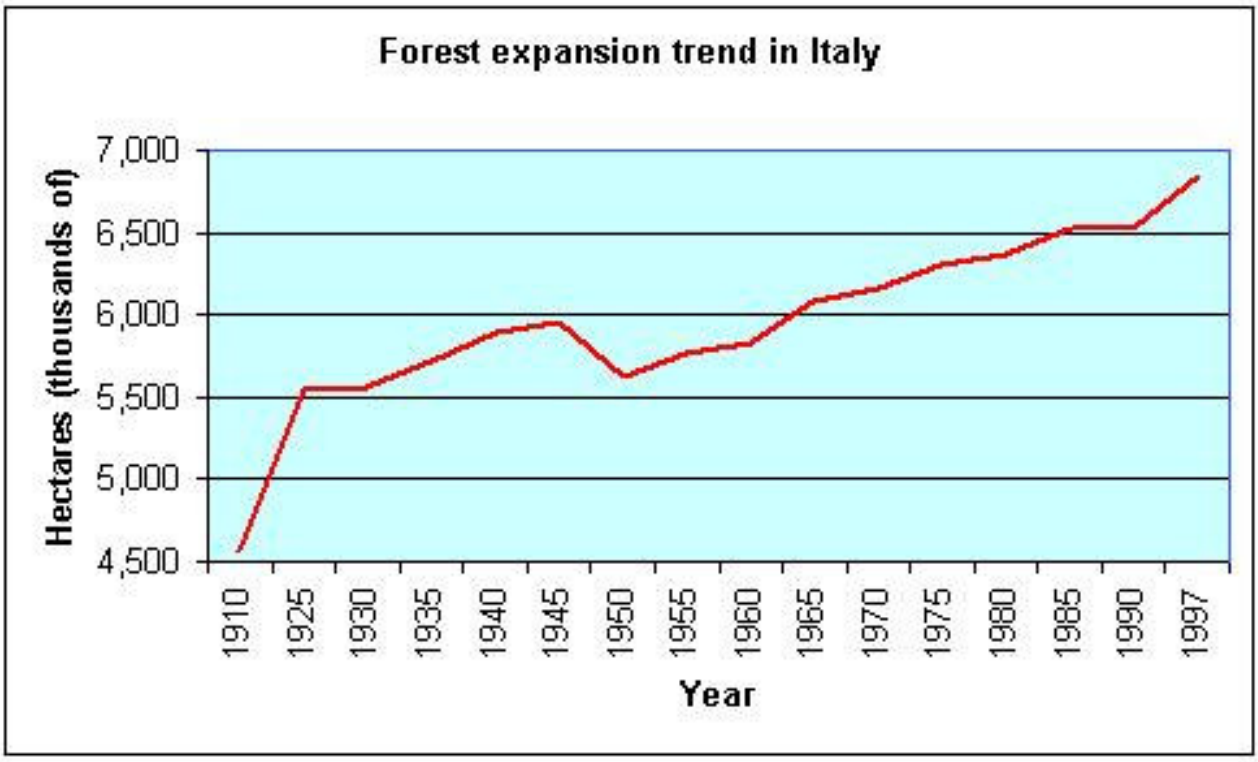
More particularly, IMAGE and CORINE Land Cover 2000 project identified the changes occurred in the 1990s for each of the 15 wider categories designated as Corine Land Cover Code Level 2. Graph 3 shows the changes referring to those categories identifying vegetation cover, together with the change related to the expansion of artificial surfaces. While open grassland and agricultural areas such as arable land, pastures, permanent crops and other kinds of farmland significantly shrank, forest area dramatically increased. At the same time, artificial surfaces, i.e. urban fabric, industrial, commercial and transport units, mine, dump and construction sites and artificial, non agricultural vegetated areas expanded to about the same extent.



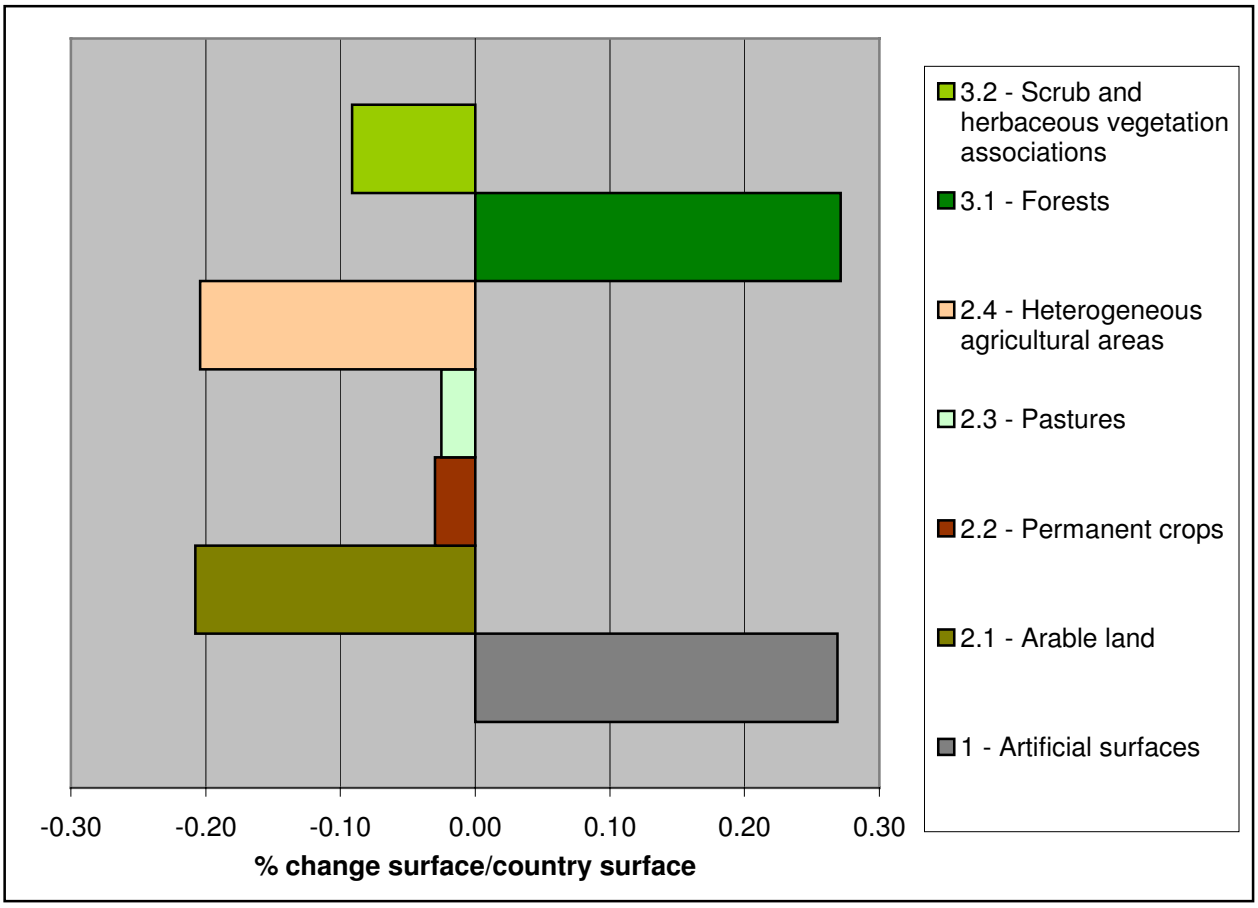
Figures 2, 3 and 4 - The worldwide famous tourist resort Cortina d'Ampezzo (Province of Belluno, Italy) in 1903 (previous page, at the bottom), 1958 (above) and 2004 (below). Along with urbanisation, also forest expansion represents a remarkably evident trend. Source: Lacedelli, 2004



Figures 5 and 6 – Cencenighe (Province of Belluno, Italy) in 1900 ca. (above; source: Archivi Alinari, Firenze) and 2005 (below; source: Fagarazzi, 2005). Small plots of arable terraced land (above) have been completely abandoned and spontaneously reforested (below).



Graph 2 – Forest expansion trend in Italy. Source: own elaboration from data provided by ISTAT in Fagarazzi, 2005



Graph 3 Land cover changes in Italy (1990-2000): vegetation cover and artificial surfaces categories. Artificial surfaces include: urban fabric, industrial, commercial and transport units, mine, dump and construction sites and artificial, non agricultural vegetated areas. Source: own elaboration from data provided by EEA, ETC/TE, 2004.

The top five changes occurred in land cover in Italy between 1990 and 2000 are listed in Table 4. It is worth underlining that the most relevant changes concern forest categories: 78,07□ ha of "transitional woodland and shrub" (a category defined as "*bushy or herbaceous vegetation with scattered trees, which can represent either woodland degradation or forest regeneration/re-colonisation*") turned either to broad-leaved (78.3%) or to coniferous (21.7%) forest. In addition to that, more than 18,000 hectares of new transitional woodland and shrub developed from natural grassland, which is likely to further evolve to forest within a few decades (EEA, ETC/TE, 2004). On the other hand, urbanisation only appears at the fourth place, involving less than one third of the area interested by afforestation processes (i.e. 17,127 hectares *versus* 78,07□ hectares).

Despite the magnitude of the phenomenon, such processes have been initially ignored by the Italian scientific and technical world (Piussi and Pettenella, 2000) and to date no comprehensive studies nor initiatives have been undertaken regarding forest expansion trends in Italy, while on the other hand large attention has been paid to urban expansion in the lowlands and – although to a more limited extent – in the large valley floors in the mountains.

		From… →	***…to…***
	Area □ha)	**Land cover 1990**	**Land cover 2000**
1°	□1,158	3.2.4 Transitional woodland shrub	3.1.1 Broad-leaved forest
2°	23,254	2.4.3 Land principally occupied by agriculture, with significant areas of natural vegetation	3.2.3 Sclerophyllous vegetation
3°	18,285	3.2.1 Natural grassland	3.2.4 Transitional woodland shrub
4°	17,127	2.1.1 Non-irrigated arable land	1.1.2 Discontinuous urban fabric
5°	1□,918	3.2.4 Transitional woodland shrub	3.1.2 Coniferous forest

Table 4 – Top five changes between land cover categories for Italy. Source: EEA, ETC/TE, 2004

4 – The impacts: effects caused by farmland abandonment and forest expansion on biodiversity and natural hazards

While negative impacts caused by intensive agricultural practices are widely costly investigated and recognised by public opinion, the favourable interactions between agriculture and environment and the ecological and social services provided by certain agro-ecosystems, such as landscape and wildlife conservation, soil protection and health, water cycle, air and water quality, carbon sequestration and so on (Aarnink *et al.*, 1998), remain largely disregarded (Dax and Wiesinger, 1997). On the contrary, farmland abandonment and the consequent forest expansion cause severe environmental, social and economic impacts, as summarised in Table 5.

Although social and economic impacts are extremely important for the viability of rural mountain areas, this article will focus in particular on environmental consequences.

As regards biodiversity, for instance, whereas the major threat is commonly perceived as intensification, the opposite trend towards farmland abandonment can have equally serious effects and should not be assumed to benefit conservation (Suárez-Seoane *et al.*, 2002). As a whole, tree and shrub encroachment leads to a decrease in open ground habitats and eventually reduces heterogeneity in the landscape.

<table>
<tr><th>ENVIRONMENTAL IMPACTS</th><th>SOCIAL IMPACTS</th><th>ECONOMIC IMPACTS</th></tr>
<tr><td>Loss of semi-natural open habitats caused by the running down of High Nature Value (HNV) farming systems</td><td>Disappearance of important features of cultural landscapes, such as:
pastures and hay meadows
small plots of cultivated fields</td><td>Economic damages caused by natural hazards</td></tr>
<tr><td>Biodiversity depletion affecting:
Species adapted to semi-natural habitats
Species living in transitional habitats
Species needing open spaces</td><td>Depletion of natural and cultural heritage: decline of empirical knowledge and skills</td><td>Loss of remarkable and highly appreciated landscapes: rural amenities as tourist asset</td></tr>
<tr><td rowspan="2">Slope instability and increased risk of natural hazards, such as:
snow gliding and avalanches
landslides
floods
wild fires</td><td>Homogenisation and closure of the landscape</td><td>Game species depletion with particular regard to avifauna</td></tr>
<tr><td rowspan="2">Change in landscape perception:
by residents (influence on territorial cares provided by local communities)
by visitors (aesthetic value of the landscape considered as a tourist asset)</td><td>Rising inaccessibility, smaller exploitability of the territory</td></tr>
<tr><td>Microclimatic changes due to forest expansion</td><td>Loss of pastures and hay meadows as economic resources</td></tr>
</table>

Table 5 - Main impacts caused by farmland abandonment and the consequent forest expansion. Source: Fagarazzi, 2005

Results from several studies specifically investigating these issues, such as the BIODEPTH project[4], suggest that preserving and restoring grassland diversity may be beneficial to maintaining desirable levels of several ecosystem processes, and may therefore have applications in land management and agriculture (Minns *et al.*, 2001).

While considering biodiversity trends related to the successional process, it is important to keep in mind that the simple number of species is not automatically a significant indicator of the real state of the environment, since the relevance of single species, in terms of rarity, ecological function, biogeographical and evolutional meaning, is often even more noteworthy. During the secondary succession following farmland abandonment, ecologically specialised species actually disappear in favour of more competitive, less valuable ones. After the cessation of any kind of management, such as cultivation, woodcutting, grazing and burning, aggressive tall grasses and thistles crowd out smaller herbs and a dense, species-poor and highly combustible weed thicket establishes itself in what used to be open woodlands and grasslands. This causes a heavy reduction of plant and animal diversity and the rapid loss of the richest and most attractive, more open and lower grass and shrubs "degradation" stages, including many light demanding, flowering geophytes and endemics (Naveh, 1994).

Therefore, there often is a sort of temporal variability in the direction of the impacts. For instance, while floristic diversity is likely to increase in the very early stages (Höchtl *et al.*, 2004; Brown, 1991; Baldock *et al.*, 199□), later on during the successional process, as the landscape becomes more uniform,

[4] The BIODEPTH project, funded by the European Commission within the fourth Framework Environment and Climate Programme, represented the first multinational, large scale experiment aimed at examining directly the relationships between plant diversity and the processes that determine the functioning of ecosystems, testing also whether ecosystem processes are affected by a decline in plant diversity in European grassland. The project started from the observation that much of the grassland pasture or hay meadow, covering half of the farmland of Europe, is being impoverished in plant species due to several processes, among which land abandonment and changes in grazing and mowing regimes play a primary role (Minns *et al.*, 2001).

plant biodiversity tends to decrease, according to the overwhelming majority of the authors, due to the invasion of aggressive pioneer or dominant species in former species-rich mountain meadows or pastures.

Also many animal species are damaged by vegetation re-colonisation, both because of the usually minor food availability provided by abandoned land compared with extensively cultivated land (Fernandez Ales, 1991), and because of the contraction of their habitats, when these are characterised by open grasslands. Although anthropogenic in nature, semi-natural grasslands are long-established habitats with a complex structure and plant composition, a crucial factor for most wildlife (Laiolo *et al.*, 2004). Semi-natural habitats host many flora and fauna species whose natural habitats have widely disappeared, to the extent that many species became dependent on semi-natural manmade habitats, which are now essential substitutes for the original ones (Baldock *et al.*, 199□).

Several bird populations in particular are threatened by the reduction of open rural areas and wood recover (Farina, 1991), since farmland habitats are known to hold a rich avifauna, comprising several specialists that are highly dependent upon agriculture and open grassland (Pain and Pienkowski, 1997).

Having developed under human influence for hundreds of years, agricultural ecosystems in environmentally sensitive areas remain vulnerable to inappropriate changes in the intensity of production, in the water regime or green cover, which could result in soil deterioration, erosion and landslides (EC, 1997).

Yet, even though in the short term neglect of mown or grazed alpine pastures determines an increased risk of natural hazards, in the long term the development of a tree cover usually – although not always – results in greater slope stability and a considerable reduction of the risks (MacDonald *et al.*, 2000). Although it might be argued that the adoption of a very long term vision makes such evolution desirable, eventually leading to a more "natural" state, i.e. more similar to the primitive conditions which used to prevail before humans started to exert their influence, however we should consider that throughout the intermediate stages of secondary succession ecosystems are unstable and there is a greater danger of natural disasters. The duration of such a time frame depends on several factors. However, this transitional period lasts for approximately 200-300 years, depending on the site conditions; in high and arid locations, for instance, it might last for many hundreds of years (Stone, 1992).

In order to better comprehend such a fundamental concept, a similitude might be useful: a man, who has been treated by giving him a certain medicine, becomes dependent upon that medicine, no matter whether he initially needed it or not. Once the therapy is interrupted, the organism starts suffering, since its previous equilibrium was subject to exogenous inputs. Until a new equilibrium has been found, a period characterised by instability and vulnerability to diseases takes place. Likewise, the same course of action occurs in semi-natural environments when they are abruptly abandoned: ecosystems became so altered by centuries of use, that they experience great difficulty in self-regulation, once abandoned, leading to serious problems such as erosion, pests and fires.

Furthermore, although it has been observed that both water runoff and soil erosion increase with decreasing density of plant cover, the highest values of soil erosion have been recorded when shrubs cover about 40-□0% of the total surface, while lightly managed meadows characterised by poor shrub cover (less than 15%) have a moderate soil loss, along with a modest quantity of runoff (García-Ruiz *et al.*, 1995). This means that a very dense shrub cover might be associated with high water runoff, thus causing floods downstream.

This phenomenon is even accentuated when are terraced sites to be abandoned (see Figure 5). The degradation of the traditional terrace systems, which represent a common construction in the Italian rural landscape, is actually one of the most evident consequences of the abandonment of cultivation in mountain territories (Piussi and Pettenella, 2000). Indeed, in these contexts significant land degradation problems occur, since the collapse of such artificial hydrological infrastructures comes together with

the cessation of their protective function against soil erosion and runoff (Dunjó, 2003). A severe cycle of degradation may be set in motion as terraces collapse and the disintegration of terrace walls potentially leads to landslips (Baldock *et al.*, 199□).

Abandoned meadows and pastures are also more prone to fire hazards, due to the features of the new vegetation cover (Höchtl *et al.*, 2004; Abramo, 2004; Gonzalez Bernaldez, 1991; Fernandez Ales, 1991; Hubert, 1991). The increased fire hazard is of particular importance especially in dry regions, where repeated fire events followed by heavy rainfalls determine a relevant erosion of productive soil, which may finally lead to irreversible desertification (García-Ruiz *et al.*, 1991; Fernandez Ales, 1991).

Along with farmland abandonment and the consequent shrub encroachment, also neglect of forests and the decline in the once common practice of collecting wood and scrub for fuel and animal bedding, together with the lower vigilance provided by mountain inhabitants, contributed to the increase in the occurrence of wild fires (Baldock *et al.*, 199□).

5 – Two different visions: *laissez faire* versus critical approach

Spontaneous afforestation of mountain areas is perceived in different ways, depending on the observer's point of view, on where it takes place, on the extent and type of new woodlands and on the time frame considered (Piussi and Pettenella, 2000). Two opposite outlooks gather most of the consensus as regards the phenomenon of farmland abandonment and particularly the consequent forest expansion trend: the "*laissez faire*" approach, characterised by an overall positive and optimistic view of the phenomena, on the one hand; a more critical attitude based on the conviction that the current trends somehow need to be counteracted, on the other hand.

The latter approach has been conquering large consent among researchers studying the impacts caused by such a process, who for the largest part – although not all of them – agree on a critical vision of the phenomenon. On the other hand, the former approach represents by far the prevailing attitude and it is particularly common in Italy, where it is widespread among the large public opinion, including some environmental organisations, certain academic circles not specifically dealing with these issues and most of the politicians, even at the highest levels. Those embracing such a vision are in favour of forest expansion, which in their opinion should not be stopped or limited significantly, although there might be room for some degree of control over it.

Some of the main aspects advocated in support of the *laissez faire* approach, together with the relative contrasting observations, are summarised in Table □.

To start with, small attention is commonly paid to forest expansion, in contrast with the great concern usually arisen by global deforestation trend. Yet, the environmental, social and economic value of secondary forests deriving from re-wilding processes occurring in abandoned land is not comparable at all with the value held by primary forests. Tropical rain forests, for instance, hold a high commercial value, are of primary importance for local populations depending upon their resources and play a fundamental role in terms of biodiversity conservation and the maintenance of hydrogeological balance, so that their removal causes devastating consequences also downstream especially in terms of landslides and floods.

Some commentators also suggest that the new forests might potentially benefit the timber industry, by increasing wood supply. Yet, the contribution of new forests to market timber is just marginal, because of the very poor quality of the raw material provided by forests resulting from uncontrolled shrubs and trees encroachment into abandoned grasslands, which are also more fragile, thus prone to pests and windstorms. Timber market has become so critical, that the already existing forests, including those which had been planted during the decades immediately following World War II, are nowadays abandoned in most of the Alps, and especially in the Italian Alpine arch, due to the harsh topographic constraints and the strong competition from other European countries.

FACTORS CONTRIBUTING TO THE *LAISSEZ FAIRE* APPROACH	…SOME CONTRASTING OBSERVATIONS
Compensation of global deforestation trend	Minor environmental, social and economical value associated with secondary forests in comparison with the primary ones, such as tropical rain forests
Increased wood supply	Already existing semi-natural forests and plantations are abandoned in the Alps, due to the topographical constraints and the overall crisis of timber market in Western European countries
Role played by secondary forests as "sinks" (carbon sequestration)	Greater efficiency of managed secondary forests with regard to carbon sequestration; spontaneous afforestation not counting as carbon credits within the □yoto mechanisms
Increased woodland connectivity, return of large and medium mammals (wolf, wild boar, red deer)	Damages caused by these species to cultivation and forests
Gain of "naturalness" (establishment of wilderness areas)	Wilderness definitions do not properly describe European cultural landscapes

Table 6 – Main aspects advocated in support of the *laissez faire* approach and relative opposing observations. Source: Fagarazzi, 2005

Similarly, the role of secondary forests as "sinks" is usually largely overestimated. Indeed the efficiency of the new forests deriving from uncontrolled natural succession is usually scarce with regard to carbon sequestration and new forests resulting from unintentional, spontaneous renovation are not counted as carbon credits, which only comprise plantations or planned afforestations or reforestations (Ciccarese and Pettenella, 2005).

Another positive aspect stressed by the advocates of the *laissez faire* approach is the fact that, in front of a progressive fragmentation of the natural landscape in many rural mountainous parts of Europe, woodland connectivity significantly increases, thus allowing forest species to spread over larger territories. Yet, although the return of some valuable large mammals such as the red and roe deer, the wild boar and even some predators which had become locally extinct several decades ago, such as the lynx and even wolves and bears, has certainly to be considered an encouraging process contributing to increase biodiversity in Europe, it is also important to take into account the damages locally caused by these species when becoming dominant, and especially by wild boars and deer, inhibiting natural renewal of trees within forests.

Finally, according to a broadly accepted opinion, the process of uncontrolled nature development taking place in large European rural areas represents a sort of reconquest of lost territories by "mother Nature", leading to a gain of naturalness. In many cases re-wilded areas even inspire a false perception of wilderness and untouched landscapes (Höchtl *et al.*, 2004). This idea of gaining naturalness thanks to the re-wilding process has been stimulated or even enhanced by the recent but very common practice of designation of long abandoned cultural landscapes as "*wilderness areas*".

Yet, in the case of European mountain landscapes, and especially the Alpine ones, the problem is not as much how to manage and maintain wilderness, as to understand whether there is some wilderness and, if so, how to recognise it. It might actually be objected that there are no landscapes left in the Alps which are either unmanipulated or uninfluenced by humans, or both. On the contrary, these landscapes are more properly described by the definition provided by the European Landscape Convention, which states that the landscape is "*an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors*" (Council of Europe, 2000). In contrast with the concept of wilderness, the definition of landscape does not exclude the human component, which on the contrary is given great relevance for its contribution in shaping the present state of the territory.

A reflection is then necessary on the purpose of establishing wilderness areas in European mountains, whether these have to respond to nature conservation demands or they are mainly related to precise regional planning choices or even marketing strategies, aimed at strengthening the tourist appeal of these areas. In the former case, a review of nature protection policy would be opportune, while in the latter case a greater transparency would be necessary throughout the decision-making process, so that the reasons leading to the establishment of wilderness areas are clearly stated, together with the meaning attributed to such a concept in the European context (Höchtl *et al.*, 2004).

6 – Conclusions

Despite their extension and the fundamental role played within the modern societies by the resources and services they provide, mountain areas are facing strong marginalisation processes in industrialised countries all around the world, mainly in terms of depopulation and ageing trends, decline of extensive farming activities and uncontrolled forest expansion. While the first two processes, i.e. demographic trends and – to some extent – mountain farming decline have been largely analysed, no or little attention has been paid to the main consequence of such processes at landscape level, i.e. forest expansion.

Indeed, the process of natural succession following farmland abandonment has been widely underestimated, both in terms of spatial extension and in terms of the impacts it causes. Yet, land abandonment and the consequent invasion of forests into farmlands represents, from a quantitative point of view, the most relevant change in land use which took place in Italy during the last □0 years (Piussi and Pettenella, 2000), whereas forests expanded as much as artificial surfaces during the last decade of the 20th century – a time frame traditionally associated with impressive urbanisation trends. Moreover, such a deep and often irreversible landscape transformation brings about several social, economic and environmental impacts, both in positive and negative terms.

Consequently, two different visions are commonly adopted when addressing forest expansion related issues: in contrast with a *laissez faire* approach, which tends to limit human intervention as much as possible, letting abandoned farmland evolve without any or little restraint, the critical approach is based on the conviction that the negative consequences prevail over the positive ones, thus spontaneous afforestation should be counteracted in several ways, by stemming, inhibiting or even preventing it. The basic idea is that we should not ignore the crumbling of mountains, as too often this has been the prelude to the crumbling of the downstream economy (Mountain Agenda, 1992).

In particular, mountains will play a prominent role in sustainable development in the next future, due to the increasing demands on limited water resources, resulting in a growing potential for conflicts (Mountain Agenda, 1999). Yet, even though sustainable water management and prevention of floods and landslides depend in large measure on the ways in which upstream water sources and soils in mountain areas are protected, upstream dwellers do not usually receive any compensation for the environmental services provided by their territory in terms of water supply and mitigation or prevention of natural hazards. Downstream populations have no tradition of negotiating environmental safeguard with mountain dwellers, nor do the latter ones take the value of such environmental services into account (Bieberstein □ och-Weser and □ ahlenborn, 2004).

To conclude, we might state that if we will continue not to face mountain issues, mountain issues will face us.

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