Chapter 19

Towards Regenerative Wasted Landscapes: Index of Attractiveness to Evaluate the Wasted Landscapes of Road Infrastructure

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19.1 Introduction

Over time, the planning process of cities has undergone enormous changes and ecological excesses. Cities have become involved, dynamic (Batty, 2008; Holling, 1973) and, at the same time, adaptive systems (Elmqvist & Bai, 2018; Elmqvist et al., 2018). They are non-linear systems capable of self-organisation, modified continuously by disruptive factors and processes within the system or exogenous factors, capable of triggering changes in urban systems, altering or modifying their state. Their development is closely linked to and influenced by cause–effect relations between the various social, political, economic and environmental components (Bottero et al., 2019).

The city's definition as a complex system capable of organising itself presupposes that it can be compared to an entire living organism with its urban metabolism (UM). The main studies concerning the relationship between the city's urban system and the external environment were first approached through socio-economic metabolism (González & Toledo, 2016) and then through urban metabolism. For decades, the latter has been the subject of many interdisciplinary studies by ecology, geography, landscape science and town planning (Fischer-Kowalski, 1998).

Anthropisation and the influences on the ecosystem—city have generated numerous impacts over time, leading to a change in its metabolism and the fragmentation of the territory, also implemented by planning that is not functional to the community's needs. All these interventions on the territory have generated abandonment and degradation areas, defined as drosscapes (Berger, 2007) and then wasted landscapes and wastescapes (Amenta, 2015; Amenta & van Timmeren, 2018; Geldermans et al., 2017; Russo et al., 2017).

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Abandoned areas also compromise the proper functioning of ecosystem services, which are fundamental for the sustenance and health of living beings and the city's metabolic process. Their characteristics lie in the condition of disconnection between these spaces and the entire topological context. On the one hand, they are excluded from the city's active life or marginalised concerning the fulfilment of its metabolic cycles; on the other hand, they are necessary for the urban system's functioning but are purely serviceable, without territorial value, inaccessible and repulsive.

The basic principle of disposable is also applied to these places rejected by the city, impacting the natural and urban environment and causing a break in the various systems' ecological structure. This is understandable, especially regarding the process of deindustrialisation that has led to the urban expansion of cities towards the peripheral areas, resulting in a territory full of spaces that are no longer in keeping with current living requirements. Large areas of abandonment cause substantial impacts and risks on the territories, fragmenting the local societies' living contexts and those settled there (Russo, 2018).

So much so that, conceptually, the same principles of recovery and reuse applied to individual objects or architectural artefacts could be used.

Instead, the problem lies in implementing viable and advantageous solutions without endangering the environment's lives and its inhabitants. It continues to produce and feed the linear production chain—consumption—waste. There are two ways to find problems and the awareness of the solutions proposed' ineffectiveness, do not seek new solutions, more advantageous and sustainable. Still, it focuses on functionality without seeing the surrounding urban and landscape fabric. Although Europe continues to show the need for planning policies that tend towards zero land consumption, on the other hand, the soil is still being designed and waterproofed, and even more so, a territory that is not infinite is being tarred.

Technological innovation contributed even more to horizontal development and the production of places that had to be isolated from the urbanised context for purely functional reasons.

Consumerism's effects on the territory have generated vast neglect areas, incredibly close to the major arteries of road connection. These should not be considered separate entities, but as part of a network: a potential to define a strategy that preserves the territory and avoids further land consumption (Paoletta et al., 2013).

As a living organism, the city has an intrinsic metabolism that works when every ecosystem network relates to the natural and built environment. The weakening and non-reproducibility of natural and environmental resources, caused by cities' uncontrolled growth, generate an imbalance between urbanised areas and the natural environment. Future transformations turn out to be unsustainable, because the territory is even more exposed to risks, not only environmental, which determine the impossibility of living in these places (Russo, 2018).

The critical interpretation of these wasted territories defines some aspects to be considered to define a sustainable, regenerative process. The loss of the environmental, natural and identity quality of the wasted landscapes of road infrastructures represents one of the challenges to intervene. These territories defined as a waste of the city must be treated as part of the landscape.

In particular, reference is made to abandoned areas, including roads interstices, abandoned subways or areas close to the same infrastructures that constitute the territory's negative aspect because they are considered urban waste (Ardita, 2009).

Contemporary planning must play a role in the regeneration of these degraded spaces. Roads create voids that generate consequent urban fragmentation, producing cumulative impacts to the detriment of the quality of life of those living there and the environment in general.

They are defined by Rem Koolhaas (2006) as "urban bubbles drawn by discontinuous and hidden boundaries". They are marked spaces recognisable in the dispersion of the contemporary city.

It is possible to focus on certain types of interstices that emerge mainly between significant roads, between ring junctions and to a lesser extent between neighbourhood streets. Each route is an insurmountable limit that creates a denial of living space. These large infrastructure networks appear to be increasingly detached from a shared, reasoned project capable of combining functional aspects with the area's identity. The monofunctional design of roads does not recognise a fundamental role. Still, it defines a negative taxonomy that inexorably determines voids and consequent urban waste. Urban voids can represent new scenarios for contemporary territories. Although they are considered the waste of uncontrolled expansion today, they can become the new porosity (Fini & Pezzoni, 2010) that triggers new mechanisms and transformations. They are strategic places for the city's sustainable development as they can be a fertile ground for experimentation in urban design. Abandoned areas are the driving force, together with roads, for urban regeneration that is attentive to sustainability principles and capable of producing quality with minimum impact on land consumption, reducing urban sprawl and activating new local economies.

In this study, wasted landscapes are explored through an evaluative key. The contribution gives importance to the general context in which the wasted areas are inserted, starting from the road system and connecting to the city context. In this sense, the evaluation of abandoned areas of the road infrastructure represents the integral key to trigger a regeneration process that is also attentive to local and environmental dynamics. By identifying areas of neglect close to infrastructures, specific indicators are analysed as decisive starting points for future planning and more specifically for the regeneration of waste landscapes.

19.2 The Wasted Land of Roads as a Resource

The road network is defined as a complex organism and articulated according to the landscape that crosses its seat involves a large territory. This road network is the structural and structuring element of the territory and the whole landscape (Guaralda, 2006). They can represent an opportunity when associated with wasted landscapes.

To implement regeneration operations for abandoned areas close to roads, it is necessary to define a series of government actions and good practices to counteract all the increasing urban development effects that have disfigured the territory and produced waste areas. It is necessary to identify these places' potential, which nowadays causes impacts for the landscape, society, and the environment because they are not connected to a utility (Russo et al., 2017).

Moreover, they cannot be considered urban waste yet, because they must be the gear that activates regeneration, the source of new opportunities. They are physical elements symbolising the rebirth of the contemporary city. Regenerating abandoned places in the roads' buffer zone generates new transversal relationships with the built and natural environment.

The various crossroads between infrastructure nodes become a privileged potential space for creating ecological corridors capable of regenerating ecosystem services that have been compromised over time. These can be new places of urban attractiveness or identity symbols of access to the city. It is essential to analyse these places to see if it is possible to define functional corridors between separate physical parts to create transversal interconnections that differ according to the context in which they are inserted. Such a process can re-evaluate the meaning of abandonment areas by thinking about innovative solutions linked to sustainability.

Each waste landscape of infrastructure (Berger, 2007) constitutes a key part of urban development to and generates new environmental value.

When building a new road, all the impacts it will have on the territory must be considered. Negative impacts are mainly linked to morphological and ecosystem fragmentation and define empty places without meaning. The positive impacts define new territorial connections, therefore new poles of attraction, and consequently an increase in tourism and economy.

The combination of urban regeneration and evaluation must be the engine that redesigns the urban and environmental system to sustainable development.

In this sense, it is necessary to structure an innovative process of regeneration by defining a methodology that can support the rethinking and the re-functionalisation of waste landscapes of infrastructure (Berger, 2007).

The challenge of sustainability must be fought in those territories that are already urbanised, in those places where economic development and urban growth must be reconciled with a necessary environmental and social balance, to move towards more sustainable city models (Coppola, 2016).

19.3 A Methodological Proposal for a Regenerative Process

The need to address current wasted landscape regeneration issues has led to a rethinking of traditional technocratic approaches. The approach to the sustainable development of a site can be described as dynamic (Cerreta & De Toro, 2002), as there can be no fixed solution (van Timmeren et al., 2012).

Each context presupposes different processes, which may change the construction and adaptive solutions to the different places they are inserted. Also, considering regeneration as one of the cogs that helps achieve urban sustainability goals means thinking about monetary investment (representative especially of regeneration processes) and social involvement and users.

From this perspective, evaluating the abandoned space and those who live in the territory is essential to help the political decision-maker in territorial planning choices related to functional aspects and the environment. The underlying complexity of urban regeneration processes is also due to the difficulty of collecting soft and hard data to track shared sustainable solutions. In this sense, the evaluation serves as a useful tool in regenerative processes. The assessment of preferred urban regeneration scenarios should be considered one of the decision-making process elements. In itself, the process of urban regeneration is one of the decision-making processes. It is essential to assess the area under consideration, define criticality and potential and then structure together with the different actors involved in which scenarios could be preferable. It is important to use indicators to define effective recovery and transformation scenarios to implement sustainable regeneration processes in an increasingly complex territory (Bottero et al., 2016; Cerreta & De Toro, 2002; Mondini, 2009; Spina et al., 2017).

The research methodology had started with the identification of the analysis context. The case study refers to Afragola, Casalnuovo di Napoli, Cardito and Casoria in Naples' metropolitan city. They are territories where the city's expansion process had defined new areas close to the road infrastructure that is now abandoned and lacking functionality. It had been defined for the first time in the Horizon 2020 REPAiR project.

Wasted landscapes close to road infrastructures refer to:

1. abandoned infrastructure buffer zones (WL1);
2. abandoned fields and agricultural plots (WL2);
3. public or disused equipment of public use or utility (WL3).

Two indicators of centrality had developed from these three types of wasted landscapes of infrastructure:

- Straightness centrality index (Barthélemy, 2011; Crucitti et al., 2006; Sevtsuk & Mekonnen, 2012; Vragović et al., 2005).
- Betweenness centrality index (Brandes, 2001; Freeman, 1977; Porta et al., 2006; Sevtsuk, 2010; Sevtsuk & Mekonnen, 2012);

Both had related to population density to estimate the number of the population served and how attractive and accessible those areas can be.

By identifying wastescapes as the focus of the analysis, it is possible to define two types of evaluation maps useful to understand if such spaces can represent an opportunity for the future development of territories.

By identifying wasted landscapes as the centroid of the analyses, two types of evaluation maps were defined, useful for understanding whether such spaces can represent an opportunity for the future development of territories. These metrics are similar to measures of spatial accessibility but have been applied to the network rather than on Euclidean space. The following paragraphs describe the study area, the central indices and the results.

19.3.1 Selection of Case Studies

The research had identified the municipalities of Aafragola, Cardito, Casalnuovo di Napoli and Casoria (east of Naples) as case studies (Geldermans et al., 2017).

These territories, located in the Neapolitan hinterland, are highly urbanised, and the presence of large road infrastructures defines a taxonomy that generates wasted landscapes (Amenta & Attademo, 2016; Geldermans et al., 2017; Russo et al., 2017) (Fig. 19.1).

In Table 19.1, it is possible to identify the main characteristics of the four municipalities. The table shows the surface area in km² of each municipality with its total population, referring to 2011. Also, the total area of the different types of abandoned areas was calculated for each municipality.

19.3.2 Presentation of Centrality Index and Results

Network centrality measures are mathematical methods that quantify the importance of nodes in a network. These metrics identify each element's centrality on the network, relative to surrounding systems and elements (Sevtsuk & Mekonnen, 2012).

Specifically, the Straightness index identifies the connection and interrelation that exists between two points. This interrelation is optimal when the path is straight. The expression can evaluate it:

$$Straightness[i]^r = \sum_{j \in G - \{i\}; d[i, j] \leq r} \frac{\delta[i, j]}{d[i, j]} \cdot W[j] \quad (19.1)$$

where $\delta[i, j]$ is the distance between the wasted landscapes i and j , $[i, j]$ the distance between the shortest paths between the wasted landscapes, and $W[j]$ the weight of the destination j . Straightness can only be estimated if the impedance units are in a linear distance.

Fig. 19.1 The spatial boundaries of the study area. The study area is chosen to consider the Focus Area identified in the Horizon 2020 REPAiR project (Geldermans et al., 2017). The focus is on Afragola, Cardito, Casalnuovo di Napoli and Casoria in the north-east of Naples. In the four municipalities, wasted landscapes close to roads are mapped to the three identified typologies: abandoned infrastructure buffer zones (WL1), abandoned fields and agricultural plots (WL2), public or disused equipment of public use and public utilities (WL3) (Source Author's elaboration)

Table 19.1 Main characteristics of the 4 municipalities selected for the Metropolitan City of Naples and the area in km covered by wasted landscapes for each municipality

Case study name	Area [km ²]	Population (2011)	Area [km ²] of wasted landscapes (WL)
Afragola	17,803	63,820	2824
Cardito	3157	22,322	0151
Casalnuovo di Napoli	7886	48,621	0456
Casoria	12,109	77,474	0478

Note that the population data refer to the database of census plots produced by ISTAT for the year 2011. The database is implemented every ten years, which is why the most recent database has been used

Source Author’s elaboration

The betweenness index (Sevtsuk & Mekonnen, 2012), calculated for wasted landscapes between the road network, defines the number of times that space is reached by defined short routes within a given radius. Each equidistant routes is assigned the same weight if a shorter route is found between two wasted areas. The index is calculated as follows:

$$Betweenness^r[i] = \sum_{j,k \in G - \{i\}; d[i,k] \leq r} \frac{n_{jk}[i]}{n_{jk}[i]} \cdot W[j] \quad (19.2)$$

where n_{jk} is the number of shortest routes between abandoned areas (j, k) , and $n_{jk}[i]$ is the number of routes passing close to the areas, in a given radius, while $W[j]$ is the weight of wasted landscapes (Sevtsuk, 2014). The analysis has also been weighted to demographic data, so in Table 19.3, the potential number of population that can use that space is made explicit.

The first map in Fig. 19.2 shows the straightness centrality index calculated as a function of the roads that cross the wasted landscapes. The straightness identifies wasted landscapes located in an optimal position about the roads’ complex network. So from green to red, we define those most walkable spaces because they are located on straight and long roads. The higher the index, the easier it is to get to those places. This is because these locations can be reached by several routes and in a direct way.

Furthermore, they are in an optimal location, unlike places with a lower index. Discontinuous roads cross these. The straightness centrality index is useful for identifying places closer to the surrounding building fabric because they are more connected. These wasted landscapes could be the first space in urban regeneration as they are already optimally connected to the urban context. On the other hand, the places identified as distant from the urbanised territory can become the new ecological corridors connected to their environmental texture.

On the other hand, the second map identifies how close the wasted areas are to the road system within a given radius. It calculated as the average of the shortest route’s lengths used to reach the different wasted landscapes. The surface area of each wasted landscape is used as a weight to analyse this indicator. All wasted landscapes that are located along the main communication routes have higher results. This result is because there are more geodetic routes between the surrounding destinations (Tables 19.2 and 19.3).

Fig. 19.2 Analysis of centrality index in Afragola, Cardito, Casalnuovo di Napoli and Casoria. In the first map, the straightness centrality index weighted by wasted landscapes area covered. In the second map, the betweenness centrality index in a 500-m network radius, weighted by wasted landscapes area covered and population density (Source Author's elaboration)

Table 19.2 Area covered by the 3 types of wasted landscapes sites in Afragola, Cardito, Casalnuovo di Napoli and Casoria

Case study name	WL1 Area [km ²]	WL2 Area [km ²]	WL3 Area [km ²]
Afragola	1.10	1.483	0.240
Cardito	0.012	0.148	-
Casalnuovo di Napoli	0.132	0.320	0.002
Casoria	0.185	0.223	0.069

Source Author's elaboration

Table 19.3 Estimated population per cadastral section living within 5 10 and 15 min' walking distance of wasted landscapes (WL) sites in Afragola, Cardito, Casalnuovo di Napoli and Casoria

Case study name	Estimated population by census living:		
	5 min' walk from WL	10 min' walk from WL	15 min' walk from WL
Afragola	18,063	38,447	68,740
Cardito	10,377	10,556	18,366
Casalnuovo di Napoli	18,485	18,563	35,412
Casoria	16,338	47,519	47,519

Source Author's elaboration

19.4 Discussion and Future Perspectives

The emergence of the landscape concept as a complex system defines a conservative policy and considers the road infrastructure as the element that produces degradation and de-qualification. It is no longer necessary to consider road infrastructure as environmental detractors. Still, it is necessary to consider them as gears capable of creating connectivity between different abandoned places and restoring damaged ecological-environmental relations. It is necessary to use decision support tools to analyse such systems' criticality and potential to minimise impacts. Also, the Leipzig Charter of 2007 addressed processes related to integrated urban regeneration and land management strategies. Objectives have been defined concerning an integrated vision of urban policies, analysing territories' status quo and the connections between the natural and built environment. A shared vision between all actors involved in the process allows an open view of innovative solutions and creates convergence between social and natural environments. The evaluation also addresses the territory's complexity by assuming an analytical technique and defining the effectiveness and soundness of choices (Bentivegna, 1995).

The analysis shown so far has made it possible to identify wasted landscapes' possible potential, explicitly identifying the most easily accessible and attractive areas. Moreover, considering the high population density in these areas, abandoned areas can become new poles of attraction.

Furthermore, as the analysed municipalities have a high population density, it is assumed that spatial planning choices can also be influenced by those who live and inhabit the area. For these reasons, we stress the importance of evaluation in urban regeneration processes. In particular, it is necessary to rely on assessment tools that can support and guide scenarios and preferable solutions linked above all to sustainability and innovation by reasoning and bringing together different points of view (Cerreta & De Toro, 2002; Spina et al., 2017). Integrating regeneration planning processes with evaluation processes (Khakee, 1998; Lichfield, 1996; Spina et al., 2017) is the first step to trigger preferable solutions that address functional and environmental aspects and sustainability.

Future research developments aim to apply methodologies linking planning and evaluation. Constructing evaluation maps acts as a support for defining optimal solutions for the regeneration of wasted landscapes.

In particular, the research aims to identify the geodesign framework as the optimal tool for achieving these objectives. In particular, the framework developed by Carl Steinitz (2012) presupposes the identification of six decision-making models that guide the process of constructing planning choices.

The method identifies six main questions used to describe the study area and its functioning, to analyse the relationships between the systems of the territory and the status quo of the area with its critical and potential aspects. Furthermore, they are used to define possible transformations linked to physical and governance actions. The answer to the questions is defined through further evaluation models related to the presentation and then to the understanding phase of the territory under examination, developed by the different actors involved in the process with expert researchers' collaboration and followed by a process model. Other models are the evaluation and change model, the change model in which strategies can be defined, the impact model in which the efficiency of solutions is assessed, and the decision model (Campagna et al., 2016; Steinitz, 2012, 2014).

In particular, the framework is implemented by defining an open-source platform, geodesign hub (Ballal, 2015), to manage and organise the complex problems of the territories through collaborative decision-making processes. Such a platform can represent a field of experimentation in the regeneration of wastescapes as it combines the principles of web 2.0 with those of the planning support system (Campagna, 2016; Harris, 1989). In this way, the community collects data and takes part in the decision-making process to define preferable solutions (Haklay, 2017; Nov et al., 2014).

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