

Special Issue Roots Tourism

FUORI LUOGO

Rivista di Sociologia
del Territorio, Turismo, Tecnologia

Guest Editors

Tullio Romita

Antonella Perri

Philippe Clairay



Direttore Fabio Corbisiero
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When Tourism is too Much. Tourist Carrying Capacity of the Vesuvius National Park²

1. Introduction and background of literature

Tourism plays a very important role in the world, both socially and economically. But it also affects cultural behaviours and the natural environment. Although several scholars have stressed that tourism can create environmental imbalances and “wear out” the places in which tourist flows are anchored (Gossling, 2000), some studies have put forward the possibility of moving beyond the morbid paradigm of a tourist resort’s “life cycle” (Holden, 2016). Indeed, tourism can both conserve and pollute the physical environment. From a non-critical perspective tourism generates economy, employment and can improve service delivery and the overall infrastructure (even digital) about the ecosystem. Thanks to tourism the liveliness and livability in several areas are boosted because services and facilities would not exist without that additional customer base. Vice versa other scholars emphasize the detrimental effects of an out-of-control tourism expansion, with a severe environmental degradation caused by an excessive exploitation of tourism resources (Apergis & Payne, 2012) or by a rise in energy use and human activities such as production, consumption, mobility, urbanization, or industrialization. However, with an eye on the concept of sustainable tourism, it is important to figure out whether and how touristic areas’ annoyances comes about, and, above all, those related to Tourist Carrying Capacity (from now on TCC) in some destinations. In other words, given the many links between the socio-economic importance of tourism phenomena and sustainability concerns, this sector’s growth appears to depend on tourist satisfaction. Quite often such satisfaction depends in turn on environmental (both natural and social) quality. This has been proven even more true for national parks and natural protected areas, where tourism demonstrated to provide jobs and income, attract capital, and avoid outmigration more than other sectors (Sugiyarto *et al.*, 2003).

For this reason, the great interest in environmental tourism, in its forms of sustainable tourism and ecotourism (Ceballos-Lascuráin, 1988; Joshi, 2011; Weaver, 2005) basically reflects an attempt to reconcile production needs of the tourism industry with sustainable development. Buckley (2018, p.47) defined this tourism segment as an “ecologically significant” contribution to the effective conservation of biological diversity, above all in anthropized areas.

In this context, it is necessary to implement strategies capable of firstly providing an opinion on the situation that a particular tourist resort is facing and, secondly, of defining guidelines capable of directing its management towards increasingly sustainable models.

In this study, we concentrate on the impact of tourism in protected areas in an attempt to shed light on the relationship between the expansion of the “culture of the natural protected areas and national parks”, and touristic flow growth accounting for the arising benefits as well as the detrimental effects. If tourism can be a tool matching growth, development, and well-being of local population (Scarlett, 2021) it is important to understand duly to what extent tourist flows guarantee a positive contribution and when the struggle with disproportionate local development needs to start (Hammit & Cole, 1998; Manning & Lime, 2000).

The debate on the role that the tourism should play in the management and development of natural protected areas is increasingly topical and is closely linked to the prevailing definition of protected areas. The most widespread interpretative paradigm assigns to these protected areas

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a privileged role in biodiversity conservation and the experimentation of best practices (Philipps, 2003). Protected areas are active players in the economic and social development of the territory. Of particular importance in this context is the phenomenon of tourism, which, while it may pose a threat to the conservation of natural and cultural assets, is a key element in terms of knowledge, environmental education and economic and social development.

The Agenda 2030 is also moving in this direction. This plays a crucial role in guiding policies for sustainable tourism. In particular, UNWTO has recommended five key areas in which tourism should focus on to make a significant and systemic contribution to sustainable development: a) inclusive growth and sustainable economy; b) social inclusion, employment, and reduction of poverty; c) resource efficiency, environmental protection and climate change; d) cultural values, diversity and heritage; and e) mutual understanding, peace and security.

Sustainable tourism in protected areas, in accordance with the "European Charter for Sustainable Tourism in Protected Areas",³ can thus be defined as any form of tourism development, planning and activity that respects and preserves natural, cultural and social resources in the long term and contributes equitably and positively to the economic development and full realization of the people who live, work or stay in protected areas.

We refer to activities that can lead to processes such as the enhancement of local natural and cultural resources within specific territories, such as protected natural areas, the promotion of the economy, increased employment, and knowledge and awareness of local products and traditions. At the same time, however, the idea that tourists (even if only by their physical presence) transform the environment around them (Citi, Chitotti & Villa, 1999) is equally widespread. Anthropogenic overuse of the natural protected areas may not only disturb soils, vegetation, and wildlife, but it may cause an unacceptable community conflict" (Corbisiero *et al.*, 2021) if nothing is done on the paradigm of carrying capacity (Pigram & Jenkins, 2006), which means mainly protection of environmental resources (flora, fauna, hydrogeological resources, climate, landscape), and the quality of tourist experience.

Setting the goal of developing such tourism phenomenon, therefore, means finding an answer to such crucial questions as the following, for example: what anthropogenic activities are allowed? Is there a need to apply the concept of TCC to limit the number of entries? Or is it preferable to limit the number of people visiting a given protected area at the same time?

In its most generic form, TCC (World Tourism Organization, 1991) refers to the amount and type of use that can be accommodated in parks and related areas without unacceptable impacts to park resources and/or the quality of the visitor experience (Manning, 2001).

Technically, the TCC is a calculation method aimed at quantifying the optimal number of tourists that a given tourist location can support. At the base of the TCC, there are three different approaches: ecological, economic and social. The first refers to the maximum number of tourists who can be hosted in a particular site before the ecological balance is compromised. The second one, instead, refers to the economic aspect, which becomes optimal for a given territory when it is possible to maximize the net turnover (i.e., revenues minus costs) deriving from the tourism investments. Finally, through the social dimension, the TCC is measured as the maximum tourist density that you can have on a specific site so that the social characteristics of the local community are not compromised (Mondini *et al.*, 2009).

In our case, the concept of TCC is intended as a tool to measure the relationship between environmental protection and conservation and the economic development. The challenge of our field research was to consider a protected area not only in its environmental dimension, but also the touristic dimension in a perspective of participatory and shared sustainable development. Decision support systems such as the calculation of the TCC are in fact tools capable of assisting, facilitating, and supporting the governance processes of the territory (Farhan & Lim, 2010). Both

3 The European Charter for Sustainable Tourism in Protected Areas reflects world-wide and European priorities, as expressed in the recommendations of Agenda 21 adopted at the Earth Summit in Rio in 1992, and by the European Union in its 6th Environment Action Programme and Strategy for Sustainable Development.

environmental and touristic governance take into account local carrying capacities and must be able to satisfy the flexibility and complexity of dynamic systems, as well as integrate multidisciplinary approaches (Farhan & Lim, *op. cit.*).

In this sense, the TCC constitutes the appropriate tool to support touristic policies in environments subject (Marotta *et al.*, 2011). In this regard, the TCC constitutes a more appropriate consultation tool to impose guidelines for a more sustainable tourism, and to support the representation of the decision in the medium and long term (Van Kouwen *et al.*, 2008; Varghese *et al.*, 2008). The determination of the TCC therefore constitutes a very appropriate management tool for regulating recreational use and ensuring a quality tourist experience, without causing destruction of the physical, economic and socio-cultural environment.

In this scenario, the National parks, a specific category of protected natural areas, become the favourite place where to develop sustainable environmental tourism and where it is important to apply a TCC strategy. Nowadays the number of the natural areas tourism sector is very large in all the world. As indicated in the "Environmental certification in parks and protected natural areas" report, in Italy this phenomenon has been growing robustly in the last twenty years, so much that the number of Italian natural protected areas counted 210 locations by 2017 (ISPRA, 2018). Most parks and protected areas need visitor management to enhance values, in particular when tourism has become an integral component of the park (Eagles & McCool, 2002).

To this aim, the paper analyses the growth of tourism in the Vesuvius National Park (from now on VNP) calculating its TCC through the data collected by the Park during 2019-2020. The data used consider two dimensions of the phenomenon analysed: 1) a micro dimension, concerning the characteristics and habits of tourists (choice of the type of tourism, economic possibilities, etc.); 2) a macro component, concerning the economic characteristics and infrastructural equipment of Vesuvius and neighbouring municipalities (presence of parking areas, lawns, bus service, etc.). The micro data are obtained through the administration of 1000 questionnaires to a random sample of Vesuvius visitors, while the macro data are provided by the various institutional bodies involved in the analysis (ISTAT, Vesuvius National Park Authority, Municipal Police, etc.).

Following the hypothesis of tourism-led growth (Balaguer & Cantavella-Jord, 2002; Scarlett, 2021, *op.cit.*) combined with the concept of sustainability of the territory, we propose an analysis of the TCC to assess the degree of tourism pressure on the VNP. Unlike the analyses proposed in other empirical works (see among others Thomas *et al.*, 2005; Santos Lobo *et al.*, 2015; Cupul Magana & Rodriguez-Troncoso, 2017), we distinguish between TCC regardless of the effects of Covid-19 and TCC in the presence of Covid-19. In this way, we define an upper and lower limit of TCC which may certainly be more appropriate than a fixed value since the limits are strictly dependent on technology and on the interaction between physical, economic, and social factors (Carboni *et al.*, 2015; Carboni *et al.*, 2017; Benedetto & Carboni, 2017). The next thing we did was to change the monthly history series of the presence of tourists on the VNP, identifying the months of the year in which the maximum TCC spikes, and the months compared to which it goes lower. Here are the implications of economic policy to consider the two extreme cases.

The paper is organized as follows: *Section 2* provides information on the case study of Vesuvius National Park, the objective is to illustrate the characteristics of the territory studied; *Section 3* refers to the illustration and discussion about the empirical investigation describing the TCC, the dataset and the data analysis; *Section 4* presents the results and the policy implications; this discussion refers to a double calculation of the TCC that takes into account the case of "normality" and that of the health emergency caused by Covid-19; finally, *Section 5* draws some conclusions about the management of the protected area.

2. The case study of Vesuvius National Park (VNP)

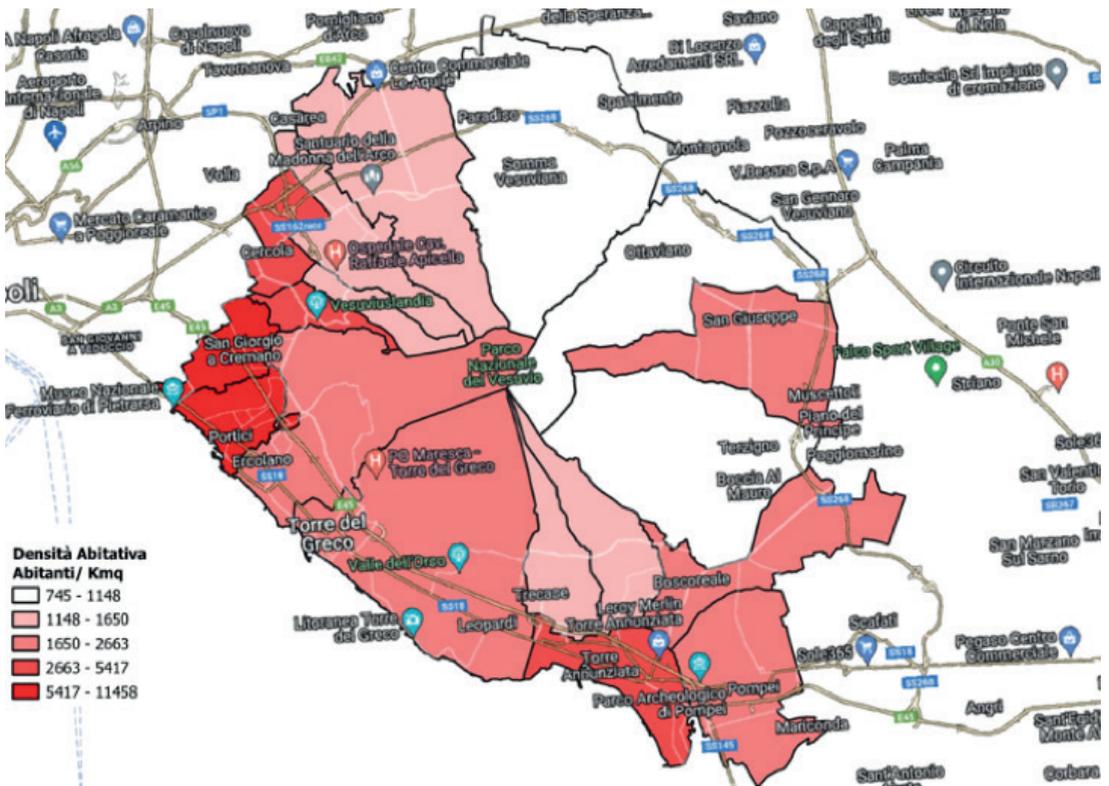


Figure 1 - Vesuvius National Park

Source: Authors

The Vesuvius National Park (VNP) is one of the 24 Italian parks (Ministry of the Environment, 2023)⁴ located in the Campania region, South Italy (Figure 1). It was established on June 5, 1995, to preserve animal and plant species, plant and forestry associations, geological singularities, paleontological formations, biological communities, biotopes, scenic and panoramic values, natural processes, hydraulic and hydrogeological balances and ecological balances of the Vesuvian territory. It occupies an area of 8,482 hectares and is present on the territory of thirteen municipalities.

VNP is one of the most anthropized parks, with 351,018 inhabitants (in 2011) and 72.59 km². A record holder with its urban density of 8% and the hundreds of thousands of residents in the immediate vicinity (Romano *et al.*, 2021).

The area represents an anomalous situation in the panorama of European natural parks, as the VNP also hosts one of the five most dangerous volcanoes in the world. In addition, the context is an area characterized by a deep socio-environmental impairment, so that it was declared in 1990, under Law 349/1996, - "area at high risk of environmental crisis" - due to the phenomena of pressing urbanization, illegal building and criminal activities (Sibilio, 2001).

From the naturalistic point of view, however, the territory of the Park is particularly rich and interesting. From the mineralogical perspective, Vesuvius is famous for being one of the richest territories of minerals of the planet: in the area over 230 different minerals have been catalogued; it is also possible to observe the deposits of different historical eruptions.

As for the vegetational and floristic profile, the trophic richness of the lava soils makes it one of

⁴ <https://www.mase.gov.it/aree-protette/mappa-parchi-nazionali> (last access: 1/02/2023).

the most fruitful areas for the presence of a great variety of species (in relation to the reduced extension). This prosperity makes Vesuvius a fertile land for agriculture. This territory is well known for the Vesuvian apricots, cherries, grapes (from which the DOC⁵ Lacryma Christi wine is obtained) and the famous tomatoes (also known as “piennolo” tomatoes).

The symbol for excellence is Vesuvius, one of the most known and studied volcanoes in the world. Although it is called the “gentle giant”, Mount Vesuvius the only active volcano recently erupted in Continental Europe (1944) and due to its position within a densely populated area, Vesuvius (and Etna as well) has been included in the list of “Volcanoes of the Decade”, a global list of volcanoes to be kept under closer surveillance edited by the International Association of Volcanology and Chemistry of the Earth’s Interior (IAVCEI, 2022).⁶

The presence of small fumaroles on the Great Cone is the sign of its “active rest” state. Vesuvius attracts millions of tourists every year. It is a typical example of a walled volcano consisting of an external truncated cone: the Monte Somma. It has a crater belt largely demolished within which there is a smaller cone represented by Vesuvius itself. Mount Somma and the main cone of Vesuvius are separated by a hollow called “Valle del Gigante”, part of the ancient caldera, where later, presumably during the eruption of 79 AD, the Great Cone or Vesuvius was formed.

There are eleven paths that can be explored along Vesuvius, which every year sees hikers coming from all over of the world. Among these, the most famous is definitely the n.5,⁷ the “Great Cone” (see Figure 2), which allows tourists to live a unique experience, walking along the crater of a volcano, enjoying the view over much of the Campania region and even reaching sometimes the southernmost part of the Lazio region (central Italy).

Figure 2 - The “Great” Cone (Il Gran Cono)



Source: Authors

5 DOC is an Italian certificate of quality, and it indicates “Controlled designation of Origin”.

6 <https://www.iavceivolcano.org/> (last access: 11/12/2022).

7 The other trails:1) The Valley of Hell; 2) Along the Cognoli; 3) The Mt Somma; 4) The Tirone Reserve; 6) Matrone Road; 7) The Profica Valley; 8) The Rack Railway; 9) The River of lava; 10) The Olivella; 11) Terzigno Pinewood. Among these paths, to date, six are not walkable due to maintenance work.

3. Materials and Methods

3.1 *The Tourist Carrying Capacity*

The problems that the tourism activity entails and the need to manage them adequately have led to the development of specific tools capable of providing an answer to the possibility of supporting certain tourist flows for a certain location. In this perspective, the concept of the carrying capacity of an area bears great importance, that is, the limit beyond which the territory is no longer able to sustain the exploitation of internal resources with a consequent loss of autonomy. The node around which we discuss, in order to define the load capacity of an area, is therefore the identification of the critical threshold beyond which it is no longer possible to withstand new pressures of anthropogenic origin.

With special reference to tourism, a well-rated empirical tool is the TCC, which refers to the analysis of the impacts related to tourism and the related consumption of resources. According to the definition of the World Tourism Organization, "the Carrying Capacity of a tourist location is constituted by the maximum number of people who visit, in the same period, a given tourist location, without compromising its environmental, physical, economic and socio-cultural characteristics and without reducing the satisfaction of tourists" (WTO, 2000).

TCC is a concept that can change significantly according to the specific context of reference, as the relationship between intensity of use and user satisfaction changes considerably as the type of "tourist product" concerned varies. It is obvious, for example, that the expectations of a hypothetical tourist who goes to a natural area will not be the same as those of a user of destinations with a strong tourist infrastructure (Coccosis & Mexa, 2002).

Each tourist area is therefore characterized by its own specific "carrying capacity", defined primarily in environmental terms, but also from a social and economic profile (expectations of tourists and residents, suitability of the territory, perception of the tourist phenomenon, of the opportunities and inconveniences that derive from it for the population, etc.).

TCC can also be imagined as an interval within which the sustainable development process of tourism occurs. The upper limit is the intensive development of the tourist resource; in this case it is the classic example of development led by external investors, who only have as their objective the maximization of profit. The lower limit, on the other hand, is defined by the tourism development option on "soft" forms of tourism; in this case the fundamental reference is the hyper-conservative approach of the territory, where tourism is experienced only as a threat and not as a resource. Between these two limits of "maximum" use of resources and "minimum" interest in tourism, there is the carrying capacity approach, understood as the realization of the concept of sustainable tourism (Michelangeli *et al.*, 2006).

The study of the carrying capacity therefore aims at defining the condition of tourist "sustainability" of a locality, understood as the ability to sustain a given influx of tourists over time, and the consequent use of available local resources. In practice, therefore, the TCC consists of a number, that is the number of tourists that can be tolerated by a territory compatibly with the maintenance of environmental standards and the quality of the service offered, by taking into account the "objective" environmental limits, legislation, pre-existing planning and the wishes of the local community. A condition that cannot and must not be forgotten in tourism resource planning is that tourism must lead to economic development, and that this must be programmed to represent a long-term resource.

The methodology for calculating the TCC was formulated by the United Nations Environment Program (UNEP, 2002). We follow an economic approach that is characterized by the maximization of the revenue function resulting from the tourist flow that affects the location but imposing that this does not cause adverse effects on the physical, cultural, and social environment (Costa & Van der Borg, 1988).

The problem of determining the TCC can be translated into a linear programming problem. In particular, the income function obtained will be the objective function to be maximized, which is however subject to a system of constraints.

In the case of the VNP, the definition of the income function to be maximized was made explicit in relation to the three different types of tourists who visit the Park and from which information was collected through a specific questionnaire administered to tourists during their visit to the Park:

- 1) tourists who use hotel facilities (TA);
- 2) tourists who use extra-hotel facilities (TE);
- 3) excursion tourists (ES), who make the visit within a single day, without therefore staying overnight in the Park.

The three different types of tourists have their own average expenditure which allows us to derive the following objective function of the linear programming problem:

$$MaxU = c_1TA + c_2TE + c_3ES \quad (1)$$

where U is the total daily tourist expenditure in the VNP, and c_i the average daily expenditure per capita for each of the types of tourists considered. The maximization of the objective function will be subject to the following constraints:

where:

$$a_{i,ta}TA + a_{i,te}TE + a_{i,es}ES \geq Z_i \quad (2)$$

- Z_i is the maximum tourist reception capacity of the VNP;

- a_i are the coefficients that measure the amount of daily use of the i -th tourist (TA, TE, ES).

The income function to be maximized is then subjected to economic, environmental, and social constraints. In our case, the constraints of the function that maximizes the income derived from tourism spending have been identified by taking into account both the characteristics of the park's territory and the way each visitor uses the resources.

Based on the analyses carried out for the VNP, the constraints are specified with reference:

- A** the number of beds in hotels;
- B** the number of beds in extra-hotel facilities;
- C** the daily bus transport capacity;
- D** the availability of parking spaces for private cars;
- E** the ability to accompany visitors to the crater.

It follows that our function to be maximized will be subjected to as many as five constraints.

3.2 Data Collection

In this section we present the variables used to implement the TCC analysis. In particular: 1) micro variables were taken into account to characterize tourists and derive the income function to be maximized; 2) macro variables to characterize the territory and to derive budget constraints. The micro variables were collected using a questionnaire administered to a sample of 500 visitors. The macro variables were collected using information provided by local police and official statistics sites (e.g., Istat)⁸ and were recorded in 2019.

3.3 The Income Functions

To explain the income function to be maximized, it is necessary to define the average daily expenditure associated with the three types of visitors (micro data). To this end, reference was made to the data of the questionnaires filled in by visitors to the park. The values derived from the answers are the following:

⁸ <https://www.istat.it/it/> (last access: 15/04/2022).

- Average daily expenditure of hotel tourists 80.00 euros;
 - Average daily expenditure of non-hotel tourists 40.00 euros;
 - average daily expenditure of excursion tourists 20.00 euros;
- As for the macro variables necessary for the definition of budgetary constraints, we have considered the following variables:
- A. beds in the hotel. The beds in the 4, 3, 2 and 1 star hotels located within the 13 municipalities adjacent to the Park were considered. In this regard, the overall availability of beds is equal to 1,642 units.
 - B. Beds in extra-hotel facilities. Reference was made to beds in rented accommodation, in agri-tourism or bed-and-breakfast accommodation located within the 13 municipalities adjacent to the Park. The total availability is 410 beds.
 - C. Daily public transport capacity. For the determination of the public transport capacity, reference was made to the public and private bus service that can reach the square located near the crater at an altitude of 1,000 meters.

To quantify the actual transport capacity, we have considered the transport service that allows you to reach the Great Cone of Vesuvius from the neighbouring towns (Naples, Pompeii, Herculaneum). In particular, the estimate was made on the basis of the information made available by the transport companies about the timetables, the frequency of the service and the average transport capacity of the buses used. The survey results are as follows:

Ente Autonomo Volturno s.r.l. Trasporto Automobilistico (EAV). The average transport capacity of the vehicles of the company that carries out the service is equal to 35 passengers per bus, the number of daily trips is equal to 10; therefore, the daily transport capacity is equal to 350 passengers per day.

Busvia del Vesuvio. The average transport capacity of the vehicles of the company that carries out the service is equal to 27 passengers per bus, the number of daily trips is equal to 6; therefore, the daily transport capacity is equal to 162 passengers per day.

Vesuvio Express. The average transport capacity of the vehicles of the company that carries out the service is equal to 16 passengers per bus, the number of daily trips is equal to 10; therefore, the daily transport capacity is equal to 160 passengers per day.

Overall, the number of tourists who can reach the Crater area by bus is therefore equal to: 672 passengers per day. In micro terms, we know from the questionnaire that respectively 22.8% of hotel tourists, 14% of extra-hotel tourists and 63% of excursion tourists use the public transport service.

- D. Availability of parking spaces for private cars
The VNP can also be reached by car. For this reason, we have taken into account the parking spaces made available by the municipality; in particular, the number of blue stripes⁹ located near the square in front of the crater was taken into account. There is an availability of 170 parking spaces. Considering a rotation of two cars per space per day and assigning a maximum number of 4 passengers per car, the maximum number of visitors who can access the Crater using the car is 1,360 visitors per day.
- E. The ability to accompany visitors to the crater
Based on the information provided by the volcanological alpine guides of the Campania Region, which provides the obligatory escort service, we have considered the maximum number of tourists who can safely visit the crater. Taking into account the average time required for the visit (from 1.5 to 2 hours approximately including the stop on site) and the availability

⁹ The blue stripes are the ones that delimit the paid parking areas.

of the daily service provided by tourist guides, the maximum daily number of tourists is 1600 units.

Due to the Covid -19 pandemic, the maximum number of visitors that can access the Great Cone area has been reduced to 15 people every 15 minutes, so the maximum number of visitors per day is 540 people. By varying this value and keeping the other variables constant (because it appears to be reasonable as they are not affected by Covid-19), we can implement a second TCC analysis that takes into account the health emergency triggered by Covid-19.

Taking into account the above data, the linear programming problem to obtain the TCC of the VNP is the following:

$$MaxU=80.00*TA+40.00*TE+20.00*ES$$

subject to constraints:

A) $1.000 TA + 0.000 TE + 0.000 ES \leq 1,642$
B) $0.000 TA + 1.000 TE + 0.000 ES \leq 410$
C) $0.228 TA + 0.140 TE + 0.632 ES \leq 672$
D) $0.110 TA + 0.362 TE + 0.528 ES \leq 1,360$
E) $1.000 TA + 1.000 TE + 1.000 ES \leq 1,600$

4. Results and Discussions

From the previously processed data, it is possible to define the values of the income function in the period of maximum crowding and the TCC for the VNP disaggregated by type of tourists. The results are shown in Table 1 and also take into account the constraint imposed by Covid-19. Our analysis will be based only on 2019 data due to the Covid-19 emergency which had devastating effects especially on tourism. To make the analysis more interesting, we do a double calculation of the TCC that takes into account the case of "normality" and that of the health emergency caused by Covid-19. Covid-19 represents a transitory shock that we use to define a lower limit of the TCC. The definition of a range of variation of the TCC is also important to define a potentially valid rule to reduce the tourist pressure in the VNP. Specifically, Covid-19 has made it possible to introduce rules of conduct to reduce the risk of contagion and among these rules, in the case of the VNP, a new dimension has been defined for groups of visitors who must alternate in defined time slots. In these terms, Covid-19 could make it possible to define a minimum of tourist flow below which it would be appropriate in terms of economic sustainability not to go.

Table 1. Results of the model for the calculation of the Tourist Carrying Capacity for the Vesuvius National Park

Results of the TCC	No Covid-19 constraint	With Covid-19 constraint
maximum possible revenue	128,000.00 € per day	43,2000.00 € per day
<i>Maximum number of hotel tourists</i>	<i>1600</i>	<i>540</i>
<i>Maximum number of extra-hotel tourists</i>	<i>87</i>	<i>30</i>
<i>Maximum number of excursion tourists</i>	<i>488</i>	<i>165</i>
Maximum daily visitors	2,175	735

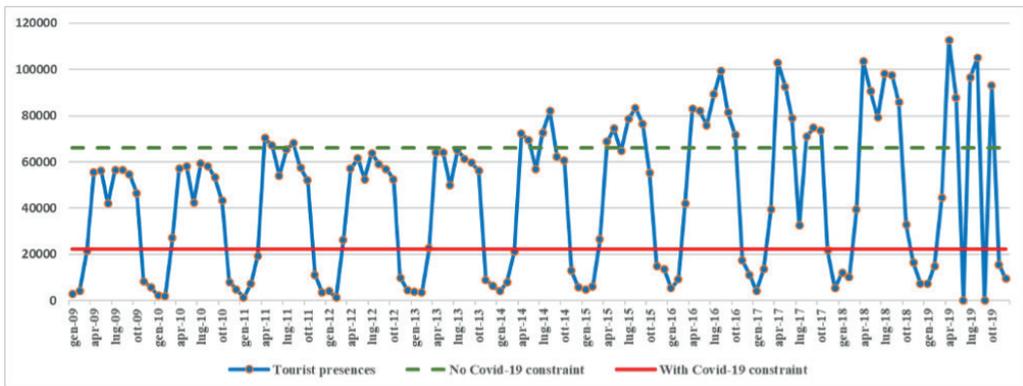
Let's move on to the comment on the results to verify whether the current model of tourism in the VNP is sustainable or not. There is no "magic number" in the literature for comparison to

determine what the actual TCC of a tourist area is; this is due to the fact that each destination has its own peculiarities that imply a different tolerance to anthropogenic impacts and moreover, the actual number of “sustainable” tourists in a location largely depends on how tourist flows are managed. All this leads to the affirmation that the TCC must be interpreted as a dynamic concept and as the starting point for the implementation of monitoring and management projects of tourist flows.

In our case, a numerical reference was obtained for each of the three types of tourists present in the Park. By summing up the three values, the total daily TCC is obtained, which is equal to 2,175 tourists per day in the case of no Covid-19 constraint and equal to 735 tourists per day in the case of with Covid-19 constraint. Tourist income amounts to 128,000.00 euro per day. Tourists who use hotel facilities contribute to this turnover to a greater extent, followed by excursion tourists and tourists who use extra-hotel facilities. Furthermore, by inserting the limitation of the maximum number of visitors to the Crater caused by the Covid-19 health emergency, the revenues are reduced to 43,200.00 euro per day; a daily reduction of approximately 33.75%.

Considering the monthly TCC value in both cases, we obtain that it is equal to 66,156.25 and 22,356.25, respectively in the case of no Covid-19 constraint and with Covid-19 constraint. In this way we obtain a confidence interval with respect to which we define a lower and an upper limit of TCC (Figure 3). At this point, comparing the maximum annual load value of the year 2019 with and without Covid-19 constraint, with the total number of presences recorded from 2009 to 2019, it clearly emerges in the first four years of the tourist presence series (2009-2010- 2012-2013) that the TCC is never exceeded; while the TCC with Covid-19 constraint is always exceeded, except in the winter months (December, January and February). For the years following 2013 (including the year 2011), the TCC without Covid-19 constraint is always exceeded in the hottest months ranging from April to October, while it is never exceeded in the remaining months of the year. Furthermore, the winter months continue to be characterized by a low tourist flow such as not to exceed the TCC with Covid-19 constraint.

Figure 3. Time series of tourist presences in the VNP, maximum number of visitors without the constraint from Covid-19 (upper limit), maximum number of visitors with the constraint from Covid-19 (lower limit)



Authors' elaboration

The results obtained allow us to make a consideration: the flow of tourists in the Park does not need to be numerically reduced, but should simply be managed in a better way, achieving a more homogeneous redistribution throughout the year. A redistribution that presents a more or less constant number of tourists for each month, while aware of the fact that certain periods are more attractive especially for climatic reasons. Other months, on the contrary, have a very low attractiveness which turns out to be so low as to present several tourists lower even than the TCC deriving from an extraordinary situation represented by the pandemic caused by Covid-19.

Another reflection derives from the evaluation of the optimal distribution between the different types of tourists deriving from the calculation of the TCC and the real situation. In particular, from the evaluation of the data in possession, it is immediate to verify how numerous excursion tourists are, with all the negative peculiarities that derive from it: less economic impact, less involvement in the activities organized by the "Park Authority", less interest in eco-friendly tourism.

The "typical tourist" of the VNP generally does not reflect the profile of an eco-tourist ideal-type. Aiming to set up a program to improve the management of tourist flows, it can be said that the main points on which action is required are as follows:

1. seasonal adjustment of tourist flows, with the creation of attractions even for the months of lower turnout and incentives for tourists who decide to go to the Park during the aforementioned periods;
2. conversion of a high share of excursion tourists into hotel and non-hotel tourists;
3. promotion of sustainable tourism, with a tendency to seek out tourists who show interest in the protected area and the naturalistic and cultural activities organized in it;
4. monitoring of tourist flows, in order to have the exact perception of how many tourists are actually present in the Park on a given day;
5. development of some procedures with a lower environmental impact, such as, for example, incentives for public transport compared to private transport, enhancement of routes to be made on foot rather than by car, development of an efficient waste collection system, etc.

The results obtained testify that the VNP area is, on the one hand, of high naturalistic value and therefore very attractive for tourists, although, on the other, it needs some interventions in order to improve its management. Several factors limit the ability of VNP to apply the carrying capacity modeling system proposed in these pages. These include insufficient budgets and personnel, limited technical expertise, frequent changes in park management over time, a very weak governance network and the long times required to get funds by Italian government (Corbisiero *et al.*, 2021, *op. cit.*). Although several factors have improved the ability of Italian National Parks to make such commitments in compliance with the carrying capacities related to sustainable tourism, the empirical analysis shows the presence of major limits linked to the distribution of the tourist flow during the different months of the year. An even distribution of tourists during the months of the year should be encouraged, trying to guarantee a tourist flow within the defined empirical interval with the aim of combining economic and environmental sustainability. To this end, policies aimed at achieving the five objectives proposed above seem appropriate.

5. Conclusions

In conclusion, we can argue that the promotion of sustainable tourism in a protected area brings into question design processes capable of linking the different actors involved and the different goals to be achieved. To this end, it is necessary to know accurate and up-to-date data on tourism flows in parks. It is clear, in fact, that knowledge of the size and characteristics of visitor flows, impacts and benefits generated by tourism from an environmental, economic and social point of view, the willingness to pay for the introduction or improvement of certain services or quality standards, the expectations of tourists and the degree of satisfaction achieved as a result of the visit, are fundamental elements for tourism planning and the achievement of the related sustainability goals.

For this proposal, reconstructing the critical issues that arise in these areas provides food for thought on these policies and TCC. It is indeed evident, according to the field work data research (Corbisiero *et al.*, 2021), that a significant percentage of tourists, when visiting a park, do not

know that they are inside a protected area. From our point of view, it is necessary to raise tourists' awareness to encourage true ecological and nature tourism. In this way, tourists also become interested in the management policies of the protected area. In addition, day hiking is, as we have seen, predominant. The numbers we have illustrated show how the park is interpreted as a "hit and run" product, to be consumed quickly and understood as a stop within a journey that contemplates other destinations.

This article contributes to enrich the literature on TCC applied to a National case study. Unlike other works on TCC, we define two thresholds with respect to standard analyses in order to think about a possible balance between economic and environmental sustainability of tourism. From the empirical analysis, a problem with the distribution of tourists emerges during the various months of the year. We move from a tourist flow greater than the upper limit, generating on the one hand a problem of congestion and on the other promoting the economic growth of the area concerned, to a tourist flow below the lower limit, generating on the one hand greater sustainability of the Park and, on the other hand, a reduction in economic revenues. The objective of the policy makers should be to favor a balance of economic and environmental sustainability, thus spreading the tourist flow in a homogeneous way during the the year. In other words, the flow would need to settle within the sustainability interval generated by the empirical analysis (TCC net of Covid-19 and TCC in the presence of Covid-19).

The case study of VNP is important because it helps the understanding of socio-economic interactions of different drivers in the sustainable growth of tourism. Our findings also show the importance of area conditions in validating specific models of management of natural areas. All in all, for promoting sustainable territorial development, the VNP management model seems to be better suited to achieve this goal, although it presents the weakness of regional and national government about this process. The good results achieved in terms of touristic hospitality and touristic fluxes improvement from the present management of this National Park are only a part of the process of sustainability of the area. A shared planning process should be started that creates new infrastructures and services or enhances those already existing, promoting the tourist potential in each municipality within the area of Vesuvius Park. An action of this type could certainly incentivize the local economy to move towards tourism, favoring, consequently, the strengthening of the accommodation offer and enhancing the multiple attractions present in the territories. To conclude, the VNP still has a long way to go to become a sustainable touristic best practice, but the potential for it exists.

From a closely operational point of view, it is possible to suggest further improvements in the sustainability analysis of tourism in VNP. In particular, following Cifuentes (1992; 1999) it will be appropriate to take into account in the future analysis of TCC also the social factors or qualitative aspects of the visit. Specifically, with social factors we mean the perception of visitors and the quality of the visit. These factors can change in relation to the type of area visited and are conditioned by a certain subjectivity, since each individual has a different perception. However, it is a fundamental component when it comes to protected areas or tourist destinations in general, as it can significantly affect the tourist and economic development of the place. In this regard, Buhalis & Law (2008) try to provide a measure of this fact. Specifically, these scholars affirm that the Internet is one of the most influential technologies that have recently changed tourist behavior. In fact, travelers like to share travel experiences and recommendations with others and as a result virtual travel communities are among the most suitable places to publish travel diaries and comments on a tourist destination. Furthermore, according to Fotis *et al.* (2012), the electronic validity of word-of-mouth present on websites is particularly emphasized since social media content is very often perceived as more reliable than official tourism or mass media advertising. TripAdvisor is among the most successful social networks in tourism as it provides reviews and comments written by its members as well as information relating to satisfied or disappointed visitors (Carboni & Pungetti, 2018). In order to integrate the model and also evaluate the social factors, it would be appropriate to analyze the comments of the visitors of the VNP to define and

understand the reasons for the satisfaction or the grievances of the visitors and what went wrong in their experience of visit, all to propose corrective actions and improve the quality of the visit in the Park (Corbau *et al.*, 2019). Once the social factors related to the VNP have been measured, it will be possible to enrich the TCC analysis to define more targeted policy recipes that take into account the guidelines emerging from the opinions of visitors.

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