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FROM THE *ITINERARIUM ANTONINI* AND AL-IDRISI TO THE MOVECOST PLUGIN: ROAD NETWORK ANALYSIS IN THE CASTRONOVO DI SICILIA AREA

1. Introduction

The Castronovo di Sicilia landscape has been the subject of an archaeogeographic analysis (Robert 2010; Chouquer, Wattaux 2013) in order to identify possible dynamics of transformation of the historical landscape attributable to different geopolitical contexts. Central to this analysis was the study of the road network elaborated by comparing data taken from traditional written sources with the Least Cost Path Analysis (LCPA) (Herzog 2013). First of all, the LCPA highlighted how the area at issue is located near the point where the least expensive natural paths that unite the island from N to S and from E to W meet (Fig. 1). Precisely this favourable location and this centrality along various routes have made the territory of Castronovo an important place of passage in all historical periods. The current municipality of Castronovo di Sicilia is in fact located halfway between Palermo and Agrigento, along the route that connects the island's two main centres on the N and S coast; it is also located along the main internal routes that connect Trapani and Marsala to the W and Catania and Syracuse to the E. Even today the centrality of this area is evidenced by the proximity to the SS189 road, which connects Palermo with Agrigento, largely exploiting the natural path of the Platani valley.

2. VIII-Item ab Agrigento Lilybaeo

The current route of the SS189, in fact, partly follows one of the main internal communication routes of the Roman era, as recorded by the *Itinerarium Antonini* in the *VIII-Item ab Agrigento Lilybaeo*. According to G. Uggeri (2004, 97-116), who was the first to study the itinerary, later followed by L. Stangati, the path started from Agrigento and headed N, passing between Aragona and Comitini, where the *statio Pitinianis* must have been located (10 miles away from Agrigento, that is only one mile further than what was listed in the *Itinerarium*). From here, according to L. Stangati (2007, 221-222), the route continued N until it was divided into two branches, before meeting the Platani River. The westernmost branch headed towards Cantarello, where the Arab toponym (*qantarah* = bridge) attests to the presence of a Roman bridge, and then continued along the Platani. The second branch instead headed towards the Campofranco

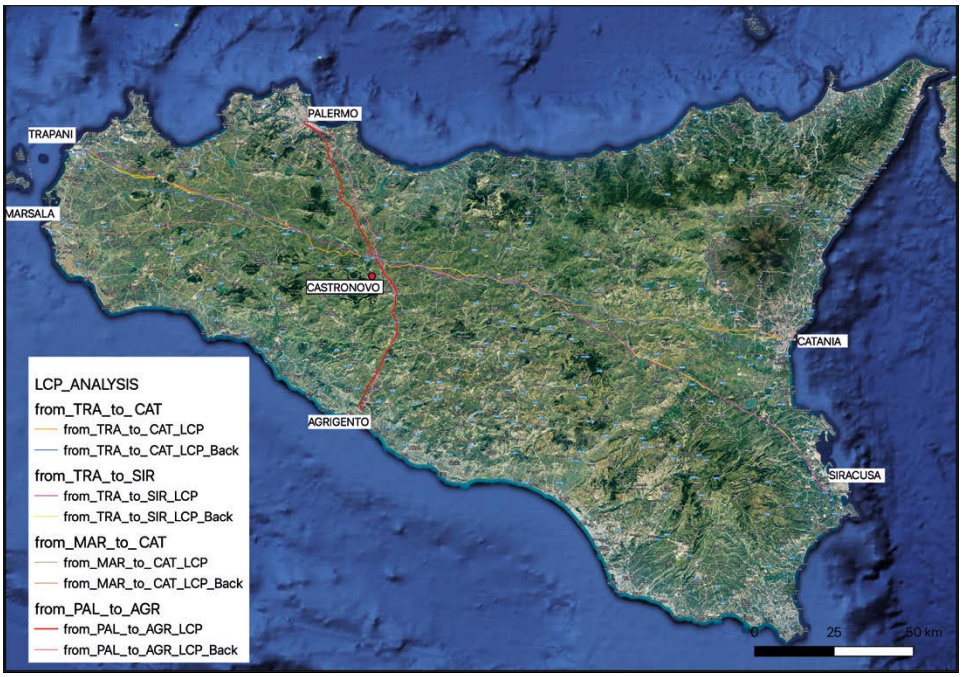


Fig. 1 – LCPA on satellite image (Google Earth).

bridge, before rejoining the Platani at Villaggio Faina. From here, the itinerary continued following the course of the river until it reached the *statio Comicianis*, which can be located using the toponym Comicia, near the current crossroads for Cammarata. The distance of 24 miles from the previous *statio* would coincide perfectly following the route that passes through the Campofranco bridge.

The following *statio Petrine*, which can be located near the current Casale San Pietro, in the Castronovo di Sicilia area (Giustolisi 1999, 30), is actually 5 miles away, only one more further than what is described in the *Itinerarium*. After the *statio Petrine* the interpretations of Uggeri and Stangati differ. Uggeri claims that the itinerary veered W continuing along the route of the older via Aurelia, and then reached Corleone before turning N again to head towards Palermo. This deviation would be testified by the only milestone now known with certainty in Sicily, found in 1954 near Corleone. However, this itinerary would not coincide with the distances reported in the *Itinerarium Antonini*.

Stangati believes that this path is the oldest of two routes that could lead from Castronovo to Palermo, probably replaced as early as the first century BCE (Stangati 2013, 41). In support of this hypothesis, Stangati reports

the distance from the *statio Petrine* to Palermo in the *Itinerarium* (48 miles, which would differ greatly from the real 60 miles of the route passing through Corleone) and the difficulty in identifying the *statio Pirama*. Stangati therefore believes that the *Itinerarium* describes a second, later route, which from the *statio Petrine* continued in a northerly direction, passing near the current Vicari and arriving at the current Fondaco Tavolacci, where the *statio Pirama* could be located (24 miles from *Petrine*, only one mile further than described in the *Itinerarium*), heading then towards the bridge and the Roman baths of Cefalà Diana, finally passing through the Misilmeri bridge and arriving in Palermo (another 23 real miles from the hypothetical *Pirama*, in this case one mile less than the *Itinerarium*).

3. Al-Idrisi: the Book of Roger, Fourth Climate - Second Compartment - The Islands

The second written source analysed is the *Nuzhat al-mushtàq fi ikhtiràq al-afàq*, better known as the Book of Roger. The author, al-Idrisi, was born in 1099 probably in Sicily (Amara, Nef 2001), where he later died between 1164 and 1166. He was commissioned by Roger II to write a text that included the entire geographical knowledge of the era. The work was published in Palermo in 1154 following the Ptolemaic tradition; it is divided into 7 climates, each one divided in turn into 10 compartments. Sicily is located in the Fourth Climate - Second Compartment - The Islands. In the central part of the writings concerning Sicily, al-Idrisi mentions Castronovo with the Arabic name of *Qasr nûbû*, listing several distances that separate it from other places located in the central area of the island.

According to al-Idrisi Castronovo is about 10 miles from Cammarata, 12 from Prizzi, 20 from Corleone, 10 from Raia and 24 from Sutera. At the time of al-Idrisi, the Sicilian mile must have had a length between the Roman one from which it derived equal to 1,478.50 m, and that recognized in 1877 by the *Regio Decreto No. 3836*, equal to 1,486.6437 m. The difference between the two is only 0.54% and for this reason the value of the Roman mile was used in the analyses carried out, as Stangati did in his research (Stangati 2020, 18-19). As we will see in detail later, most of these distances are different, especially the arrangement of Raia. Raia, whose toponym is still preserved, has been identified with a farmhouse, located 4.5 km NW of Prizzi. Furthermore, Raia turns out to be much closer to Prizzi than to Corleone, compared to what al-Idrisi seems to indicate. Consequently, even the distances between Raia and Castronovo and between Prizzi and Raia cannot be equal, as indicated by al-Idrisi, since Prizzi is on the road between Castronovo and Raia.

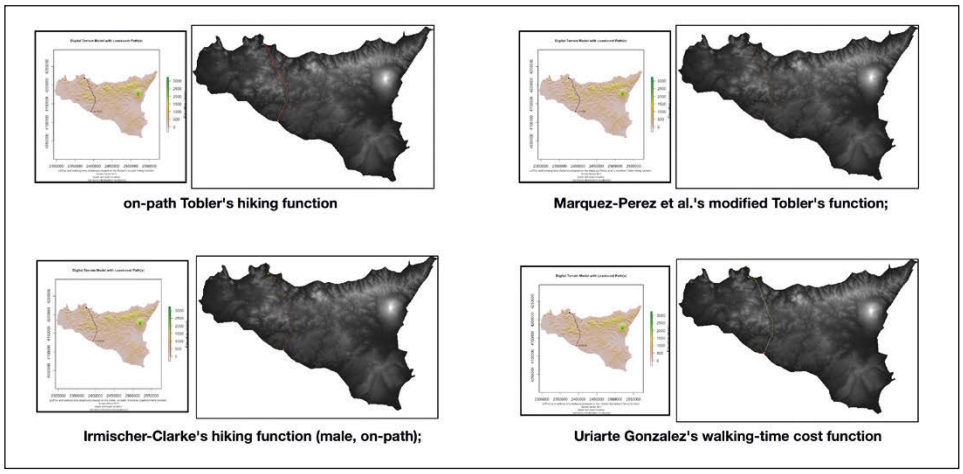


Fig. 2 – Results of the different LCPA functions tested.

4. Least Cost Path Analysis

The Least Cost Path Analysis was carried out using "movecost", a QGIS plugin (https://github.com/enzococca/movecostTOqgis) developed by E. Cocca (2022) based on the algorithms elaborated by G. Alberti for the R software (Alberti 2019). The plugin offers the possibility to choose which function to use for the cost calculation, from a list of 23 available functions (for a list of the ones most used in the archaeological field see Herzog 2020, 337, Tab. 18.2). For this research, different functions were tested: Marquez-Perez *et al.* modified Tobler's function (Márquez-Pérez *et al.* 2017); Irmischer-Clarke's hiking function, male, on-path (Irmischer, Clarke 2017); Uriarte Gonzalez's walking-time cost function (Chapa Brunt *et al.* 2008) (Fig. 2) before deciding to use the on-path Tobler's hiking function (Tobler 1993). The choice was motivated by the minimal differences with the other functions, as well as the fact that this function is currently the most used for LCPA in the archaeological studies (Herzog 2010, 376). The plugin also allows you to automatically download the DTM of the area of interest obtained from the NASA Shuttle Radar Topography Mission (SRTM GL1, 30 m), which is what was used during the analysis. The comparison between the results of the LCPA and the historical road network was mediated by the use of the CAD images, relating to the reconstruction of the Roman and Arab-Norman road network, elaborated by Stangati (2012, 2013).

The LCPA was elaborated on two levels: at a regional level, to analyse the distance between the Castronovo area with the least cost paths which

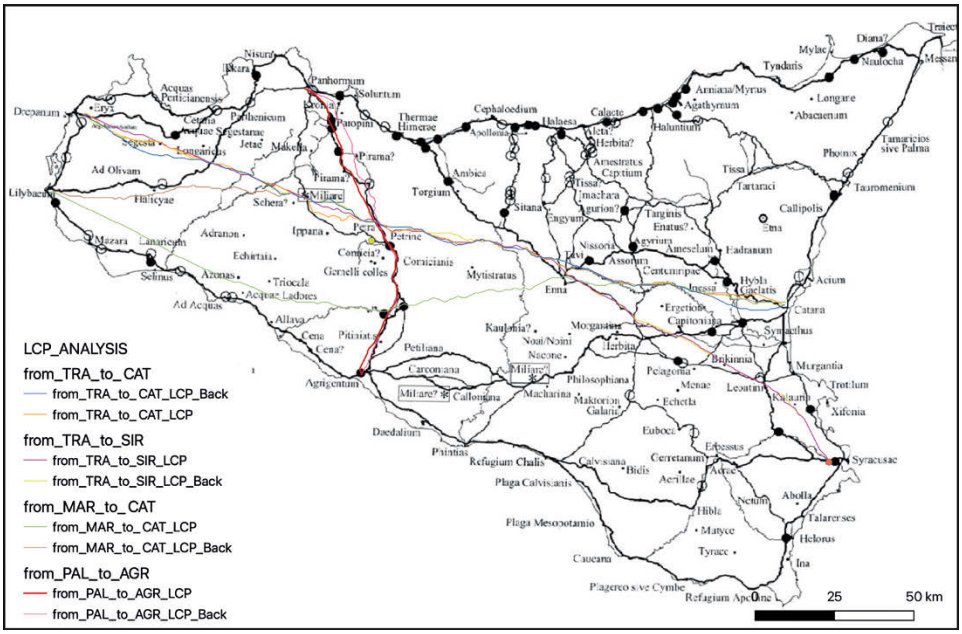


Fig. 3 – LCPA results overlapping the Roman road network map elaborated by Stangati 2007, 226.

unite the island from N to S and from E to W.; and at a local scale, to compare the data of the distances from Castronovo expressed by al-Idrisi with the paths obtained through the LCP algorithms. Regarding the regional analysis, Palermo and Agrigento were therefore used as starting and finishing points for the NS direction, while Trapani, Marsala, Catania and Syracuse were used for the EW direction (Fig. 3). For each link, the plugin highlights two distinct results, the outward path and the return one which obviously can differ, considering that the slope sections that are favourable in one direction might not be as favourable in the opposite direction.

Along the NS route from Palermo to Agrigento, it should be noted that the outward stretch differs from the return stretch in particular in the first half (from Palermo to Lercara Friddi, spacing a maximum of about 5 km near Villafrati) and in the final stretch (from Aragona to Agrigento, with a maximum distance of about 1.5 km). In the central section however, the two routes find a much higher correspondence, perfectly coinciding for a substantial part of it. The reason for this overlap is the presence of the Valle del Platani which is the best route in both directions.

The result of the LCPA between Palermo and Agrigento passes at a minimum distance of approx. 3.4 km from the centre of the current municipality

DISTANCES FROM PETRINE

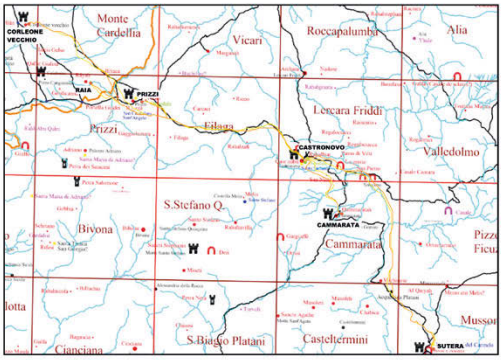
	Itinerarium Antonini	Uggeri	LCP
Agrigentum	37 miles	39 miles	31, miles
Pitinianis	28 miles	29 miles	22,3 miles
Comitianis	4 miles	5 miles	4,2 miles
Pirama	24 miles	X	16 - 23,8 miles
Panormo	48 miles	60 miles	41 miles
Agrigentum To Panormo	85 miles	99 miles	72 miles

Fig. 4 – Comparison of the LCPA distances with the *Itinerarium Antonini* and the path proposed by Uggeri, on a map elaborated by Stangati 2007, 226.

of Castronovo and only 885 m from the Casale di San Pietro. Regarding the analysis of the EW paths, first of all it should be highlighted how the results of the Trapani-Catania and Trapani-Syracuse routes, in both directions, and Catania-Marsala tend to coincide in the central section from Corleone to Enna. All these routes pass just at 5.5 km from the centre of Castronovo, while from Casale San Pietro the minimum distance is about 4.2 km.

What is evident is the proximity of Castronovo to the area where the NS least cost paths intersect with almost all of the EW least cost paths. Secondly, a strong correspondence emerges between the road system of the Roman age and the least cost path between Palermo and Agrigento, which in some points seems to follow the sections described by the *Itinerarium Antonini*, according to the path suggested by Stangati (Fig. 4). The next phase of LCPA focused on a smaller scale, to compare the routes cited by al-Idrisi linking Castronovo to Cammarata, Prizzi, Corleone, Raia and Sutera (Fig. 5). Starting to analyse the path towards Cammarata, one immediately notices that the distance expressed by al-Idrisi is almost double that what emerged from the LCPA. In this case, Stangati also argues that the Arab geographer's distance is wrong, but only by two miles (Stangati 2010, 106).

Surely the difference between al-Idrisi/Stangati and what is expressed by the LCPA is determined by a rather decisive physical factor: the passage of the Platani river. During the Arab-Norman era, the only known crossing of the river in this area is the *Saraceno* bridge, located approx. 4.5 km E of Castronovo, near Casale San Pietro, of which only toponymic evidence remains.



DISTANCES FROM CASTRONOVO

	al-Idrisi	Stangati	LCP	LCP_Back
Cammarata	10 miglia	ca. 8 miglia	5,3 miglia	5,1 miglia
Prizzi	12 miglia	ca. 15 miglia	11,7 miglia	12 miglia
Corleone	20 miglia		21,1 miglia	21,3 miglia
Raia	10 miglia	ca. 18 miglia	15,3 miglia	15,6 miglia
Sutera	24 miglia		17,11 miglia	16,9 miglia

Fig. 5 – Comparison of the LCPA distances with the al-Idrisi path and the distances proposed by Stangati, on a background map elaborated by Stangati 2013, Tab. 1.

Therefore, analysing a path that from Castronovo heads to Cammarata crossing the river near the toponym *Saraceno*, we approximately reach the distance of 8 miles proposed by Stangati. Analysing the path towards Prizzi, the LCPA highlighted a value almost identical to that expressed by al-Idrisi. By superimposing the LCPA on various maps, it is evident how, in this case, the least cost route corresponds quite faithfully to the road network of the Roman era which headed W from Castronovo. For this reason, it is therefore possible to consider Stangati's calculation incorrect, which exceeds by 3 miles, and highlight how, in this case, the distance proposed by the Arab geographer corresponds to the LCP. The same thing happens for the route to Corleone. Also in this case the LCPA's results closely follow the historical road network while the calculated distance is just over a mile greater than the one expressed by al-Idrisi, which also in this case seems to be quite similar. However, the distance that the Arab geographer describes for the hamlet of Raia is much different, positioning it 10 miles W of Castronovo, despite the fact that the hamlet is located a few miles beyond Prizzi which, as we have seen, is already at a distance of 12 miles. The results of the LCPA give us values of 15.3 miles and 15.6 miles to reach Raia, which would seem more correct than the 18 miles calculated by Stangati.

The distance from Castronovo to Sutera is also different, which al-Idrisi calculates as 24 miles. According to the LCP analyses, the least cost routes, in both directions, are around 17 miles and, considering that the results of the analysis follow quite faithfully the stretch of Roman road system which connected Castronovo to Casale San Pietro and from here headed to S towards Agrigento, it is possible to argue that the distance of the least cost stretches is, in this case, quite reliable.

5. Discussion

The LCPA have shown that al-Idrisi appears to be quite accurate regarding the western stretch Castronovo-Prizzi-Corleone, while he is not as accurate regarding the southern stretch towards Cammarata and then Sutera. Wishing to speculate on these few data, it is possible to hypothesise that the Arab geographer actually travelled from Castronovo to Corleone (or in the opposite direction), probably stopping at Prizzi, which is halfway between the two; while he had only indirect knowledge of the road system that from Castronovo headed E towards Casale San Pietro where it crossed the Platani river and then headed SW towards Cammarata or, following the river, S towards Sutera. If we wanted to look for further clues to support this hypothesis, it could be highlighted how both Corleone, Prizzi (Stangati 2010, 96), and to a lesser extent Castronovo (Stangati 2010, 98) are described in sufficient detail, while Sutera is only mentioned without any description.

In contrast to this hypothesis, we certainly have the wrong location of Raia which would seem to testify to an indirect knowledge of the farmhouse which, although not exactly on the road between Prizzi and Corleone, must have been only a little further than a mile away from it. On the other hand, the description of Cammarata is more dubious: although it seems similar to those of Prizzi and Corleone, it concentrates mainly on the surrounding area, citing only the castle but without mentioning any springs (such as in Prizzi) or any running water (such as in Castronovo, Corleone and again Prizzi), despite the town being surrounded by two tributaries of the Platani. It is currently impossible to know whether this oversight is accidental or due to an indirect knowledge of the town, but not of the surrounding area, which in any case is visible from Castronovo.

6. Conclusion

In conclusion, it is evident that both the analysis of traditional written sources and LCP analysis emphasise the geographical importance of Castronovo along the NS axis, which runs from Palermo to Agrigento, and the route that connected the main coastal centres on the eastern and western shores of the island. Furthermore, the Castronovo area has undergone a series of transformations that have partially modified its roadways throughout historical periods. The initial road network in this area dates back to the phase of Roman conquest (milestone of Corleone). In the imperial age, the *Itinerarium Antonini* describes a second road system that takes advantage of the natural corridor of the Platani valley to connect Palermo to Agrigento, continuing no longer W but N of Casale San Pietro (*statio Petrine*), quite faithfully tracing

the least cost path between the two towns. Contrarily, during the Arab-Norman age, the primary road network appears to have been the EW axis, to the detriment of the NS path which continued northwards from Casale San Pietro, which seems to have been completely forgotten.

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REFERENCES

Alberti G. 2019, *movecost: An R package for calculating accumulated slope-dependent anisotropic cost-surfaces and least-cost paths*, «SoftwareX», 10, 100331 (https://doi.org/10.1016/j.softx.2019.100331).

Chapa Brunet T., García J., Mayoral Herrera V., Uriarte González A. 2008, *GIS landscape models for the study of preindustrial settlement patterns in Mediterranean areas*, in A. Vassilopoulos, N. Evelpidou, O. Bender, A. Krek 2008 (eds.), *Geoinformation Technologies for Geo-cultural Landscapes*, Boca Raton, CRC Press, 255-273.

Chouquer G., Wattaux M. 2013, *L'archéologie des disciplines géohistoriques*, Paris, Éditions Errance.

Giustolisi V. 1999, *Petra. Atlante delle antiche strutture rupestri dell'alta valle del Platani (Castronovo)*, Palermo, Ars Nova.

Herzog I. 2010, *Theory and practice of cost function*, in F. Contreras, M. Fracas, F.J. Meteor 2010 (eds.), *Fusion of Cultures. Proceedings of the 38th Annual Conference on Computer Applications and Quantitative Methods in Archaeology (Granada 2010)*, BAR International Series 2494, Oxford, Archaeopress, 375-382.

Herzog I. 2013, *The potential and limits of optimal path analysis*, in A. Bevan, M. Lake (eds.), *Computational Approaches to Archaeological Spaces*, Walnut Creek, California, Left Coast Press, 179-211.

Irmischer I.J., Clarke K.C. 2017, *Measuring and modeling the speed of human navigation*. «Cartography and Geographic Information Science», 45, 2, 177-186 (doi:10.1080/15230406.2017.1292150).

Márquez-Pérez J., Vallejo-Villalta I., Álvarez-Francoso J.I. 2017, *Estimated travel time for walking trails in natural areas*, «Geografisk Tidsskrift-Danish Journal of Geography», 117, 1, 53-62 (https://doi.org/10.1080/00167223.2017.1316212).

Robert S. 2010, *Sources et techniques de l'archéogéographie*, Paris, Press universitaires de Franche-Comté.

Stangati L. 2007, *Nuove considerazioni sulle comunicazioni stradali siciliane in età romana*, in C. Miccichè, S. Modeo, L. Stangati 2007 (eds.), *La Sicilia romana tra Repubblica e Alto Impero. Atti del convegno di studi (Caltanissetta 2006)*, Caltanissetta, Siciliantica.

Santagati L. 2012, *Storia dei bizantini di Sicilia*, Caltanissetta, Lussografica.

Santagati L. 2013, *Viabilità e topografia della Sicilia antica*. II, *La Sicilia alto-medievale ed arabo normanna corredata dal Dizionario topografico della Sicilia medievale*, Caltanissetta, Lussografica.

Stangati L. 2020, *La Sicilia di al-Idrisi ne Il libro di Ruggero. Estratto relativo alla sola Sicilia nella traduzione in italiano di Michele Amari annotato e comparato con la traduzione in italiano di Umberto Rizzitano e con la traduzione in francese di Pierre Amed e Jaubertt poi rivista da Annliese Nef ed annotata da Henri Bresc*, Caltanissetta, Sciascia Editore.

Tobler W. 1993, *Three Presentations on Geographical Analysis and Modeling: Non- Isotropic Geographic Modeling; Speculations on the Geometry of Geography; and Global Spatial Analysis*, 26, Technical Report, 93-1, UC Santa Barbara:ì, National Center for Geographic Information and Analysis (https://escholarship.org/uc/item/05r820mz).

Uggeri G. 2004, *La viabilità della Sicilia in età romana*, Galatina, Congedo.

ABSTRACT

The area of Castronovo di Sicilia was analysed by integrating different methodologies. In terms of the road network, it was decided to compare information from traditional written sources, such as the Itinerarium Antonini and texts from the Arab geographer al-Idrisi, with the results of the Least-Cost Path Analysis (LCPA) conducted using the QGIS plugin 'movecost'. The primary objective of this analysis was to evaluate how the centrality of the Castronovo area was determined by environmental factors that made it easily accessible along the main long-distance routes connecting the island. At the same time, the analysis aimed to highlight similarities and differences between the written sources and the LCPA results.