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PROMOTION OF SUSTAINABLE TOURISM IN MARGINAL RURAL AREAS: A GIS DATABASE FOR THE PLANNING AND THE DEVELOPMENT OF EQUESTRIAN TOURISM (CASE OF STUDY IN TUSCANY - ITALY)

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Abstract: A form of rural tourism in expansion is horse tourism. Equitourism is a form of hiking that allows for an intimate and natural use of landscapes and local territories. Equestrian tourism today no longer represents a small elite market niche, as it has become a true form of pastime for an increasing number of users. Trail planning and management need to consider the changes that are already occurring, as well as those that are predicted to lie ahead. The key trends that are expected to have an impact on recreational horse trail planning and management are highlighted in this research. Many of these trends have been emerging over decades and have rapidly increased due to the impacts of the COVID-19 pandemic. In recent years, in many Italian regions, especially in Tuscany, thanks to the enhancement of the Tuscan equestrian routes, projects for the promotion of equestrian tourism have been developed. In this work the methodology applied was based on the identification of an appropriate database created in the GIS context and specifically coded for equestrian tourism. The aim is to guarantee the creation of an innovative and functional product to meet the needs of this sustainable tourism sector, providing information capable of facilitating the end user, who, through their GPS, georeferenced images and maps, will have the possibility of planning and traveling the horse trail in complete safety. The final result of this research (the first case study in Italy) is the creation of a modern and complete information database of a horse trail that can be managed using GIS.

Key words: sustainable tourism, equitourism, horse trail, information database, Geographic Information Systems

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INTRODUCTION

Horse riding in Italy and in Europe in general has become big business (in France, it is the third biggest sports federation, with around 700,000 members in 2016). The number of riders in Italy is one of the highest in Europe, and the Tuscany region is considered the number one equestrian tourism and outdoor destination, with an institutional network at every administrative level in the country (regional and departmental) and around 1,000 businesses specializing in equestrian tourism (and/or stabling) and 30.000 km of equestrian trails (Italian Equestrian Tourism Federation, 2016).

In the Tuscany region, there exists 4000 km of equestrian trails designed by various associations, of which only 500 km has been identified by public administrations without any official design criteria or methodology. Equestrian tourism is a non-competitive riding practice, which is combined with an exploration of the territory.

It favors slow travel and being immersed in nature, having the concrete possibility of encountering the rural environment made of history and ancient flavors. Horse-riding tourism is open to a large number of people. The equestrian tourist can be either a professional sportsman or an amateur. Horse-riding tourism is a tool for the sustainable development and enhancement of the territory because of the following:

- It respects the environment (it is an ecotourism practice);
- It favors the discovery of the territory, its history and its culture;
- It promotes the recovery of ancient crafts;
- It promotes the discovery of gastronomy and typical products;
- It allows for the maintenance and use of ancient rural paths;
- It promotes human relationships through encounters between riders and local populations;

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- It promotes the possibility of farms, above all in marginal rural areas, to maintain themselves by offering accommodation for riders (agritourism) and diversifying horse breeding (equitourism).

There are many recreational activities that can be practiced outdoors: hiking, walking, paddling, biking, bird watching and horseback riding are the main travel motivators. These activities are intricately linked to the tourism development process, and they are often developed by entrepreneurs within the community.

However, existing tourism development models often do not consider the importance of outdoor recreational tourism, which is studied much less than other forms of tourism, such as equestrian trail tourism (ETT). Effective land management plans are required to favor the proper multi-use of trails by different kinds of tourists, avoiding conflict between horseback tourists and other tourists (Beeton, 1999). Multi-use trails can be successfully managed by integrating trail management strategies, persuasive communication theories and marketing (Beeton, 2006).

According to the International Ecotourism Society, “ecotourism” is defined as "Responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education". The riders are visitors who create a positive impact on the local community and the environment. A good sign of responsibility and sustainability is a horseback riding business that follows the area’s guidelines. Horseback riding is a great way to relax and take in all that nature has to offer. One can encounter all kinds of wildlife and beautiful flora while horseback riding in various locations around the world. Equestrian tourism, as with other forms of “soft tourism”, requires excursions and holidays to be carefully prepared beforehand with great professionalism (services are organized by riding centers or specialized tour operators) or with the skills of experienced riders (planned several days in advance, using up-to-date technology: downloading maps and routes, and increasing the use of GPS).

A correlation between equestrian tourism and sustainable development exists, and it is essentially dependent on the actions of the local authorities, associations and institutions. In summary the highlights are:

- A network of routes and historical itineraries are essential for the development and promotion of rural tourism, as they promote forms of sustainable mobility in rural areas, particularly in marginal ones.

- The recent European explosion of rural tourism is undoubtedly the result of two phenomena that have only recently become far-reaching:

- The "environmental question", relating to the growing human impacts (air, water and soil pollution) both in cities and in the countryside;

- The growing attention paid to the quality of life, also increasingly judged in terms of the actual accessibility and usability of green areas, as well as the offer of recreational opportunities.

- Equestrian tourism represents a strategic segment of a new tourist offer based on sustainable development criteria.

- The importance of spatial information has been defined by the European directive 2007/2/EC, INSPIRE (acronym for INfrastructure for SPatial InfoRmation in Europe). The directive aims to create spatial data infrastructures in the European Community.

- The research actions can be summarized as follows: (a) a complete GPS survey of a horse trail network, of the variants and of the equestrian stops; (b) the checking of the feasibility and practicability of the entire route for horse users; (c) the identification of critical issues along the route; (d) the identification of temporary and night staging points for horses and riders; (e) the identification of points of interest (PUNs), such as panoramic points and points of historical, religious, cultural and natural interest; (f) the planning of the installation of signs and the locations of points where vertical signs have to be placed; and (g) the drafting of an information database of the Monte Pisano horse trail.

- The cartographic database collecting information for the management and maintenance and the GPS survey of the routes, the equestrian variants and all the points of interest allowed for the realization of an innovative and functional project addressing the needs of this tourism sector.

Sustainability and horse riding

For equine tourism, environmental sustainability is probably the most difficult and least addressed aspect of the sustainability triad. Issues of overuse, particularly the impact of large numbers of horses on plant species on ridden trails, have been a significant concern in the literature. Similarly, to the impact of large numbers of ramblers on sensitive mountain habitats, concerns have been raised about the negative impacts of equine tourism, primarily in terms of ground disturbance and the diffusion of exotic seeds in manure (Newsome et al., 2008). Many of the objections to the riding of horses in national parks and outdoor recreation areas actually appear to be perceptions rather than facts, and many of these perceptions focus on aesthetic concerns. As documented by Newsome et al., 2008 other user groups often disapprove of the equine use of wilderness areas, and this is often expressed as perceptions of negative environmental impacts. As Newsome states in other studies, however, whilst soil compaction and the other impacts of hoof prints are definite issues, the impacts of other aspects of horses’ presence are mainly aesthetic—in terms of seeing/smelling muck or encountering excessively noisy parties of riders on trails. Interestingly, there are claims that many walkers surveyed “had actually not encountered horseback groups, with many of their attitudes not based on actual experience.

Those walkers who had encountered horseback tour groups had a more positive attitude towards them than those who had not”. It remains clear, however, that there is a need for more research on how to set acceptable levels of equine use, both on dedicated bridleways and in open countryside. In this research, for the identification of horse trails, we chose roads that are suitable for horses and that do not suffer damage from trampling. These forest roads and tracks, due to the fact that they were created for the passage of only cars for the management of the woods, limit the damage to horses, are not very busy and always have a natural background. Equestrian tourism represents a strategic segment of a

new tourist offer based on sustainable development criteria. So, horse-based tourism can affect traditional economic sectors. Regarding the growth of equestrian tourism, it is essential that research is conducted to determine how to properly plan and help ensure that this product is a sustainable option for the local community (Kline, 2015).

Equestrian tourism represents a new strategic segment of rural tourism and a new opportunity for farms

Bruch, 2013 states that horse-based tourism can be classified as ecotourism, involving farms. It is already a fundamental part of the rural tourism sector in many countries, such as Iceland (Helgadóttir, 2008). In order to become sustainable, a tourist project needs to involve various kinds of stakeholders at national and local levels, as well as from business to ecological and territorial representatives (Butler, 1999). The vertical quasi-integration of a network of small- and medium-sized firms maintaining relations, which are as competitive as they are cooperative, could be particularly well adapted to equestrian tourism. Equestrian tourism requires an image of a "Horse" associated with an area linked to the presence of a set of activities (equestrian culture, shows, sports events and tourism on horseback), as well as with the way they are networked (marked equestrian routes, accommodation, sites and shows). Equestrian tourism makes it possible to keep the farms located along the horse tracks running, and farms are instruments for the sustainable development and enhancement of the territory (Luloff et al., 1994; Sharpley, 2000). The presence of well-managed farms is fundamental, favoring people's discovery of the territory and its history and culture, gastronomy and typical products (Hoefle, 2016; Lee et al., 2015; McAreavey et al., 2010; Saxena et al., 2007).

Furthermore, the presence of farms allows for the maintenance and use of ancient rural paths (Bambi et al., 2019). This is very important for more peripheral regions, where the emergence of new sectors has not been able to overcome the reduction of rural communities' economic opportunities, the declining of public service provision and the deficits of infrastructure. In marginal areas, characterized by high-quality landscapes, horse tourism could have a great potential for growth in the presence of other factors, i.e., infrastructure (Mastronardi et al., 2017). As stressed by several authors (Cristóvão et al., 1999; Baum et al., 1999; Eusébio et al., 2017; Kastenholz et al., 2008; Wilson et al., 2008), one of the most popular non-traditional rural development strategies has been tourism and complementary businesses, such as recreational activities, arts and crafts. A network of routes and historical itineraries are essential for the development and promotion of rural tourism, as they promote forms of sustainable mobility in rural areas, particularly in marginal ones. In Kentucky, the economic value of riding trails is noted with reference to the local rural economy (Hackbert et al., 2011). With regard to equestrian tourism, horse riding is a popular, high-impact recreational activity carried out worldwide. Horses have been used for tourism activities in various countries, such as Australia (Beeton et al., 2001; Ollenburg et al., 2005), Finland (Räbinä, 2010), France (Pickel-Chevalier, 2015), Hungary (Könyves, 2009; Iceland Helgadóttir, 2006; Schmudde, 2015). Moreover, wild-horse-based tourism is taken into account as an important part of tourism in some places, such as in the western US and western Canada (Notzke, 2016).

However, the study of equestrian tourism lacks a clear definition of what constitutes horse-related tourism. Instead, there is a range of definitions and interpretations, as well as diverse terminology, including horse-based tourism, equestrian tourism, equine tourism, riding tours, horse rental, horseback riding, horsemanship travel, equestrian vacation, riding vacation and equestrian holiday (Buchmann, 2017). Notzke (Notzke, 2016) focused on the core element of equestrian tourism, travel on horseback and the role of equine animal agency in the co-creation of tourism experiences and tourism places. In future research Newsome et al., 2008 recommended paying more attention to experimental design, with research spanning across and into new ecosystems to improve the generalization of findings, and they also recommended researching management effectiveness.

The creation of a modern database for the management of linear and punctual data of equestrian routes

The main objective of this work is to describe the setting up of a specific and modern correct database with the aim of managing linear and punctual data of equestrian routes. Good management of these data allows for the promotion of local development and the enhancement of rural tourism. In particular, in this study, the construction of the information database was carried out within a research project for the design, survey and promotion of the horse trail of Monti Pisani in a Tuscan region in Italy. This project finds its purpose in the will to create a sustainable hiking network expressly dedicated to the use of the territory through horses. The creation of an information database relating to the equestrian project allows one to obtain a product that represents an opportunity to optimize territorial and tourist management.

Furthermore, this tool allows public administrations to have a spatial data infrastructure that is standardized at national and European levels and, therefore, can be shared with other management institutions. At the European level, the importance of spatial information is defined by the European directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007, which established INSPIRE (acronym for INfrastructure for SPatial InfoRmation in Europe), Directive INSPIRE. Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community). The INSPIRE directive is a project of the European Commission with the aim of creating spatial data infrastructures in the European Community. It arised from the need to make large quantities of spatial data (of multiple forms and origins) sharable in order to constitute a single infrastructure for spatial information at the European level based on infrastructures operating at the national level.

The Italian legal system has implemented the European directive 2007/2/EC of the European Parliament with the legislative decree of 27 January 2010, n. 32, which, in Italy, establishes, the national infrastructure for spatial information and environmental monitoring as a node of the community infrastructure. The documentation and accessibility of the Public Administration's knowledge assets are the basis for encouraging both reuse by other public bodies—to ensure the

consistency of various decision-making processes based on the same information—and use by citizens and companies in participatory and productive processes, as well as to encourage the maximum transparency of decision-making processes and administrative activity. The creation of a Equestrian infrastructure database data can simplify the sharing of the spatial information between public authorities, to facilitate public access to environmental spatial information across Italy and Europe and assist decision-making processes concerning the environment and the territory.

The creation of a specific database for horse-riding tourism is was based on 5 principles:

- More efficient management – data should be collected once and maintained where this can be done more efficiently;
- Interoperability – it must be possible to combine data from different sources and share them between several users and applications;
- Sharing – it must be possible to share information picked by the various levels of government;
- Abundance and usability – the geographic information essential for good governance must exist and be truly accessible to conditions that do not restrict the possible use;
- Availability and access – it must be easy to identify which geographic information is available, to evaluate its usefulness for their own purposes and conditions under which you can get it and use it.

MATERIALS AND METHODS

With regard to the regional geographic infrastructure, this consists of a set of tools that allow cooperation between entities for the management of the regional geographic information database, with reference to the guidelines formulated by the European Union in the context of the EU INSPIRE Directive. The region of Tuscany, as part of the actions aimed at the expansion of knowledge, enhancement and protection of its environmental and territorial heritage, favors the development of hiking activities as a tool to achieve a balanced relationship with the environment.

It also promotes the recovery of viability through the creation of a hiking network and trails. The Tuscan hiking network, called R.E.T. (Regional Law 20 March 1998, n. 17 "Tuscany hiking network and discipline of hiking activities", Consolidated text of the regional laws on tourism; Firenze, 17 January 1998), is a set of roads, mule tracks, paths and tracks that, located outside of urban centers and inserted in a special land register, allow for hiking. With regard to the standardization of the information models of geographical data and the sharing of methodologies among the local Tuscan authorities, the information and technical data on the R.E.T. (Tuscany Hiking Network) paths must be archived and organized in a specific cadastre, containing the minimum number of information layer archives relating to the implementation of the database of Tuscan paths. In drafting the specifications, the region paid particular attention to defining the coding of the paths so that (a) each path can be easily identified by the hiker on the ground and on hiking maps and (b) the univocal identification of the Tuscan paths in the whole national territory is allowed. A characteristic element of the archive is the "path" from whose aggregation the hiking itineraries and stages are organized. The paths are uniquely identified in the territory and in the archive through their belonging to a specific geographical area.

The objective of this research (the first case study in Italy) is to create a modern and complete information database of a horse trail that can be managed using GIS (Geographic Information Systems) and that can be replicated in other situations. The actions carried out to obtain the information data used to complete the database can be summarized as follows: (a) a complete GPS survey of the horse trails, of the variants and of the equestrian stops; (b) the checking of the feasibility and practicability of the entire route for horse users; (c) the identification of critical issues along the route (fallen trees, eroded ground, etc.); (d) the identification of temporary and night staging points for horses and riders; (e) the identification of points of interest (PUNs), such as panoramic points and points of historical, religious, cultural and natural interest; (f) the planning of the installation of signs and the locations of points where vertical signs have to be placed; and (e) the drafting of an information database of horse trails that can be replicated in every other territory.

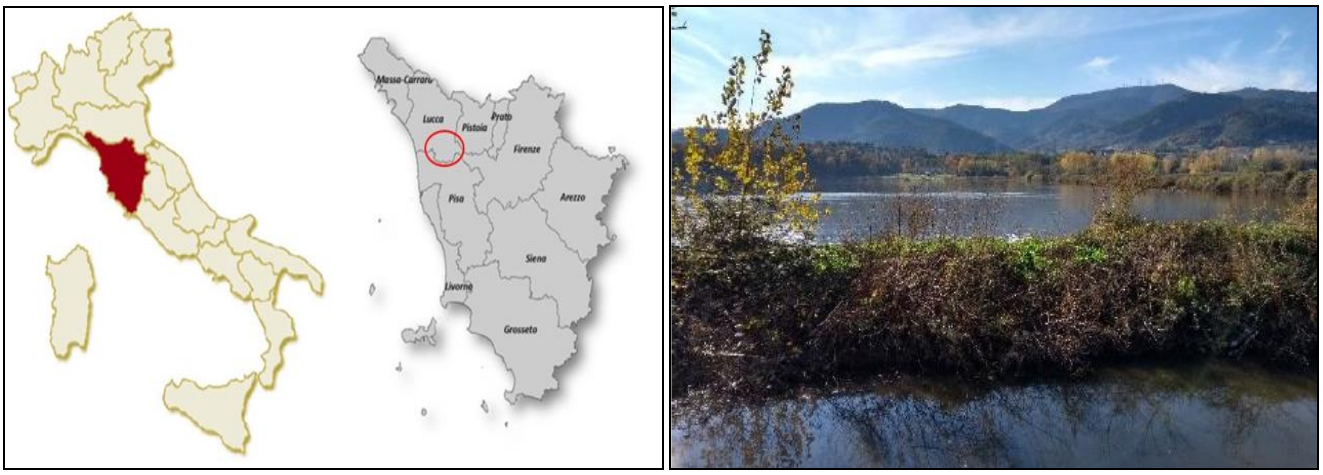

Figure 1. The area in Tuscany Region and Gherardesca's lake with the panorama on Pisano Mount

STUDY AREA

Monte Pisano is a modest mountain system belonging to the Tuscan Subappennino, located in the central–northern

part of Tuscany and separating Pisa and Lucca, with reliefs less than 1000 m high and slightly higher than hills. The Monte Pisano chain forms an extension of the Apuan Alps between the Serchio and Arno rivers. The highest peak is Monte Serra (917 m), and the municipality of this territory is Capannori, which is located in the center of Tuscany and is one of the largest municipalities in Tuscany and Italy. The Monti Pisani area is an area characterized by a strong landscape with regard to the quality and variety of the environmental context in which it is located. The area affected by the Pisano Mount horse trail project is characterized by the presence of important environmental sites such as regional nature reserves and Natura 2000 sites, like the Gherardesca's lake (Figure 1).

Around Pisano Mount there are also numerous ancient churches and abbeys and stone villages typical of the Tuscan landscape. The area also has a strong history of individuals participating in discovering the area through horseback riding. For these reasons, the municipality of Capannori has identified an opportunity in the area for the development of equestrian tourism. The Monte Pisano horse trail project, in addition to guaranteeing a network dedicated to equestrian tourism on Monte Pisano, aims to guarantee a safe alternative to the Via Francigena on horseback, which, from Lucca to Altopascio, presents numerous critical issues related to the transit of motor vehicles and the absence of low-traffic roads. The research project led to the identification of 52 km of horse trails, all identified on a network of historical trails. The route consists of two main rings (western and eastern rings) and functional links to other routes, fitting into a sustainable mobility system that involves the neighboring municipalities (Figure 2).

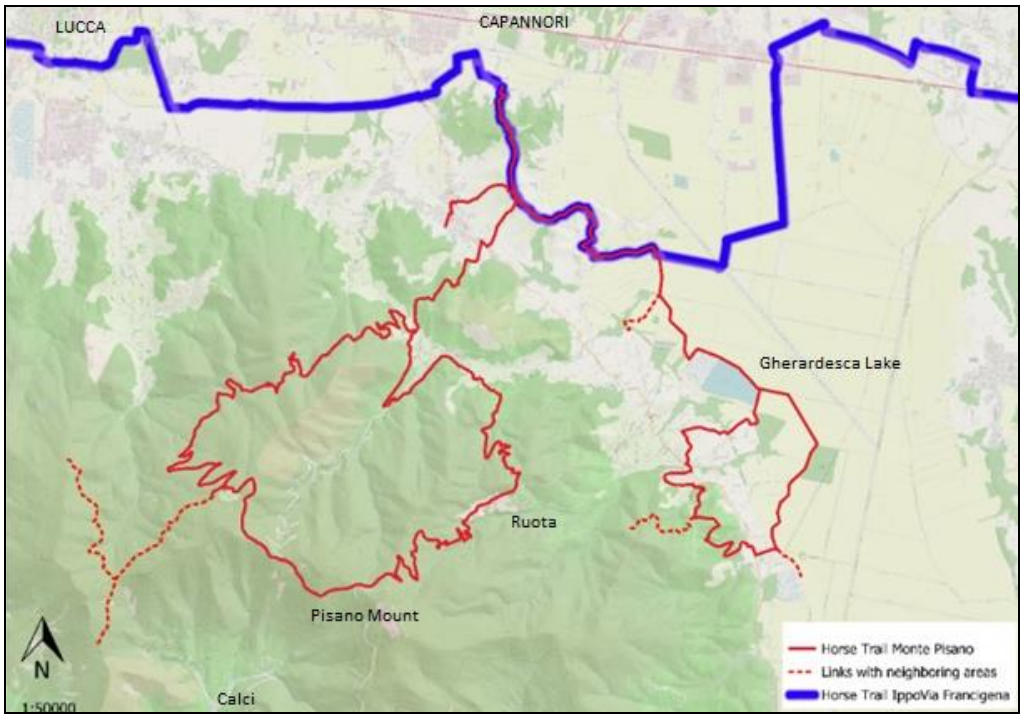

Figure 2. Study area: Source: geographic data by Tuscany Region cartography office

The methodology applied for the realization of a horse trail is defined by a three-phase approach: phase 1 - preliminary map analysis, phase 2 - field survey, and phase 3 - processing and realization of the final product (Figure 3).

The following tools were used for the planning of the horse network: QGis software (release 3.4); basic cartography of the Geographical Military Institute (IGM) at a scale of 1: 25.000; regional technical cartography (CTR) at scales of 1:10.000 and 1:2.000 of the Tuscany region in raster and digital formats; and aerial photos of the area.

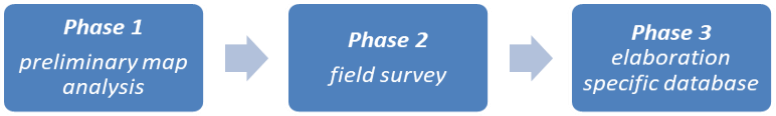

Figure 3. Phases of the methodology identified for the database creatione for horse-ridind tourism

Phase 1: Preliminary map analysis

The preliminary analysis allowed us to identify a route hypothesis using already outlined and existing routes, highlighting possible feasible improvements or possible variants. The route hypothesis was identified by using the existing cartography, trying to use the present pathways as much as possible and favoring the routes that pass on roads or forest tracks (easily identifiable from the 10.000 scale cartography and from aerial photos).

Technical data sheets were also specifically created to facilitate the survey of the tracks and points in the field, and they were subsequently digitized via data entry. The realization of the cartographic survey resulted in (a) an analysis of any existing routes, allowing them to be inserted in the tracing of the final route, whether they were sections of the main route or possible minor variations of the route, and (b) the identification of the points of interest (PUNs) present in the territory,

allowing them to be enhanced through the passage of the route, such as panoramic points and points of historical, religious, cultural and environmental interest. The identification of the route concerned the following: the study of the route on cartography at a scale of 1: 25.000 (a hiking map or an IGM sheet if available); route control also on more detailed maps (1: 10,000 or 1: 5,000 if available); and the loading of the map onto a GPS device.

Phase 2: Field survey

The operational steps followed the preliminary analyses on the field. Having set the appropriate tool settings, the data processed in the preliminary phase were inserted into the cartographic GPS for the field survey. With a GPS instrument for excursion use (considered the most suitable for accuracy), the hypothesized route was detected through the acquisition and recording of points and tracks, and a technical data sheet was compiled for the survey. The technical data sheet, designed to make the survey easier and faster, was used with the aim of acquiring information on the track for subsequent data entry into the database. The tools and software used for the survey were a GPS Garmin 64 ST with an external antenna; a Nicon ColdPix digital camera; and a folder with the technical data sheets for the survey.

The operational steps included the following: (a) a survey of the entire route carried out directly in the field; (b) a survey and check of the path identified on paper; (c) the detection of any changes based on possible anomalies found between the cartography and the real geography of the territory; (d) the detection of possible critical issues, such as fords, road crossings, landslides, real or possible dangers and the crossing of private property; (e) photographic documentation of the route: critical points, parking and/or reception facilities, and naturalistic and historical–artistic emergencies.

For the correct execution of the survey, the following tools were necessary: (1) GPS with the possibility of adding an external antenna; (2) paper survey forms; (3) a pencil and an eraser to fill in the forms; (4) a digital camera with an image georeferencing function; (5) a 25k map extract of the area to be surveyed; (6) a tablet or smartphone with a dedicated app containing offline preloaded maps of the area to be detected (IGM, CTR, open streetmap, cadastral maps, historical maps, etc.) or directly viewable online through the WMS function; and (7) spare stylus batteries. Tablets and smartphones were also useful for importing drafts of the track (in .gpx or .kml format), viewed through dedicated apps in order to facilitate, in moments of uncertainty, an easy and quick understanding of the surrounding geography. Each track is generally composed of "n" linear geometric contiguous elements, with the "sections" corresponding to the center line of the route and acquired with GPS instrumentation in dynamic mode (i.e., in motion).

Because of reasons related to the impossibility of connecting the corresponding alphanumeric data directly to the geometric element and because of digital memory limits, the survey was made up of a single polyline of the entire path, associated with a series of start and end points, which were inserted for each change in the same characteristic. Each piece of information associated with a change in the section was identified by an abbreviation; this could be consulted in a decoding table, which was reported in pencil on the survey form.

Ultimately, the start and end of each leg were recorded by marking a corresponding waypoint and reporting the relevant code on the paper form. With this type of instrument, the tolerable planimetric error could be contained within 10 meters. In cases of a satellite reception insufficient to achieve the required accuracy for signal obstructions, it was necessary to repeat the survey by waiting for a few minutes to obtain the best accuracy. The missing parts or those with poor precision were modified and improved via post-processing in the GIS environment, relying on a basic cartography. Operationally, the detection method with the combination of a GPS receiver and a card was carried out as follows: (a) the waypoint was taken (with the GPS “MARK” function), and (b) the progressive Id number automatically provided to the GPS was transcribed on the cards in the first row in the first column called “GPS Code”. In the column named “START SECTION”, all the codes that characterized a change in the route (background, type and safety) were inserted (Table 1).

Table 1. Detail of technical data sheet

Gps Code	Start Section	End Section	Point Of Interest	Notes	Photo Code
001	TIP02-FON01-SIC00				
002	FON02-SIC01	FON01-SIC00			

Phase 3: elaboration and realization of the final product

Once the GPS data were obtained from the survey phase, we proceeded with transforming the original (raw) data into geographical elements. The following operations were necessary for this: (a) the exporting of data in a format compatible with GIS systems (shapefile); (b) geometric correction on a cartographic basis identified as CTR 10K; and (c) the structuring of the database (the assignment of alphanumeric information to geographic elements).

The third phase therefore concerned the digitization, always on the reference map, of the best route; of the accommodation facilities; of the most interesting naturalistic, cultural and religious emergencies (PUNs); of the water points; and of the panoramic points surveyed. The processing of the collected data took place with the correction of the GPS data and adaptation to the basic cartography (CTR 10k Regional). Once the tracks and WPs (waypoints) detected with GPS were downloaded, the GPS data were cleaned and converted to the shapefile (.shp) and Keyhole Markup Language (.kml) formats for viewing on GIS and Google Earth. In fact, the track detected during the field phase presented some more or less pronounced deformations, which were generally deemed to derive from possible reception problems of the satellite signal. The data were grouped by themes and inserted in GIS in the shapefile format, creating a collection of digital thematic maps that are easy to view and update. The data examination phase consisted of the following: (a) an examination of the data collected using the satellite navigator; (b) the identification of GPS tracks detected on the control cartography and the overlapping of the acquired data; (c) the control of the track on Google Earth

panoramic satellite view or using a similar instrument; (d) the extraction of georeferencing data and the creation of Excel tables using the collected data; and (e) the processing of the database.

Technical information for the processing of the equestrian database trails

The classes of the georeferenced geometric entities that make up the archive of the equestrian trails are listed in the following way: Areas; Sections; Paths; Stage; Itineraries; Nodes/Junctions; and Points of Interest (POIs) (Table 2).

Table 2. Classes of georeferenced geometric entities

Class	Name	Class definition and acquisition criteria	Geometry
Areas	RET_ ARE	Based on the numbering of the regional paths, the territory of Tuscany is divided into territorial areas corresponding to the provincial administrative areas	Area / Multiarea
Sections	RET_ TRA_ L	Section means a linear element delimited by two nodes, identified by an ordered set of points and, normally, connected to other sections. The section constitutes the elementary geometric element of a path that has homogeneous characters. In other words, a path can consist of one or more sections. The geometric continuity of the path is divided into two sections, connected to each other through a node or junction, whenever events along the way require a change of attributes between the previous and next sections. The acquisition of the sections takes place substantially in two ways: 1. from topographic cartography; 2. with direct surveys via GPS	Lines / Multilines
Paths	RNC_ SEN	The Paths class is made up of all the path-type entities that make up the national path network. From a geometric point of view, the path entity derives from the composition of one or more connected sections	Lines / Multilines
Itineraries	RNC_ CAM	The Path class is made up of contiguous linear entities derived from the composition of the geometry of sections belonging to one or more paths.	Lines / Multilines
Nodes / Junctions	RNC_ NOD	The nodes and junctions correspond to particular vertices of the section that represents the path: the beginning and end vertices of the path, the way and the stage are nodes; those of bifurcation of the path in multiple paths and also those of junction that are created at the intersection of paths, itineraries and different stages.	Point
Points of Interest	RNC_ POI	Useful points for greater characterization of the section, both from point of view of the use by the walker, and from the point of view of management and maintenance by the manager.	Point

RESULTS AND DISCUSSION

Geographic Information Systems provide the best environment for the collection, storage, management, processing, analysis and cartographic representation of information (Pantelias et al., 2008), and they can play an important role in examining the suitability of locations for sustainable development (Bahaire et al., 1999). Web-based GIS models with dynamic and interactive maps are useful for managing and promoting tourism resources using data collected in the field (Mango et al., 2020). According to Eremitaggio (Eremitaggio et al., 2010), in recent years, with the spread of plans in digital format, public bodies at different levels have launched actions to harmonize the cartographic databases and the data used in order to make different policies comparable. Creating harmonized and consistent data models between different regions and countries can provide an opportunity to build more robust planning practices.

For this reason, for the planning of a hiking route, the development of an information database that contains all the information relating to the route and the sections and POIs that compose it is fundamentally important. Once the route was detected, the cartographic and alphanumeric data collected in the field were processed according to national standards and loaded onto the cartographic database.

The level of information required fluctuates between the need to collect useful information for the management and maintenance of the network and the need to provide users with the greatest amount of useful data for the full enjoyment of the routes from the tourist and hiking points of view. In this phase, the punctual information (recorded during the survey) was processed and transposed onto the linear geometric entity of the entire path. Then, tables were compiled listing the attributes of the paths and points based on the information collected during the survey with related identification codes. To optimize the overall organization of the database, the elements to be detected along a path were divided into two large groups: (a) section change points, necessary to indicate changes in a specific feature of the linear path, and (b) points of interest (POIs). By section, we mean a linear element delimited by two nodes, identified by an ordered set of points and, normally, connected to other sections. The section constitutes the elementary geometric element of a path that has homogeneous characteristics (attribute code). Before proceeding with the assignment of the codes to the linear elements, we proceeded with the definition of their characteristics in order to make the survey more precise. The definitions of the linear elements are presented in Table 3. The use of univocal codification responds to the need for the uniformity of information required by the INSPIRE directive, with the aims of harmonizing and promoting the interoperability of spatial data at regional, national and international levels (Balawejder et al., 2016).

In the hiking sector, too often we observe the creation of local initiatives for routes that do not satisfy the INSPIRE directive (2007), leaving out the possibility of creating a network for large-scale tourism promotion. For this reason, it is necessary that the paths are designed by creating a database of standardized information interchangeable with other management bodies. This work created a database connected to the route of the Monti Pisani horse trail, following the coding indicated by the R.E.T. (Tuscany Hiking Network). The geometric continuity of the path is divided into two sections, connected to each other through a node or junction, whenever events occur along the route that require a change in attributes between the previous and the following sections. The events that require the interruption of the continuity of the path and the insertion of a connection node are as follows: (a) the type of section (field TIP_TRA—values: drive-over, non-drive-over and drive-over with limitations); (b) the type of land (FON_TRA field—values: dirt,

on rock, natural and artificial); (c) the degree of security (SIC_TRA field—values: criticality 0/safe, criticality 1 and criticality 2); and (d) the ownership of the estate (field PRO_TRA—values: section on public estate and on private estate).

Table 3. Definition of linear elements

Linear element detected	DTB Code	Definition
CLA_TRA		
Main	01	Main path
Variant / alternative	02	Variation to the main route due to logistical or historical-environmental reasons
Functional connection	03	Connection to a place / site of particular interest not far beyond 1.5 km
TIP_TRA		
Accessible to vehicles	01	This category includes roads with a width exceeding 2.5 m and with a bottom, slope and width of curves that allow the transit of vehicles
Not accessible to vehicles	02	Roads less than 2.5 m wide and not suitable for vehicles fall into this category
Accessible to vehicles with limitations	03	This category includes all the driveways on which restrictions on use are applied based on current state and regional legislation
FON_TRA		
Natural	01	Natural background typical of the path due to the repeated passage of people
Asphalt / concrete	02	It includes all types of flooring made by man with plastic materials such as concrete, asphalt, bitumen etc.
Gravel / dirt road	03	This category includes all the driveways on which restrictions on use are applied based on current state and regional legislation
Paved / cobblestones	04	Paving made of flints or other irregular stones (paving, roadbed, etc.).
Pedestrian and bicycle route	05	This category includes all those pedestrian and bicycle paths with an improved bottom
SIC_TRA		
Zero criticality - safe section	00	They are sections classified with a large safety margin. They are sections generally identified on paths, tracks, dirt roads, driveways on asphalt but with the presence of a sidewalk, low traffic and good visibility conditions
Criticality 1	01	These are sections in which the walker does not have a sidewalk, platform or lateral space along the roadway. The walker must therefore be careful to avoid the cars that come even if the visibility is good and the traffic is low
Criticality 2	02	These are sections with the same conditions with criticality 1 but with the aggravation of the fact that pedestrian / vehicle intervisibility is completely absent

In the data processing and database construction phase, the support waypoints recorded during the field surveys, indicating the attribute change points, represent interruptions on the path polyline (nodes), generating a number of contiguous sections that differ in attribute values. In Table 4, the values of the attributes referable to the sections detected are reported. Figure 4 shows an example of a change in the estate's attribute.

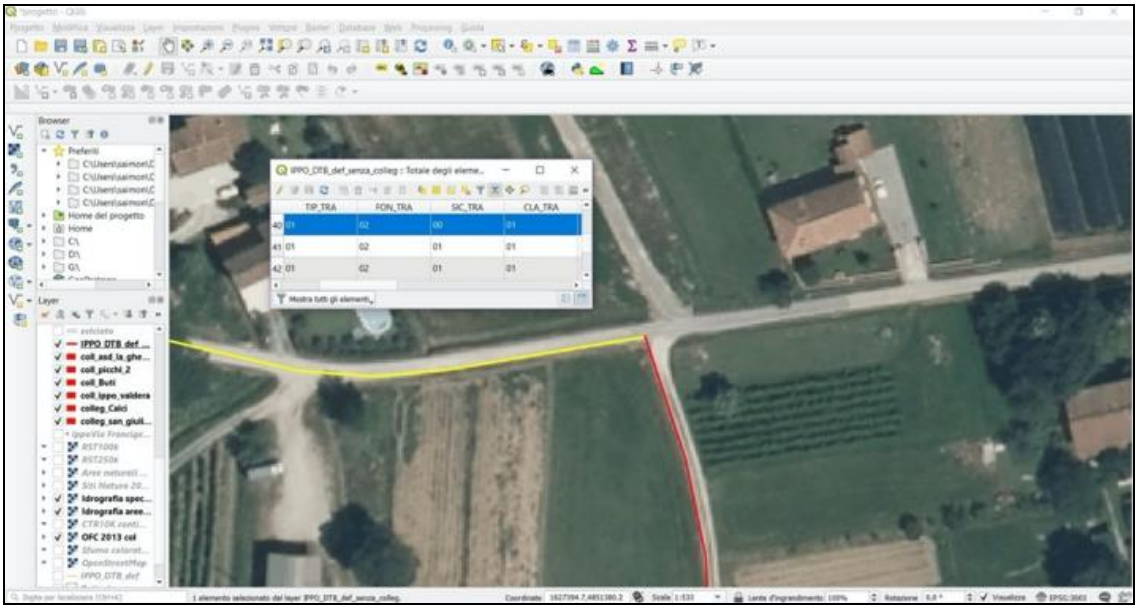

Figure 4. Example of estate's attribute change, elaborated in QGIS

With regard to the attribution of information to specific elements, a number of points of interest (POIs) are associated with the route; they are not directly connected to the route but are useful for its greater characterization. This allows for better utility in terms of hiking and in terms of management and maintenance by the manager. From a geometric point of view, notable points are recorded as point entities in the real geographic position in which they are found. The POIs that are located directly along the routes (main, variants and connections) or that are located in a buffer of up to 600 meters (300

meters per road side) are part of the archive. The points that report any criticalities due to landslides, dangerous fords, etc., are also included in this information level. Table 5 shows the descriptions of the codes assigned to the points of interest.

Table 4. Attributes codes for sections

Name	Description	DTB code
Geometry	**Entity geometry**	
CLA_TRA	Section classification	Domain: 01 = main; 02 = variant / alternative;03 = functional connection to POI
TIP_TRA	Type of venue on which the section passes	Domain: 01 = accessible to vehicles; 02 = not accessible to vehicles;03 = accessible to vehicles with limitations
FON_TRA	Type of land on which the section develops	Domain: 01 = natural; 02 = asphalt / concrete; 03 = gravel / dirt road; 04 = paved / cobblestones; 05 = pedestrian and bicycle route; 00 = other
SIC_TRA	Degree of section security based on 3 levels of criticality	Domain: 00 = safe zero criticality; 01 = criticality 1; 02 = criticality 2
PRO_TRA	Estate ownership	Domain: 01 = section on public land; 02 = section on private land; 03 = for public use
DATA_RIL	Date relating to the acquisition or the last geometric / information modification of the "section" element	YYYYMM; Where YYYY indicates the year e MM indicates the month
NOTE_GEN	General information relating to the element "section"	Character format A / b

As for Yosemite National Park, in the same way, the availability of the spatial information database of the Monti Pisani Horse Trail can allow for the creation of an interactive hiking map and a web-based hiking information system, providing interactive topographic maps, hiking information and thematic and touristic information. The chosen trail is displayed on the map, along with a profile and a list of useful information and tips (Williams et al., 2006).

Table 5. Attributes codes for points of interest

Name	Description	DTB code
Geometry	**Entity geometry**	
TIP_POI	Type of Point of Interest POI	Domain: SR = reception / receptivity; PA = water supply; PI = points of interest; SE = services; CR = point criticality
SR_POI	Accommodation facilities	Domain: SR01 = hospitable / poor receptivity; SR02 = guesthouse; SR03 = hotel; SR04 = hostel; SR05 = rent-rooms; SR06 = holiday farm; SR07 = camping; SR08 = refuge; SR09 = bivouac; SR10 = horse shelter; SR00 = other
PA_POI	Water points	Domain: PA01 = source of drinking water; PA02 = drinking water fountain; PA03 = fountain of uncontrolled water; PA04 = seasonal source; PA05 = horse drinking trough; PA00 = other
PI_POI	User services	Domain: SE01 = refreshment point ; SE02 = information point, visitor center ; SE03 = railway station; SE04 = bus stop; SE05 = bicycle assistance ; SE06 = pharmacy ; SE07 = hospital ; SE08 = release of official stamp; SE09 = dedicated Wi-Fi point; SE10 = equipped rest area; SE00 = other
CR_POI	Critical points	Domain: CR01 = landslide; CR02 = dangerous ford; CR03 = mud, flooding; CR04 = gate / barrier; CR05 = free dogs; CR06 = particularly luxuriant vegetation; CR07 = missing pedestrian crossing; CR00 = other
QUO_POI	Altitude of the point of interest expressed in m.a.s.l.	
NOM_POI	Toponym identifying the point of interest	Character format

The standardized information database represents a useful tool, because not only is it possible for users to access the route information through web services, but it also serves as a management tool that can be consulted by the administration for the management and maintenance of the same route, and it can also be shared with other management bodies and with those who work in the tourism sector. Cooperation is perceived to be an important factor for successful tourism development. Rural tourism requires different types of businesses to work together because, by its nature, tourism has intertwined relationships between different types of businesses, such as shops, hotels, restaurants and tourist attractions (Wilson et al., 2001). The possibility of having a management tool such as the spatial information database facilitates the sharing of information data between entities, given the importance of strategic planning for the development of tourism, which is fundamental for the efficient and effective use of resources and funds, especially in rural areas that have few funds and resources. Good planning for the development and promotion of tourism can help develop and support local tourism-related businesses (Riberio et al., 2020). With regard to value from a managerial point of view, a well-structured database allows an administration to identify the critical points of a route and take action to make them safe; define the best strategies for achievement using information relating to the points of interest and available rest stops along the route; proceed with the maintenance of the path, where necessary, in relation to the characteristics of the land and possible invasion by infesting vegetation; and integrate the existing database with variants, ring routes, connections to routes of neighboring municipalities, new parking points or new points of interest.

CONCLUSIONS AND FUTURE PERSPECTIVES

The research carried out in this paper ended with the delivery of a management tool (an equestrian database manageable using Gis) to the local public administration for the management and promotion of equestrian tourism.

In addition to the GPS track of the horse trail and the connected points of interest (in the various consultable and work formats), a true management tool, that is, a map database, was realized. This tool contains information relating to the route and regarding the safety of the sections that make up the entire route, their practicability characteristics and any critical issues on which the administrator will focus their actions in order to maintain it for the use of users. Such a structured system allows one to create a territorial information system in compliance with regional directives, constituting the deepest knowledge of the territory. The information packaged in a well-structured database can then be used for the creation of path promotion tools, such as webgis portals or applications for smartphones, in order to facilitate use by users. The cartographic database aims to collect useful information for the management and maintenance of the network and to provide users with the greatest amount of useful data for the full enjoyment of routes from the tourist and hiking points of view. The GPS survey of the routes, the equestrian variants and all the points of interest dedicated to equestrian tourism allowed for the realization of an innovative and functional project addressing the needs of the tourism sector. A digital detection and computerization system of the routes, through the detection of the attributes of sections, paths and significant points, allows one to create a database containing uniform information for the whole region, obtaining a management tool and an achievement of fundamental importance. Further research needs to be undertaken in the future not only to determine the effects of these developing initiatives but also to better understand the individual person–place relationships of horse riders with their environment and their evolution.

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