

Land Suitability Analysis for New Urban Development Strategies Oriented to 'Active Mobility' and Walkability: Potenza Case

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Abstract. An urban characteristic directly connected with the principle of well-being and with sustainability concept is walkability. It influences the way people perceive and experience the city. The objective to increase pedestrian urban mobility in the city of Potenza represents the general purpose of this research. The analytical approach discussed in the paper carried out an assessment of the propensity to walkability of the city of Potenza, focusing on different attributes assigned to the roads and divided into three different groups: road characteristics, comfort and safety. The hypothesized interventions, in view of a strategic and integrated approach to urban planning, are aimed at completing the urban road network infrastructure for active mobility in Potenza and represent a precondition for citizens to implement modal shift from your own vehicle to more sustainable forms of travel in the city.

Keywords: Walkability · Urban development · Sustainability

1 Introduction

Sustainable mobility is an objective pursued of many countries, driven by the need to protect the planet, promote relevant welfare and improve the comprehensive development. 17 are the intentions/objectives of the United Nations gathered in Agenda 2030 [1, 2]. Of them, 4 fall within the sustainable mobility (Health and Wellness - Clean energy is available - Cities and sustainable communities - Climate action).

A key element is connected with the principle of well-being to that of sustainability is the concept of walkability. Wanting to provide a more comprehensive definition, but at the same time easy deduction say that walkability is the spatial quality and the ability to welcome and encourage pedestrian mobility in urban and along the roads (cfr [3–5].

It influences the way people perceive and experience the city. A key example it addresses global attention is inherent in the city of Stockholm. In virtuous northern metropolis and 'witnessed in recent years to a net reduction in accidents and a significant lowering the number of road victims as well as the emergence of greener cities, less polluted, free from the car, ready to welcome young people, workers, families and

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tourists. This objective and 'reached with an increase of the pedestrian internal mobility, on two wheels and electric.

We may affirm that to develop a 'sustainable' and walkable city represents an heavy challenge in conjunction with many factors including: the morphological characteristics, the climate but also the economic interests of the big oil multinationals.

Shrinking the scope on a small town 'of southern Italy: Potenza, it is possible to understand how and why 'morphological characteristics and climate penalize the spread of sustainable mobility, made even more' difficult by fragmentation the territory [6] which disadvantages optimal public service management and thus induces the public to the use of private vehicles.

In the next section, attention is focused on sustainable mobility from a global point of view, starting with an analysis of the objectives, and proceeding to the definition of the purposes referred to in the NUA.

In the paragraph 3 analyzes in-depth case-study of Potenza city also with the objective to proceed to a critical review of PUM, configured from a European guidelines in order to obtain a new PUMS.

With a 'geo-swot' analysis [7], all the territorial features have been outlined, taking into account, through brainstorming, the opinions and views of all the players in the game who may be affected or influenced in a more or less appreciated the process.

In the paragraph 4, and is' taken as a reference, the methodology of urban walkability assessment of the city of Alghero proposed by Blečić et al. [5], had been applied to *the case of Potenza municipality according to several specific adjustments*. Finally a land suitability had been achieved: it represents the observation of potential suitability of the area to be transformed considering the program structure of the LFM.

In the paragraph 5, taking into account the data acquired from the previous analysis preliminary assumptions on a strategic vision for the future of Potenza walkability were discussed.

2 NUA and Urban Sustainable Mobility in the Framework of EU New Cohesion Policy

The New Urban Agenda adopted by United Nations Conference on sustainable urban and development (Habitat III held in Quito, Ecuador, 17 to 20 October 2016) [1] represents a global reference framework for urban development. The objectives proposed by the New Urban Agenda are related general issues on which the agreement of sighing States identified a global commitment on: education for all, dignity at work, hunger, gender equality, the environment and urban living. They are interconnected and indivisible objectives and balance the three dimensions of sustainable development: economic, social and environmental [8, 9].

In reference to sustainable urban mobility there New Urban Agenda expresses a focused commitment to:

- *We are committed to promoting public spaces safe, inclusive, accessible, green and quality, including roads, cycle paths and sidewalks, plazas, promenades, gardens and parks, which are multifunctional areas for social interaction and inclusion,*

health and human well-being, economic exchange and expression and cultural dialogue among different people and cultures, and are designed and operated to ensure human development and build a peaceful, inclusive and participatory society, and to promote coexistence, connectivity and the inclusion social;

- *We will support the delivery of well-designed network of roads safe, affordable, green, quality and other public spaces accessible to everyone and free from crime and violence (…) involving people in public spaces and promote walkability and cycling with ' aim to improve the health and well-being;*
- *We will take measures to improve road safety and integrate it into sustainable mobility and in the planning and design of transport infrastructure. Along with raising awareness, we will promote the security approach required in the Decade of Action for Road Safety, with special attention to the needs of all women and girls, as well as children and youth, the elderly and people with disabilities and people in vulnerable situations. We will work to adopt, implement and enforce policies and measures to actively protect and promote the safety of pedestrians and bicycle mobility (…) We will promote as a priority healthy and safe routes to school for each child;*
- *We will promote universal access to urban mobility, allowing a significant participation in social and economic activities in cities, integrating shippingrto and mobility plans in urban and regional plans and the promotion of a wide range of transportation and mobility options, in particular by supporting: a significant increase in accessible infrastructure, secure, efficient, affordable and sustainable public transport, as well as non-motorized options, such as walking and cycling, giving the above priority over the private motorized transport;*
- *We will encourage national and local governments to develop and expand financial - instruments that enable them to improve infrastructure and transport and mobility systems such as (…) walking and safe cycling infrastructure, sufficient and appropriate (…) to reduce congestion and pollution and improving efficiency, connectivity, accessibility, health and quality of life.*

3 Case Study Area: Potenza Town

The city of Potenza in Italy, with its 67,122 inhabitants, is the most populous city in Basilicata, with a demographic weight of around 12% on a regional basis and around 18% on a provincial basis. The population is distributed over an area of 175.43 km^2 with a density of 382.6 inhabitants per square kilometer. The morphology of the territory is purely mountainous, recording 1345 m s.l.m. as maximum quota and 605 m s.l.m. as a minimum quota; the maximum quota in urban areas is 819 m s.l.m. This is a highly vulnerable territory, both in terms of seismicity and hydrogeology. The city is characterized by the presence of various services: hospital, university, high schools, archiepiscopal see, prefecture, decentralized offices of the state administration, court, administrative offices of the Region and of the Province, centers of economic activities.

The town due to morphological reasons but also due to inadequate urban plans, has consolidated structural problems in urban mobility. The structure and functionality of the local public transport network is strongly conditioned by the morphology of the city and the characteristics of the road network, forcing tortuous routes with conventional means of modest capacity. To overcome the considerable height differences existing within the city, Potenza is crossed by a mechanized escalator infrastructure, the longest in Europe, which altogether extends over a distance of 1.3 km.

The city approved a Urban Mobility Plan (PUM) in 2008, which proposes a multimodal and multi-agency approach to urban mobility ensuring environmental, technical and economical sustainability. With the growing attention to the issues of sustainable mobility and the pursuit of urban development goals set by the European Union, it would be necessary to revise such mobility plan assuming new European guidelines (Sustainable Mobility Urban Plan (SMUP)).

This work considers as an assumption the strengthening of pedestrian mobility in the urban environment as an operational tool to structure a policy for sustainable urban development with consequent advantages in the field of transport and on public health, the economy and the environment. Walking is the most natural and spontaneous way of moving from one place to another and a way through which citizens become aware of the environment features around them. Individuals walking have the opportunity to establish a direct and non-mediated relationship with urban spaces, this helps to widen access to the opportunities offered by the city and make it easier, easier and more pleasant to use [10].

Due to the urban dispersion that has affected the city since the 1960s, pedestrian mobility has become an unusual option for citizens to move. Potenza has an urban dispersion index among the highest in Italy, equal to about 90% [11]. The phenomenon of urban dispersion manifests itself in the gradual abandonment of the historic center towards peripheries, complicating the management of infrastructures and services and making relations between the urban area and peripheral areas unsustainable.

The Integrated Territorial Investment of Urban Development in the city of Potenza [12] is the main strategic intervention program for the city financed with EU funds. It aims to strengthen the role of urban poles that supplies local services for regional basins: the city of Potenza has assumed such role over the years.

Within the ITI, the sustainable mobility strategy for the city is directed towards specific actions concerning: the infrastructure of new interchange areas, both rubber-rubber for the transfer from extra-urban buses to urban buses in order to reduce the overall bus traffic in the city, both rubber-installations to implement the use of mechanized systems linking with the historic center; the gradual decommissioning of the more obsolete TPL buses, to be replaced with Euro 6 and electric vehicles to achieve a reduction in polluting emissions and the development of an ITS infomobility project, to provide innovative services in the various modes of public transport and traffic management and urban mobility networks.

The pedestrian mobility of the urban environment and in particular of the road that includes the sidewalks and roadways, influence the way in which individuals perceive and use the city. What the concept of walkability allows to detect, in fact, is the quality of accessibility: how and how much the urban environment is able to encourage walking and to offer itself as a platform for a daily life based on pedestrian mobility [13, 14].

The classification of an urban area, in addition to the presence of opportunities, places of interest and services in space and in addition to their distances, it becomes relevant if they can also be reached on foot or by bicycle. Additionally If the pedestrian connection path is pleasant and spatially integrated with the environment surrounding, if it is rich in activity, if it is well maintained and perceived as safe, if it is not subservient to car traffic for design choices or for the prevailing social practices of use of space [15]. The research work was developed in the framework of the LFA methodology [7]. The SWOT analysis and the problem tree are shown below, from which emerges the picture of the critical issues identified regarding the general strategy to improve urban mobility according to environmental sustainability criteria (Table 1 and Fig. 1).

Table 1. SWOT analysis

Strengths:	Weaknesses
University city (30% of students living away from home on about 8000) Safe city compared to larger realities Presence of personnel to facilitate pedestrian crossing near to school Low pollution Presence of green areas Presence of pedestrian area in the historic centre Presence of places dedicated to culture, sport and leisure Presence of escalators and elevators Cultural and religious events	Weather and climate characteristics of the territory Morphology of the territory Demographic decline Bad rainwater runoff Low walkability (degradation, absence and inadequate size of sidewalks, poor lighting) Low maintenance of escalators Limited hours for the use of escalators and elevators Absence of information points Little control of isolated areas Fragmentation of the urban territory Peripheral shopping areas Cultural heritage not widespread and used Poor architectural, historical and urban quality High motorization rate (72 cars per 100 inhabitants)
Opportunities:	Threats:
Operational Programme - European Regional Development Fund (PO - ERDF) Urban Plans for Sustainable Mobility (UPSM) Bremen Declaration Amsterdam Pact European Urban Agenda 2014–2020 (5% of ERDF resources are allocated for sustainable urban development) Initiatives that promote sustainable mobility Administrative measures decided by public authorities for sustainable mobility development Natura 2000 Network Tourist, cultural and image effects thanks to Matera European Capital of Culture 2019 Rural Development Programs (RDP) - European Agricultural Fund for Rural Development (EAFRD)	Aging of the population (189,9 elderly people per 100 young people), depopulation and youth emigration Population profile Unsupervised pedestrians (security, stray dogs, prostitution, drugs, etc.)

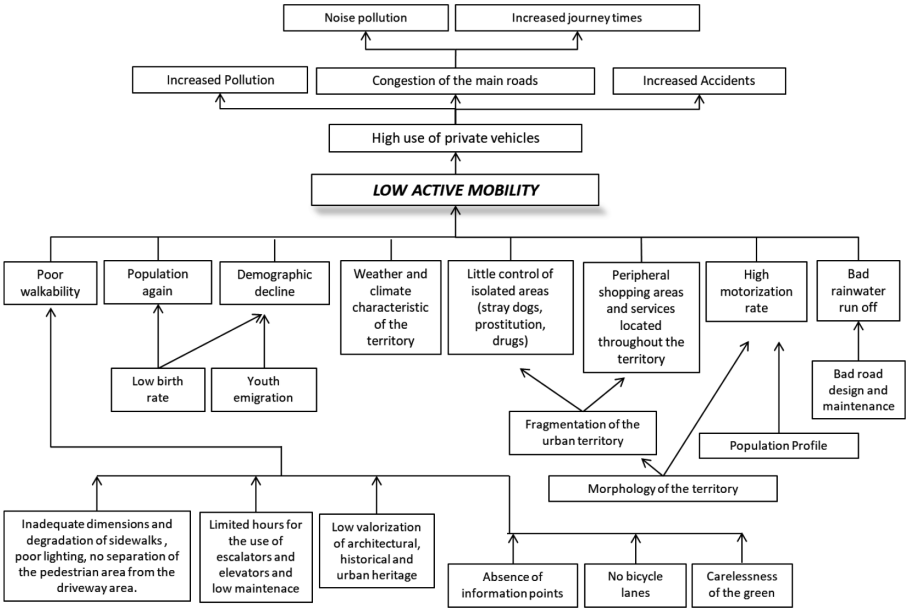


Fig. 1. Problem tree

4 Walkability Assessment: Criteria and Land Suitability

Walkability describes the characteristic of the urban environment to welcome and encourage walking and represents an indicator for assessing the liveability of places.

A substantial literature produced in recent years identifies walkability: the attribute of the physical environment to "be walked" as an important requirement of the quality of life in the city [16, 17]. In this context, walkability represents not only as an objective to be pursued in order to improve the citizens' quality of life, but also as a tool that urban planners and designers can use to re-develop methods of assessing the quality of life.

Providing a measure of walkability is a complex problem due to the multidimensional and multi-scalar nature that the concept implies. Therefore, measuring walkability levels can be interpreted by classifying the ability of a space to be traveled on foot; which translates into building a methodology that is able to synthetically express this quality of urban spaces. In recent decades, various methods and tools for measuring and assessing urban walkability have been proposed, which have allowed us to deepen our knowledge of the interdependent relationships between the organization of urban space and the spatial behavior of individuals.

Our approach is aimed at identifying the aspects that characterize the quality of the roads and that predispose the urban environment to encourage pedestrian mobility.

The assessment of walkability in Potenza was performed by associating to each arch of the road network, a specific set of attributes describing physical characteristics and qualitative aspects of roads. Each of these attributes has been assigned through in situ observations.

The methodological reference is the work for assessing the urban walkability of the city of Alghero proposed by Blečić et al. [5]. The proposed approach is oriented to the classification of routes (represented by arcs) through a walkability score based on the combination of three components: (1) the number of destinations of urban interest/opportunities within walking distance; (2) their distances; and (3) the quality of pedestrian routes to these destinations. The destinations have been divided by type (trade, services, green and recreational areas) and by user profile (tourists, parents, culture and education).

In our work on Potenza case study, the same attributes proposed by Blečić were used but it was decided to generalize the evaluation without distinguishing specific categories of destinations and users.

The road sections have been assessed taking into consideration both the presence of services typologies (shops, offices, schools, banks, post offices, parks, theaters, cinemas, sports and leisure facilities, etc.), useful not only for citizens but also for commuters (workers, students) or also for tourists from out of town. Additionally, secondary and too peripheral roads were excluded from the evaluation.

In Blečić work the aim is to verify for Alghero the effectiveness of active mobility on the current context situation for the enhancement of urban quality of life; in our case the evaluation is also aimed at providing a tool to support the allocation of resources for public investment in urban mobility.

Some of the attributes used represent requirements and characteristics of easily observable, recognizable and measurable roads such as: the presence of bicycle lanes, proximity to escalators and elevators, one-way streets, stops and parking along the road, the slope, the lighting, quality and level of maintenance of the flooring. Other attributes require a technical evaluation judgment. It is the case of "useful width of the pedestrian section" presenting values ranging from very wide sidewalks to the complete absence of space for pedestrians along road arcs. The separation of the pedestrian area from the driveway area is represented by the presence of horizontal and vertical physical elements (flower beds, trees, fences, walls, etc.) that increase the safety of pedestrian. Since the pleasantness of the walk is also given by the aesthetic aspect of the space surrounding the streets, they have been used as attributes: environmental interest and historical, architectural and urban interest, evaluating the presence and prevalence of pleasant elements or disturbing. The possibility of sheltering from sun, rain and wind, thanks to the presence of naturalistic and architectural elements, was assessed by the attribute of the shelter, a further factor of comfort for the pedestrian together with the possibility of parking and sitting, offered by the benches but also from staircases, walls and edges of the fountains. Another important attribute is the presence of activities and services, which not only constitute elements of attractiveness for pedestrians, but also increase the level of safety perceived along the roads thanks to the presence of other people and the increase in lighting. The attribute integration with the urban fabric serves to describe how the streets are integrated into the surrounding environment and finally the urban fabric attribute is evaluated based on the presence of squares, green spaces and parks (dense urban fabric) or based on in the presence of abandoned or non-built areas (low density urban fabric).

The attributes chosen for the assessment of the walkability of the streets of Potenza, have been divided into three groups: road characteristics, comfort and safety and each

of them has been arbitrarily assigned a weight according to the degree of importance that has been given to each group (5, 3 and 1 respectively).

For each road section considered a walkability index was calculated, obtained as a linear combination of the judgments given to all the attributes considered for the evaluation, weighed with the values assigned to the groups to which they belong.

Below is the synoptic table of the attributes, divided into the three main groups, specifying the values assigned to each with reference to the descriptive meaning considered.

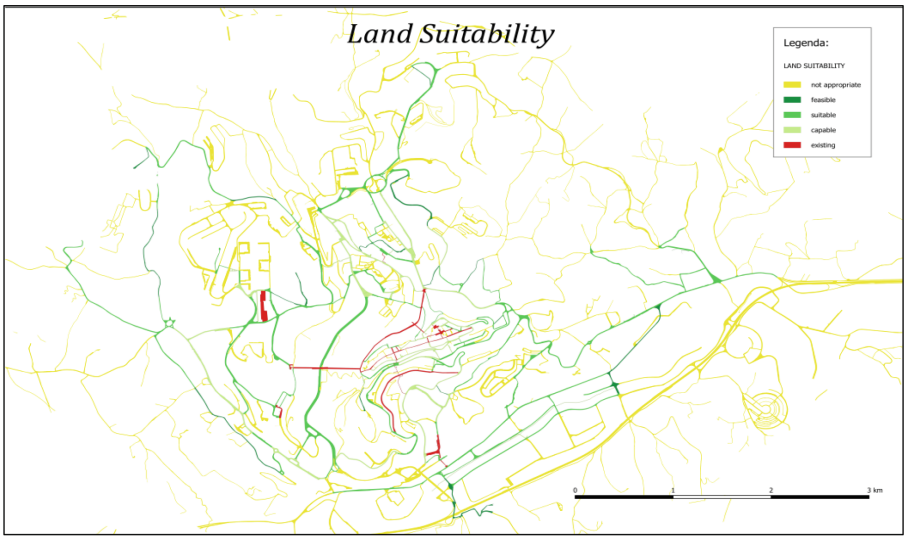
Table 2. Land suitability criteria.

Groups and weights	Attributes	Values
Road features Weight 5	**Width of sidewalk**	Wide (0.8) - Comfortable (0.7) - Minimum (0.5) - Inadequate (0.3) - Lacking (0.1)
	Cyclability	Exclusive lane (0.8) - Off-road lane (0.5) - On-road lane (0.3) - Not possible (0.1)
	Escalators	Directly connected (0.8) - Near (0.5) - Distant (0.1)
	Paving	Fine (0.8) - Cheap (0.5) - Bumpy(0.1)
	Path slope	Smooth (0.8) - Light (0.5) - Rise (0.1)
	Separation of pedestrian route from car roadway	Marked/Strong (0.8) - Weak (0.5) - Lacking (0.1)
Comfort Weight 3	**Lighting**	Excellent (0.8) - Good (0.6) - Inadequate (0.3) - Lacking (0.1)
	Sitting	Extended (0.8) - Thin (0.5) - Lacking (0.1)
	Shelter and shade (trees, cantilever roofs, porticos, balconies)	Strong (0.8) - Weak (0.5) - Lacking (0.1)
	Urban texture	Dense (0.8) - Park or green space (0.5) - Low density (0.3) - Undeveloped land (0.1)
	Frequency of services and activities	Abundant (0.8) - Somewhat (0.6) - Rare (0.3) - No services/activities (0.1)
	Transparency and permeability of the public-private space	Integrated (0.8) - Filtered (0.5) - Separated (0.1)
	Attractiveness from an environmental point of view	Preponderance of pleasant elements (0.8) - Presence of a few pleasant elements (0.6) - Lack of pleasant or disturbance elements (0.4) - Presence of few disturbance elements (0.2)
	Attractiveness from an architectural and urban viewpoint	Preponderance of pleasant elements (0.8) - Presence of a few pleasant elements (0.6) - Lack of pleasant or disturbance elements (0.4) - Presence of few disturbance elements (0.2)
Security Weight 1	**Width of the roadway**	Pedestrian way (0.8) - 1 car lane (0.6) - 2 car lanes (0.5) - 3 car lanes (0.3)
	One way street	Pedestrian way (0.8) - Yes (0.5) - No (0.1)
	On-street parking	Prohibited parking (0.8) - Permitted (0.5) - Illegal parking (0.1)

The walkability index, obtained for each road arc, allowed to construct synthesis maps in a GIS environment according to a land suitability approach [18]. Land suitability represents the degree of suitability of a land for a specific land use or for a specific transformation, and can be assessed for current conditions (suitability of the current land) or after an improvement action (suitability of the potential land). The suitability of real land is based on current soil conditions, without applying any input; information is based on physical environmental data obtained from soil surveys or from land resources. The potential suitability is the suitability that could be achieved after the land has been improved.

The methodology of GEODESIGN [19–22] foresees that the land suitability is represented through the following five classes: feasible, suitable, capable, not appropriate and existing; each class is symbolized by a different color: dark green, intermediate green, light green, yellow and red respectively.

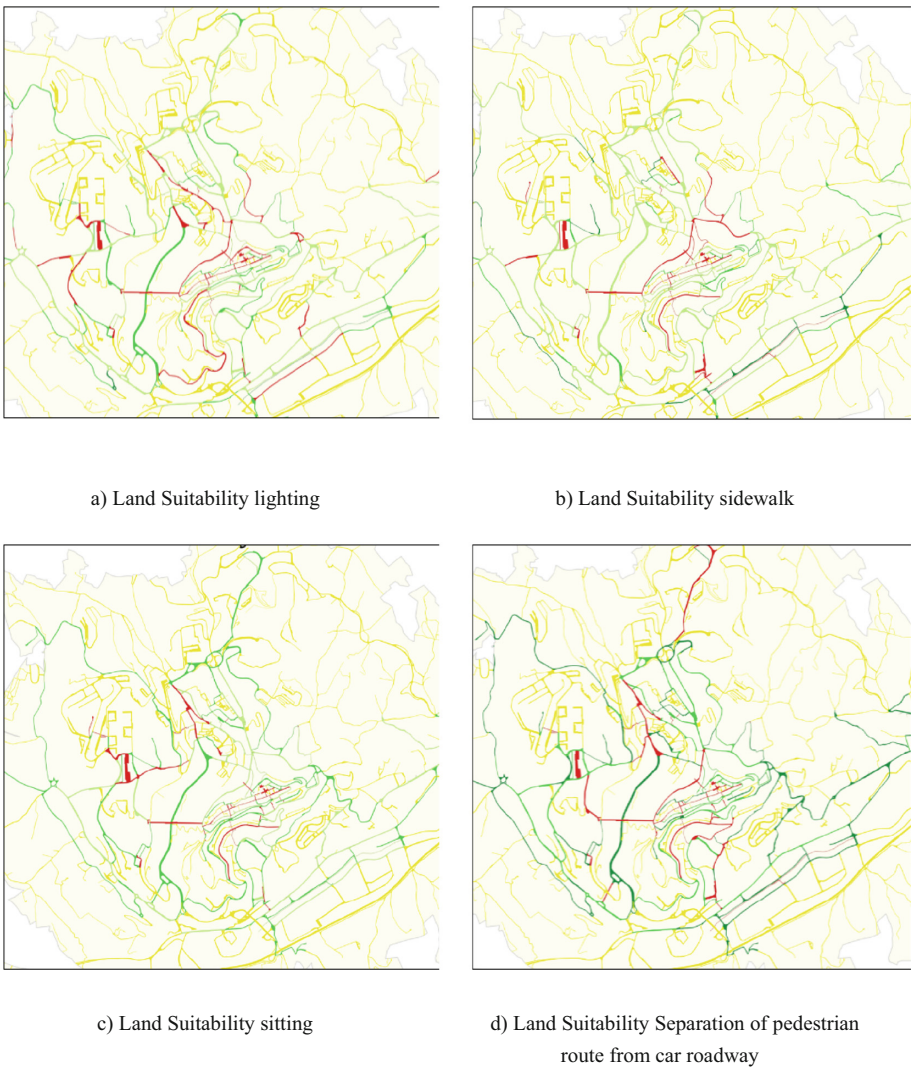
The following maps represents the results obtained in terms of land suitability of main road network for walkability development policies in of Potenza (Figs. 2 and 3).



Description of the evaluation: increase and promote active mobility in the city of Potenza. The classification was carried out taking into consideration the physical characteristics of the roads (width of the pedestrian section, number of vehicle lanes, paving, slope of the route, lighting, etc.), their connection with the surrounding urban fabric, the presence of activities and services and elements with environmental, historical, architectural and urban interest

FEASIBLE	SUITABLE	CAPABLE	NOT APPROPRIATE	EXISTING
Roads that limit active mobility due to the absence of the characteristic elements of walkability in the most central areas of the city and in the areas where services, cultural and leisure	Roads that do not have overall characteristics that are favorable to pedestrian mobility, since most require interventions.	Roads suitable for walking but need some improvements to make active mobility optimal.	Areas that do not need intervention	Roads with high walkability: optimal lighting, possibility of parking and sitting, presence of activities and services,

Fig. 2. Land suitability (Color figure online)



a) Land Suitability lighting

b) Land Suitability sidewalk

c) Land Suitability sitting

d) Land Suitability Separation of pedestrian route from car roadway

Fig. 3. Land suitability per attributes (Color figure online)

5 Strategic Vision and Conclusions

This study carried out an assessment of the propensity to walkability of the city of Potenza, focusing on different attributes assigned to the roads and divided into three different groups: road characteristics, comfort and safety.

Starting from the evidences discussed through the land suitability calculations described in the previous paragraph, a strategic proposal based on a program structure (objectives, results and actions) has been designed. The general objective is to enhance active mobility in the city. This is consistent with the pillars of the NUA [1], with the

SDGs [23]. The specific objectives, interconnected with the general objective, are: improving pedestrian areas, increasing safety in isolated areas and improving connections with peripheral areas.

These objectives refer to active mobility system in Potenza that have been analyzed through the attributes in Table 2. This critical description makes it easy to identify types of intervention.

The hypothesized interventions, in view of a strategic and integrated approach to urban planning [8, 9, 24–30], are aimed at completing the urban road network infrastructure for active mobility in Potenza and represent a precondition for citizens to implement modal shift from your own vehicle to more sustainable forms of travel in the city. A preliminary estimate of the cost of the interventions was also produced, which is useful to define the order of magnitude of the investment (which due to the nature of the works must be carried out mainly with public resources) amounting to 7 million euros.

Even in morphologically complex contexts, due to the high slopes or meteorological and climatic characteristics, with the right intervention and planning policies, it is possible to improve the conditions of the roads and make the city walkable with a consequent increasing pedestrian mobility of citizens.

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