

Maurizio Conte  
Dora Francese  
Giuseppe Vaccaro

# ENVIRONMENTAL HAZARD AND RESOURCE USE: A COMPARISON BETWEEN VOLCANIC LANDSCAPE OF VESUVIUS AND STROMBOLI

## Abstract

The paper deals with a specific aspect of hazard, the overexploitation of landscape due to touristic effect. In particular it makes an attempt to compare two different scenarios in very similar landscape areas: the volcanic territory of the Vesuvius near Naples and that of Stromboli in Sicily.

The goal is that of investigating the environmental and landscaping factors which characterize the two-land use, and which creates the similarity or the disparity between the two realms. The peculiar volcanic territory, which at the same time attracts and repel or frighten people due to the danger of the eruptions, is analyzed as a potential as well as an hazard factor for conservation, maintenance, and enhancement of so beautiful a landscape. The definition of the decay aspects which tourist involvement produce is also interfaced with the environmental and sustainable factors aimed at preservation of natural ecosystemic areas. The two districts are described in terms of landscape potential and environmental eventual benefits, and some proposals for promoting and enhancing a more sustainable tourism are outlined.

**Keywords:** levels of exploitation of the landscape, tourism, volcanic landscape, Vesuvius, Stromboli.

## Introduction

Volcanic activity is one of the most common and most natural hazards on earth, as far as the dangerous effects towards anthropic realm are concerned.

The involvement of a number of other factors within a Volcanic area can actually create a multiplication of hazards and dangers, which do not only add to the main factors (the eruptions, the dangerous ardent sands, the fire, and so on) but also amplifies the discomfort and the potential of dead or injured.

One of the main aspects which produces this situation is due to the fact that humans tend to settle within areas of great beauty and fertility, where mountains, water and vegetation are rich, so as to favour a good quality of life: and – low and behold – exactly in the volcanic areas many of these factors are present in a good deal.

A comparison between two wide areas of Volcanic hazard in Italy can be made, for they actually offer – jointly - most of the aforesaid factors: Vesuvius near Naples and Stromboli in the Aeolian islands.

This study is aimed at analyzing the similarities

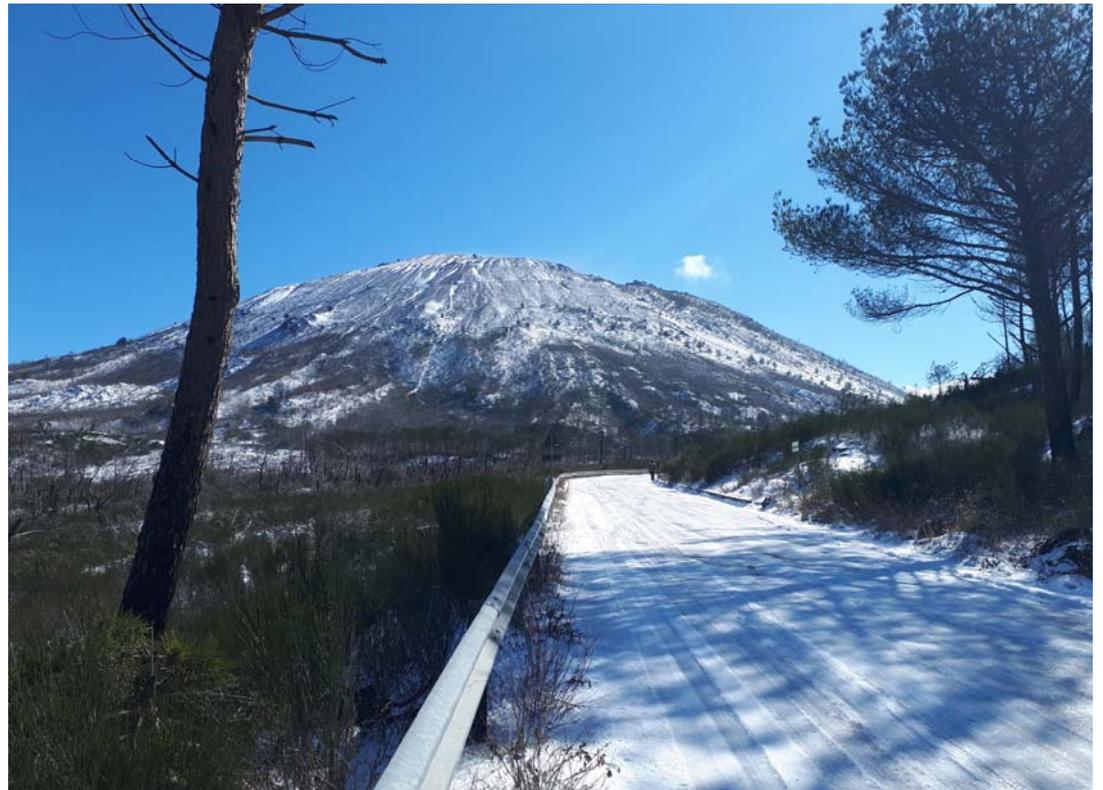


Fig.1. The snow-covered Vesuvius.

between these two environments, as far as the potential of risk and of benefits for humans are concerned, and thus defining the tourist involvement in the decay of the wonderful landscape existing there.

## Description of Vesuvius' landscape

Symbol of the city of Naples, silent guardian of the gulf, marker of the scenic characters, the "good giant" that over time has conditioned - positively and sometimes negatively - the number of civilizations that have followed one another, a real visual hinge for the whole the Neapolitan area, both for the coastal strip and for the inland areas of the plain [1].

Vesuvius has shaped its skyline and has continued to affect human settlements following the last eruption of 1944. The particular environmental, geological and geomorphological factors have in fact conditioned the choices of urban settlements. Vesuvius is a rare example of a "re-encircled volcano" whose cone is surrounded by a much older crater that had a circumference of about 11 km long. It is characterized by the typical truncated cone shape whose highest point reaches 1,277 m a.s.l. The crater currently has a diameter of 450 m and a depth of 300 m.

In the geological era of the Eocene, the mountain appeared as an island surrounded by the sea – not so different from the island of Stromboli – only in the Pliocene did it weld to the mainland due to the accumulation of ejected materials, probably during the so-called "Ignimbrite campana" where up to 15 km<sup>3</sup> of magma was emitted. Vesuvius is a characteristic polygenic and mixed volcano, i.e. made up of lavas of different chemical composition (for example trachytes, tephrites, leucitites) and formed by both lava flows and pyroclastic deposits. All the areas on the slopes of the mountain are to be considered formed by land transported by mud lavas that descend from the steep slopes in the rainy seasons through deep and narrow valleys called riverbeds or more commonly lagni. The high banks are formed by heaps of lava slag, which - precipitated in an incandescent state and spread towards the lower slopes - are now revealed because of their fertile material, rich in silicon and potassium, precious for the vegetation.

These factors make the Vesuvius National Park [2] a treasure chest of biodiversity: the sea, the mountains, the volcano, the variety of places, the splendid naturalistic views, the many

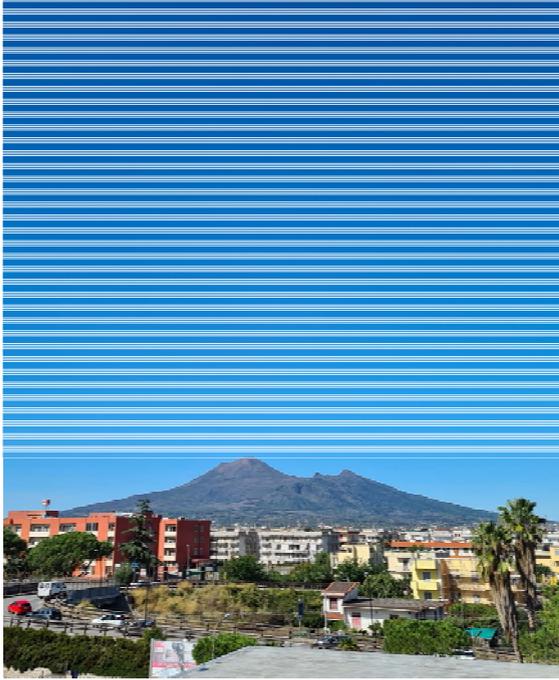


Fig.2. Vesuvius seen from Scafati (SA).



Fig.3. An aerial view of Vesuvius, to Google Earth.

species of plants, animals, minerals, the many countries each with their own history and tradition, make the Vesuvian area one of the most fascinating places to visit.

The first attested presence of man in the Vesuvius area dates back to around the third millennium BC: it is therefore a strongly and long-man-made territory, exploited for the great fertility of its land and for the opportunities it offered. However, the activity of man has been very intrusive through the practice of fire, the realization of reforestation with non native species and, above all, through the urbanization process, which has gone up to the slopes of the volcano and beyond, sometimes indiscriminately. All these elements have profoundly transformed the territory, with a strong impact on the ecosystems that characterize the volcanic complex.

Vesuvius National Park, among the 21 Italian National Parks, is a territory characterized by the most striking contrasts: the extension of 8,482 ha. includes thirteen municipalities with a total population of about 350,000 inhabitants, to which the residential pressure of five contiguous municipalities are to be added that have grown in an urban continuum covering over 530,000 inhabitants; a presence that over the decades has gradually expanded towards the slopes of the volcano by public, private, speculative and abusive initiatives, definitively compromising the already poor transport network and the possibility of solution except at exorbitant costs; in the Park area, seven municipal waste dumps have been established over the years in many abandoned lava stone quarries, the last two by government decree in 2008 in the midst of the regional waste crisis; Herculaneum, Oplonti, Pompeii, Stabiae, which are the most relevant archeological remains from the Roman era, together with the priceless heritage of villas and farms that excavation campaigns are still bringing to light today, show how much these settlements encircled Vesuvius before the eruption of 79 AD; in Portici Carlo III built a magnificent palace that opened its arms on the Gulf of Naples and consequently the Neapolitan noble families began to build

splendid villas along the so-called Golden Mile, actually hosting the Grand Tour that had moved south, and in Naples in particular, following the discoveries of Herculaneum in 1738 and Pompeii in 1748; the volcanic earth has made this area particularly fertile since the Roman presence, at the extent that some food and wine products are unique and famous in the world.

Such marked contrasts in this area have created conditions of use and exploitation that have shown the possibility of sharing so much extraordinary land and landscape and at the same time its own disaster. Which was first embodied by the indifference of the inhabitants who at different levels attacked it with wild overbuilding, with the small systematic non-legalism, with the dispersion into the environment of small and large waste, and finally with the progressive shrinking of very fertile agricultural areas.

The terrible fire that broke out in July 2017 on the slopes of Vesuvius, investing in a few days an area equal to that affected by the fires of the previous 21 years, triggered a huge international media echo, which was due to the experiences of great travellers who from the eighteenth century onwards had paved the way for a tourism of beauty, which in the post-war decades of the last century became more and more massive, almost placing its sustainability at risk.

Since the previous month of February, the date of establishment of the new Direction Board of the National Park, the political management body had expressed the need of changing the Authority's conduct, evaluating delays and lacks in the protection management of natural areas, in the inadequate administrative incisiveness, in the shortage of confrontation with local institutions.

Moreover, the same disaffection of the citizens, who had mainly considered the institution of the Park as an impediment to freedom of action for the small and large illegalities to be carried out in its territory, says it all about the general precarious condition in which the Park Authority is to be found, for its being an

institution as well as a territory, far from being understood as a great resource to be defended in order to generate direct and reflected benefits for the entire community, up to the possibility of economic redemption for the younger generations.

The fire forced the Direction Board of the National Park to proved a sort of being back at the start about the actions to be undertaken by approving the Great Vesuvius Project in September of the same year, a compendium of interventions that can be summarized into three fundamental axes:

1. Planning of forestry interventions aimed at the reclamation and recovery of areas affected by fire;
2. Redevelopment of the network of paths, recovery of historical paths and definition of extensions to the green infrastructure network;
3. Implementation of accessibility projects with low environmental impact for the ascents to the Gran Cono, creation of access doors and info-points.

#### Description of Stromboli's landscape

The island of Stromboli (from the Greek Strongyle, round), with the islands of "Lipari", "Vulcano", "Salina", "Filicudi", "Alicudi", "Panarea", as well as five smaller islands ("Basiluzzo", "Dattilo", "Lisca Nera", "Bottaro" and "Lisca Bianca") establishes the Aeolian archipelago identified, in its peculiar terrestrial and marine ecological characteristics, by its recent and fascinating geological history, as well as by its significant naturalistic value to which some phenomena of volcanism and hydrodynamics, unique in the Tyrrhenian Sea can be added [3].

It is located in a marine portion characterized by a superficial circulation with waters of Atlantic origin (through the Strait of Gibraltar) which, in this area, takes a counterclockwise flow direction, parallel to the Northern Sicilian coast.

From the geodynamic point of view, Stromboli and all the Aeolian islands represent the superficial part of a larger volcanic system that



Fig.4. An aerial view of Stromboli's island and volcano, to Google Earth.

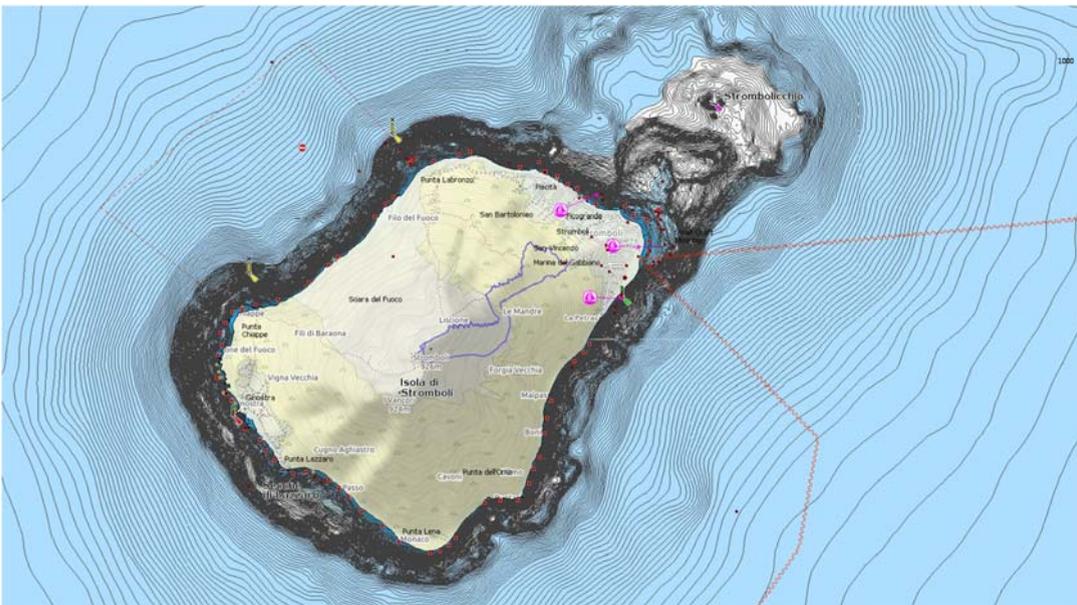


Fig.5. Maps of Stromboli's island and sea.

extends for about 87 km with the emerged systems, but which lengthens with other submarine volcanoes forming a semicircle structure open to the north, over 200 km long. These peculiarities are joined by the profound historical-cultural contaminations resulting from the migrations of the navigating communities of the Mediterranean since 4000 BC, which reinforce the great environmental and anthropic richness, and that represent, at the same time, a formidable economic potential. Since its origins, the island has always been inhabited, with a peak of population towards the end of 19th century when it reached far beyond 2,500 inhabitants (ISTAT). The strong eruptions of Stromboli have led to the abandonment by many Strombolians, and those few still remaining on the island, despite the anxiety that "Iddu", as the volcano is called by the Strombolians, provide to them, still see Stromboli almost like a divinity close to natural

and often catastrophic phenomena, justifying all its eruptive activities with the phrase "*iddu sta facennu u so misteru*" [4]. The "UNESCO site management plan" focuses on the biocoenosis activities of the areas characterized by hydrothermalism, defining them as "... an extraordinary example of the volcanic phenomenon still in progress. Studied since the 18th century, the islands have provided volcanology with two types of eruptions (Vulcanian and Strombolian) and have consequently occupied an eminent place in the education of all geologists for over 200 years" [5]. The same document underlines how the island of Stromboli (12,2 sq km) were characterized by an inaccessible territory and, for this reason, has maintained a good level of naturalness. The less unreachable areas were occupied by now abandoned crops. As far as land is concerned, Stromboli represents the termination on the northeastern end of the

particular "Y" configuration given by the coexistence of three main lines and rises from the seabed for 2.400 m, starting from a metamorphic base, through an almost regular conical apparatus which in the emerged part culminates with the peaks of "Vancori" located at 924 m asl.

The island is morphologically characterized, besides by an elongation in the NE-SW direction, by steeply sloping sides (35°-40°) and by not very extensive sub-flat areas on which the main inhabited centers or scattered dwellings are located ("Stromboli", "San Vincenzo", "Ginostra", "Punta Lena").

An Oriented Natural Reserve and Integral Natural Reserve "Stromboli and Strombolicchio Island" has been established as protection regime. For almost all of the cartographic extension, the island has a perimeter of Site of Community Importance (SIC ITA030026: island of Stromboli and Strombolicchio) and Special Protection Area (ZPS ITA030044: "Archipelago of the Aeolian Islands - Marine and terrestrial area").

The continuous explosive activity of Stromboli<sup>1</sup> has changed the morphology of the pick and lowest area through the distribution of the erupted materials with different frequencies and heights, as well as through the different mouths distributed in the three craters (North-East, Central and South-West).

Nevertheless, there is still a network of paths maintained by the Regional State Forestry Company and by the Civil Protection Department which keep some accessible itineraries - Stromboli-Filo del fuoco (4.7 km), Ginostra-Punta dei Corvi (0.8 km) and Scari-Punta Lena - which highlight areas of extraordinary landscape interest such as "Serro Adorno, Serro delle Capre, Punta dei Corvi; Fico Grande, San Bartolo, Petrazza; the beach from Pizzillo to Punta Lena, to the Chiusa di Forgia Vecchia; Punta Lena Sud; Strombolicchio".

These geomorphological, landscape and naturalistic characteristics are subjected to the action of risk factors that should not be underestimated. From the morphological point of view, for example, it can be noticed how the instability of the slopes, made up mainly with large basaltic lava flows, modifies the orography of the places due to frequent fracturing and alterations provided by intense erosive agents, so modifying the slope angle.

It can be reminded that "... the last "Plan for National emergency for Stromboli Island, made in 2015, has transferred the management to the Lipari municipality (which actually is the administrator of various territories among which the island of Stromboli), in collaboration with the advanced operative centre in Stromboli," [9] and that after this period a great parossistic event occurred in 2019 summer, which created risks as well as attractions. Conversely as far as environmental factors are concerned: those at short-time scale - (such as precipitation) and at long-time scale (such as sea level variations) can equally play an important role in triggering the instability phenomena of the Stromboli volcanic building. Most of the rainfall occurs between the months of December and March; the minimum monthly value recorded is 6,5 mm in August (Stromboli). However, these data may be significantly different according to the elevation and the orography of the individual zones.



Fig.6. Carneval in Stromboli: a moment of crowd before Covid.

In fact, Stromboli has always been an extraordinary natural laboratory of great interest for the scientific community but, at the same time, a popular destination for tourists due to the different perceptions that may contextually arise. This attractiveness is favored by the presence of a small port which, in addition to represent the most important connection infrastructure, is also an indicator of the level of hospitality and accessibility through the docking of ferries, hydrofoils and private boats.

A peculiarity of Stromboli is also the way to "experience the moment" in an alternative way. In fact it is known that "... Stromboli is not a touristic place like the others, for it obeys to a rhythm and a spatial function which are very peculiar and which attribute to it the turnover of very animated and almost empty sectors, hours of congestion and others of totally tranquility." [9] (Fig. 6)

Frequented mainly during summer months - and with minor peaks in the off season -, it hosts groups of people climbing with the Guide every evening to the slopes of the volcano so as to witness closely the eruptive activity. Another attraction is the "Sciara del Fuoco", which offered the magnificent view of large lapillus landslides emerging from the volcanic crater and sheer falling towards and into the sea: a real flow of fire.

In conclusion, if tourism represents an important factor for economic development, it also stands as a strong risk factor. Summer mass tourism violates the small island, regardless of the fragile ecosystem within the place itself (EU Commission 2013<sup>2</sup>, ISPRA 2017<sup>3</sup>), so compromising the environmental integrity of the destinations.

To this the volcanic risk should be obviously added, which could actually leads to the danger of a total desertion of tourism: "... no zero hazard exists, and the tourists' number will dramatically decrease, not even compensated by the lovers of shows and risk." [9]

#### Potential of landscape exploitation

Wherever tourism is present, two main aspects are to be taken into account: the first being some kind of attraction which the place offers for eventual desire of travelling there by people, and the second the facilities for access to and hosting eventual tourists. Although the landscape is in fact a valuable attraction factor for any kind of tourist, either for amusement and picnic, or for scientific and cultural interest, it is well known that any time the human presence starts to be very notable, the

landscape itself, as effect of his passage, will be modified and thus lose its precious naturalty and beauty.

Nevertheless, perception of landscape cannot be deprived to any person, for it can gratify both physical and spiritual education of anyone. Focusing now on the cases here facing, their likeness can be characterized in two main aspects: the presence of Volcano and the nearness to the sea. Therefore an investigation have pointed out how any kind of under-group of factors, strictly depending on the Volcanic wide presence, could be considered as a potential of benefits for tourists and inhabitants, and at the same time as a factor of hazard for the landscape, for the biotic and abiotic portions of the environment, and last but not least for people.

A number of factors have then been identified, in particular the following exploitation of:

- touristic resources, such as the beaches in the waterfronts and the areas of geological interest;
- material resources, such as stones from the ground or from the quarry, wood and derivates from vegetation;
- edible resources, such as plantation and farming from the fertile and very fruitful volcanic soil;
- energy resources, such as sun (from the very climatically favourable sites), wind (from the well-known presence of high trend of air movement), waves and tides (from the sea), organic and inorganic wastes (from agriculture and other human activities);
- cultural resources, such as archaeology, monuments, churches, historical centres (from the anthropic transformation in the ancient times);
- erosion of the coastlines and eventual sand nourishment (from the Volcanic activity).

The study has reported that the two situations, Vesuvius and Stromboli, are slightly different as far as the eventual exploitation of the resources themselves.

If in fact the two main kinds of resource, touristic and material have been through time exploited in a very great amount, thus leading to the importance of underlining their eventual secondary damaging effects, both energy and cultural resources have been underestimated and therefore not enough and properly enhanced. As far as food farming and animal fostering are concerned, the situation is different for the two areas: where the Vesuvius area has been very intensively exploiting since very ancient times, the Stromboli communities have instead long stopped to care for earth growing, due to the easier and more profitable activity of tourism. Only few small categories of picturesque plants are still cultivated, such as capers, honey, some olives and some kitchen garden products, aimed similarly to be sold to tourists.

The situation of energy resources is not different in the two areas: the Vesuvius offer great amount of solar radiation all over the year, but only lately the National Park Authority has started to establish a proper exploitation, while the private housing and enterprises around the slopes of the mountain actually employ very small solar technologies in their buildings and infrastructures. The wind is not at all exploited, even being present a great deal

especially in springtime. Other energy saving devices and policies are of scarce interest. The marine renewable sources, as far as waves and tide are concerned, is almost completely ignored. The last potential for renewable energy sources, the wastes, which could produce, by means of special treatment, both energy from the organic transformation into Methane with the Digesters, and products from the recycling of inorganic matter, is far from being actually converted into a productive richness all over the region, for it is still an inconvenience and a risk rather than considered as a fruitful benefit.

Stromboli instead has been a little more conscious of the strong presence of high levels of solar power especially in summer, where it reaches the 6.0 MJ/m<sup>2</sup> as solar daily Direct Irradiation, but only few private buildings actually employ either photovoltaic or solar thermal power, while the presence of a municipal power plant for providing electricity to all the villages is fed by fossil fuel. The wind resource has been during times employed for sailing navigation and for wind mills, but lately this renewable source, which is very strongly active all over the year (let us not forget that the name of the Archipelago is actually come from Aeolus the ancient Greek God of wind) has been completed neglected. As far as the waves and tide are concerned, not even an attempt to think about the possible use of these two potentially high-powered renewable sources of energy has been carried out; even though the waves are particularly strong all year long. Another source of energy, the geothermal, is instead slightly employed, for in any spot of the villages on the volcano's slope it is possible to dig few metres and find very warm sea water, obviously heated up by the volcanic activity. Nevertheless, some little device has been provided to the citizens' habit, for there is no public lightning in the little streets (so saving energy and reducing light pollution), and the combustion-engine transportations are forbidden during the nightly hours.

#### Sustainability of Tourism

The sustainability of tourism is not a legislative requirement, even if it is relevant for the sector itself and for the environment. Most of the ongoing European initiatives, both at the monitoring and management level, continue to be based on voluntary tools and proposals of concerned stakeholders.

Similarly, environmental certifications and labelling in the tourism sector regard beaches and marinas (Blue Flag) or the evaluation of companies' conduct that more or less incorporate the principles of sustainability in their offers and development operations.

Therefore, taking advantage of the modification of the opportunities that the European Community proposes through its financing calls and operational hints, it would be appropriate to promote a process for defining practices and strategies aimed at mitigating the risks caused by uncontrolled tourism, which could be not only voluntarily, but also mandatory, starting from a macro-territorial sphere up to the accurate analysis of a specific context.

In particular as far as the tourism hazard in the volcanic areas is concerned, being well known that "... the tourism system is based mainly on the Volcano's attraction, ... this system includes

then the assumption of a risk by the tourist, for ... the danger in volcanology is a probabilistic phenomenon (the probability that a dangerous event will occur in a defined time);” [9] and that “... human mind ... cannot balance the unpredictable risk with the attraction of telluric strengths, for it is a rare moment in which men feel the deep-rooted existential link with the Earth housing them. And if contemporary argument on global warming stresses on human responsibility, but also on his omnipotence (for what he has done and now trying to delete), the contact with an active Volcano is, conversely, a source of humility, in the relationship that we keep with the earth where we built our habitat and in which only two are the solutions: accept the risk – by those who knows it – or escape.” [9]

A final consideration can be made in terms of diversity of exploitation in the two compared volcanic areas: if the natural landscape in the Vesuvius has been mainly modified by the local inhabitants, with their built and agriculture activities, while the tourism has provided less damage, conversely in the Stromboli situation, the local communities have been very aware and responsible over years for the magnificent natural territory, while the more recent touristic activity has greatly compromising the landscape, and so requires great care and protection actions.

#### Acknowledgement

The work is the result of a common reflection of the three authors. Despite this, the introductory paragraph and the paragraph entitled “*Potential of landscape exploitation*” are to be attributed to D. Francese; the paragraph entitled “*Description of Vesuvius’ landscape*” to M. Conte; the paragraph entitled “*Description of Stromboli’s landscape*” to G. Vaccaro. All authors approved the final version and conclusion that converge in the paragraph “*Sustainability of Tourism*”.

#### REFERENCES

- [1] Regione Campania – Assessorato al Governo del Territorio (2006), *PTR – Piano Territoriale Regionale*, [on-line] available at [http://www.sito.regione.campania.it/PTR2006/PTR\\_All2.pdf](http://www.sito.regione.campania.it/PTR2006/PTR_All2.pdf).
- [2] <https://www.parconazionaledelesuvio.it/biodiversita/>.
- [3] Brullo, S., Scelsi, F., Siracusa, G., Spampinato, G. (1996), *Caratteristiche bioclimatiche della Sicilia*, in: *Giornale botanico italiano*, 130:1, pp. 177-185, [on-line] available at <https://doi.org/10.1080/11263509609439524>.
- [4] Villaggio D. (2019), *Stromboli, l’isola che trema tra fascino ed inquietudine*, [on-line] available at <https://www.centrometeosicilia.it/stromboli-lisola-che-trema-tra-fascino-ed-inquietudine/>.
- [5] REGIONE SICILIANA (2014), *Piano di Gestione UNESCO Isole Eolie*, [on-line] available at <http://unescosicilia.it/wp/wp-content/uploads/2014/09/PdG-Eolie.pdf>.
- [6] Bertolaso, G., De Bernardinis, B., Bosi, V., Cardaci, C., Ciolli, S., Colozza, R., Cristiani, C., Mangione, D., Ricciardi, A., Rosi, M., Scalzo, A., Soddu P. (2009), *Civil protection preparedness and response to the 2007 eruptive crisis of Stromboli volcano, Italy*, in: *Journal of Volcanology and Geothermal Research*, 182, pp. 269-277, Elsevier B.V. DOI: 10.1016/j.jvolgeores.2009.01.022.
- [7] Regione Sicilia, Dipartimento del Turismo, dello Sport e dello Spettacolo (2017), *Il turismo in*

- Sicilia. Rapporto 2017*, Osservatorio Turistico Regionale.
- [8] <http://www.comunelipari.gov.it/lipari/zf/index.php/servizi-ggiuntivi/index/index/idtesto/8>
- [9] Knafou, R., (2019), *Stromboli, una roulette russa turistica*, [on-line], 16 | 2019, mis en ligne le 30 mars 2020, consulté le 02 juin 2021, URL: <http://journals.openedition.org/viatourism/4856>;
- [10] Regione Siciliana, (2019), *Le isole minori della Sicilia*, Presidenza, Segreteria generale, Coordinamento Attività isole Minori.
- [11] Cavallaro, C. (1976), *Evoluzione e prospettive della regione turistica delle Isole Eolie*, in: *Rassegna di Studi Turistici*, anno XI, n. 1-2, gennaio-giugno, pp. 51-64.
- [12] Di Blasi, E., Arangio, A. (2016), *Il territorio delle Lipari tra ambiente, cinema e turismo / The territory of Lipari between environment, cinema and tourism*, in: *Il Capitale culturale: Studies on the Value of Cultural Heritage*, 4, pp. 455-465.
- [13] Famularo, F. (2008), *...e poi Stromboli*, Edizioni Strombolibri, Pomezia.
- [14] Protezione civile (2015), *Isola di Stromboli, Piano nazionale di emergenza a fronte di eventi vulcanici di rilevanza nazionale*, (38 p. + 94 p. annexes).

#### NOTES

1. A study published in the journal *Lithos*, entitled, conducted by researchers of the Laboratory for High Pressures and High Temperatures of Experimental Geophysics and Volcanology (HPHT) of the National Institute of Geophysics and Volcanology (INGV) in collaboration with the University La Sapienza of Rome, the University of Queensland (Australia) and with the Natural History Museum of London, demonstrated how behind the violent explosive eruptions of the Stromboli volcano, there would be the interaction between magmas of different temperatures. Cfr. Di Stefano F. et al (2020), *Mush cannibalism and disruption recorded by clinopyroxene phenocrysts at Stromboli volcano: new insights from recent 2003-2017 activity*, in: “*Lithos*”, Volumes 360–361, May 2020, 105440, [on-line] available at <https://www.sciencedirect.com/science/article/abs/pii/S0024493720300773>.
2. Cfr. Unione Europea (2013), *Il Sistema europeo di indicatori per il turismo. TOOLKIT For Sustainable Destinations*, Unione Europea, Lussemburgo. The document represents the result of the study on the feasibility of a European system of indicators in the tourism sector for sustainable management at destination level. Cfr. ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale (2017), *Ambiente: sfida e opportunità per il turismo*, “Stato dell’ambiente” n. 73/2017, ISPRA, Roma, [on-line] available at <http://www.sinanet.isprambiente.it/gelso/tematiche/buone-pratiche-per-il-turismo/statoamb73.pdf>.