

# Measuring Resilience for Territorial Enhancement: An Experimentation in Trentino

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*Key words:* indicators and indexes, economic value of landscape, spatial planning, Territorial Integrated Evaluation, retail structures

## Abstract

*Urban resilience – namely the capacity of a territorial system to persist, adapt or transform in the face of pressure – calls for an adaptive approach to planning, able to face uncertainty and unpredictability. Evaluation plays a key role to support a "learn-by-doing approach", providing tools and methods able to sustain the definition of territorial and landscape policies under a*

*resilience perspective. The present article illustrates an experimentation developed on a real-world case study in Trentino Region. In particular, the paper describes an integrated model aimed at providing an overall evaluation of the territory under examination, by means of multidimensional indicators and synthetic indexes useful to support planning and management processes.*

## 1. INTRODUCTION

Evaluation plays a key role in planning approaches aimed at fostering territorial resilience. Resilience is defined as the capacity of a territorial system to persist, adapt or transform in the face of pressure<sup>2</sup>. The resilience concept is therefore characterized by a strong evolutionary nature and it understands the world as complex and unpredictable (Davoudi, 2012). To operationalise resilience, a planning

approach that includes and addresses the concept of "uncertainty" is thus urgently needed. Adaptive planning able to promote a "learn-by-doing approach" (Kato and Ahern, 2008; Gunderson, 1999; Holling, 1978) can respond appropriately to this challenge. The adaptive approach to planning – namely an approach able to accept and manage uncertainty (Light *et al.*, 1995) – has been used for decades in the field of planning and management of natural resources (Mondini, 2016; Walters and Holling, 1990). On the contrary, its systematic application in spatial and landscape planning policies, although desirable in a resilience perspective, is not common (Ahern, 2011).

This paper presents an experimentation that fully fits into this approach and puts evaluation at the heart of planning policies aimed at promoting territorial resilience. In particular, a set of indicators was designed and applied to assess and monitor the state of the landscape in the Autonomous Province of Trento. The Trentino landscape is currently subject to uncertain evolutionary dynamics due to the liberalization processes of the retail sector and therefore to the potential settlement of retail structures with a high landscape impact (see Section 2). In line with the holistic dimension of landscape, the set of indicators

<sup>1</sup> The research here presented was developed within the framework of the activities implemented for the Autonomous Province of Trento (2011-2017) by the multi-disciplinary research group of the Interuniversity Department of Regional and Urban Studies and Planning (DIST), Politecnico di Torino, coordinated by Grazia Brunetta. The results of the research were also developed with the support of the Interdepartmental Responsible Risk Resilience Centre (R3C) of the Politecnico di Torino.

<sup>2</sup> "Urban resilience refers to the ability of an urban system – and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales – to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity" (Meerow *et al.*, 2016, p. 39).

reads landscape values and pressures considering ecological, scenic, historical-cultural and economic aspects. The economic-estimative dimension of the landscape is of particular interest both from a theoretical-disciplinary point of view – since it introduces innovative evaluation approaches and techniques – and from a political-administrative point of view. The economic valuation of the landscape is actually useful for decision makers since it can provide information to support strategies for the resource allocation efficiency and it proves to be highly effective in communicating with stakeholders (Lombardi and Cooper, 2016; Storm, 2014, Heijman and Van der Heide, 2012). The most recent literature agrees in attributing to landscape the characterization of “economic good”, from which the community can receive several benefits (Bottero, 2011). Moreover, economic activities, linked to the use and transformation of the landscape, cause on it different kinds of effects and consequences; according to the economic literature, this means that landscape can be defined as a positive or negative externality (Tempesta, 2009).

The set of indicators was applied in those Trentino territorial areas (Valle Communities, VCs) situated along the Adige river (the so-called “Asta dell’Adige”, consisting of VC Rotaliana Könisberg, VC Val d’Adige, and VC Vallagarina). This is a man-made environment, characterized by extensive urban settlements and transport infrastructures which coexist with high landscape values. The evaluation model aims at providing an integrated assessment of the “Asta dell’Adige” landscape, through multi-dimensional indicators and synthetic indexes useful to support planning and management processes.

In this article, characteristics and challenges of the Trentino context are described in Section 2, while the methodology, application, and results of the evaluation analysis are presented respectively in Sections 3, 4 and 5. Eventually, some considerations on the evaluation model’s significance and its potential for further development are discussed in Section 6.

## 2. THE INSTITUTIONAL AND TERRITORIAL CONTEXT

The evaluation analysis here presented was applied in the territorial context of the Autonomous Province of Trento (APT). Here, interesting challenges for territorial government and spatial planning have recently arisen. Nearly eight years ago (Provincial Law 17/2010 and Provincial Resolution 1339/2013), APT chose to completely redefine retail territorial policies in compliance with the European Directive 2006/123/CE (the so-called “Bolkestein Directive”) and the national Law Decrees (201/2011 and 1/2012), that established the liberalization of services. APT eliminated from regulations (Provincial Law 17/2010) and Territorial Plans (Provincial Territorial Plan, PTP, and Community Territorial Plans, CTPs) any reference to retail

typologies, quantitative parameters, and zoning<sup>3</sup>. Consistently with a consolidated tradition of territorial planning – from the first PTP, 1967, by Giuseppe Samonà, to the one, 2008, that is still in force (Giovanazzi and Franceschini, 2012; Zoller, 1983) – it was however clear that promoting a logic of reform of retail policies could not mean abdicating to territorial planning and landscape conservation. The Province has therefore embarked on a political path aimed at combining the needs for economic development and landscape conservation. This process has been supported since 2011 by the research activity carried out by the research group from the Interuniversity Department of Regional and Urban Studies and Planning (DIST), Polytechnic of Turin<sup>4</sup>, which defined and applied, in Trentino, the methodology of Territorial Integrated Evaluation (TIE)<sup>5</sup>. TIE was aimed at steering retail planning policies of the VCs (CTP, 2015), and of the Municipalities of Trento and Rovereto (PRG, 2015), towards sustainability objectives, taking in account territorial criteria instead of merely quantitative parameters: landscape, environment, and economy were, in fact, the pillars on which local development scenarios were defined, conceiving retail as a driver for territorial and landscape enhancement (Brunetta and Salizzoni, 2016). Through TIE, a planning approach based on a process of evaluation, monitoring and institutional learning (Brunetta, 2013), instead of on quantitative forecasting and control (the so-called “blueprint strategies”), was therefore promoted. This

<sup>3</sup> The only parameter indicated by the regulations and respected by Plans is that given by quantitative thresholds of sales area, which define different formats: Mid-sized retail shops (MRSs) are retail stores whose sales areas are more than 150 sq m and up to 400 sq m in cities with 5,000-10,000 permanent inhabitants and up to 800 sq m in other cities. GLAs are retail stores whose sales areas are more than 300 sq m in cities with fewer than 5,000 inhabitants, more than 400 sq m in cities with 5,000–10,000 permanent inhabitants, and more than 800 sq m in other cities (Provincial Law 17/2010, sec. 3). With respect to these different formats indications for localization are not provided, but different tools and planning levels are indicated: (i) “deprogramming” for MRSs, (ii) planning competence of the VCs for GLAs with a sales area of less than 10,000 sq m, and (iii) planning competence of the Province for GLAs with a sales area exceeding 10,000 sq m.

<sup>4</sup> Research group: Grazia Brunetta (scientific responsible), Ombretta Caldarice, Silvia Giordano, Patrizia Lombardi, Roberto Monaco, Attilia Peano, Lorenzo Piacentino, Emma Salizzoni, with the collaboration of Antonio Cittadino and Francesco Fiermonte. See: Brunetta G., ed., 2012, “Applicazione della metodologia di Valutazione integrata territoriale per la costruzione di scenari territoriali del commercio in Provincia di Trento”, Research Report, DIST, Polytechnic of Turin, Turin, June.

<sup>5</sup> The Territorial Integrated Evaluation (TIE) methodology is the result of a research programme coordinated by Grazia Brunetta and conducted from 2004 to 2008 for Piedmont Region. The research had to do with the designing and preliminary experimentation of this methodology in some territorial retail planning contexts in the region, to support the planning of territorial retail development, in particular Gross Leasable Areas (GLA). See Brunetta, 2008.

*adaptive* approach to planning can foster territorial resilience (Crowe *et al.*, 2016; Redman 2014; Plummer *et al.*, 2013), especially in the Trentino context that is subjected to no longer certain and predictable evolutionary perspectives as a result of the liberalization process.

More specifically, the research activity implemented by DIST since 2011 provided for:

- the definition of local, open scenarios (non-prescriptive “open routes”) for the development of retail territories, based on a new paradigm that fosters the enhancement of historic centres, the support to secondary centres and inter-territorial cooperation;
- a constant monitoring of the main components of this development paradigm;
- a widespread action of knowledge transfer aimed at promoting institutional learning (Brunetta, 2015; Walker and Salt, 2006) for the application of the development paradigm.

This work has already given significant outcomes to date. The VCs, that are responsible for the planning of Gross Leasable Areas (GLAs) outside the historic centres, incorporated in their CTPs the main guidelines emerging from the application of TIE; in some cases, the envisaged local development scenarios were directly adopted by CTPs.

In 2017, the study here presented was developed by DIST<sup>6</sup> in the context of the above mentioned territorial monitoring activities carried out in order to facilitate a “learn-by-doing approach” to retail planning. The study concerned the updating of the environmental and landscape dynamics evaluation that was carried out between 2012 and 2014 through TIE on the whole provincial territory. This updated analysis was implemented also in order to support the retail planning phase of provincial competence, concerning the possible localization of a GLA with a sales area exceeding 10,000 sq m (Provincial Law 17/2010, article 11). The analysis focused on the “Asta dell’Adige” area (VC Rotaliana Könisberg, VC Val d’Adige, VC Vallagarina), since, as already shown in the previous TIE application (Monaco, 2015), precisely this area appeared as the most suitable to potentially host a GLA with a sales area exceeding 10,000 sq m, due to the presence of a lively retail system and of important urban settlements and transport infrastructures. Considering the potential impacts of a GLA of such importance on the environmental and landscape system (e.g. land consumption, increase in emissions), it was deemed necessary – as required also by the provincial legislation<sup>7</sup> – to assess the current state of the landscape along the

Adige river, verifying the opportunity to locate in this area such a structure (Brunetta, 2014).

### 3. EVALUATION METHODOLOGY

The complexity of the landscape under evaluation has been analysed by disaggregating the different components of this landscape, according to a system of indicators that considers environmental, scenic, historical-cultural and economic aspects. In this sense, the various aspects of the landscape are interpreted in a coordinated way in order to calculate synthetic indexes (Gómez-Sal *et al.*, 2003). These indexes can produce systematic information useful for supporting strategies of territorial protection and transformation (Cassatella and Peano, 2011; Ingaramo *et al.*, 2017).

The system of indicators is structured into two different sub-systems: the indicators of value and the indicators of pressure. The indicators of value measure the landscape quality in the considered Municipalities, while the indicators of pressures investigate the considered negative impacts on the landscape components in the context under examination. For each of the two sub-systems, the evaluation model proposed in this research defines a synthetic index given by the aggregation of the different indicators (Jesinghaus 1999; JRC 2009; Rajesh Kumar Singh *et al.*, 2012). Therefore, each Municipality will be characterised by two synthetic indexes, one for value and one for pressure, able to define, on the one hand, the level of quality and, on the other, the level of pressure within the landscape.

The evaluation procedure entails the following steps:

1. Definition of a system of landscape indicators of values and pressures. The indicators have been selected according to the following criteria:
  - representativeness of the holistic dimension of landscape, namely its environmental, scenic, historical-cultural and economic components (OECD, 2004; Malcevschi, 2004; Sowińska-Świerkosz and Chmielewski, 2016);
  - consideration of the programmatic themes as highlighted by the Provincial Law (LP 17/2010, art. 11.2) regarding the localisation choices of GLAs (e.g. limitation of soil consumption, enhancement of historic centres, reduction of road traffic emissions);
  - replicability of the methodology to allow a monitoring action to be implemented by the institutions (institutional learning process), thanks to the use of

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<sup>7</sup> The Provincial Law 17/2010 (art. 11.2) states that the localization of GLAs must also be based on studies that consider “the parameters relating to the reduction of the territorial and

environmental impact of large-scale retail structures, the promotion of territorial and urban quality, as well as the need for environmental and health protection from pollution; the studies take into account, in particular, the strategic objectives of the PTP, also with regard to (...) the objective of a balance between free and built areas”.

indicators based on accessible and constantly updated public data (MEA, 2005).

2. Collection of municipal data, which are available from the main statistical sources at national and provincial level. Table 1 describes the statistical sources considered for the data processing with respect to the main categories of aspects included in this evaluation model.
3. Calculation of the indicators for each Municipality and normalisation of the results on a common scale so that each indicator is included in the interval [0,1], in order to make the indicators comparable to each other<sup>8</sup>, according to the following formula (1):

$$I_j = \frac{x_j}{x_j^{max}} \quad (1)$$

where

$I_j$  = normalised value of the indicator

$x_j$  = original value of the indicator of the Municipality  $i$

$x_j^{max}$  = maximum value of the indicator with respect to the all Municipalities of Asta dell'Adige

4. Definition of the synthetic indexes of value  $V$  and pressure  $P$  for each Municipality of the territory, through the application of the mathematical procedure for the combination of partial data, according to the arithmetic mean calculation.

It should be noted that all the indicators equally contribute to the definition of the final synthetic indexes. This choice derives from the context of the decision-making problem in question in which the specific objective of the evaluation, i.e. supporting the location choice for a GLA of more than 10,000 sq m, has been achieved through an ad hoc resolution (see Section 6). In this case, it has been decided to assign an equal weight to all the indicators, to construct a "neutral" decision-making scenario that can represent the point of view of the provincial administration.

5. Calculation of the final synthetic index for each Municipality according to the following formula (2):

$$I_{V/P} = \frac{V - P}{V + P} \quad (2)$$

where

$I_{V/P}$  = synthetic index value/pressure

<sup>8</sup> It should be noted that this step was necessary for all the indicators, with the exception of the indicator V.09 (Table 2). The indicator V.09 represents the real estate value of residential buildings for the sub-system of value indicators. In fact, this indicator was already calculated as the ratio between the market value of residential buildings in the Municipality under examination and the maximum market value of residential buildings within the "Asta dell'Adige" Municipalities. Therefore, no further normalization was necessary.

## 4. APPLICATION

### 4.1 The indicators of value

The subsystem of the indicators of value includes several indicators that represent the landscape economic value, such as indicators V.08 "BIO/DOP/PGI farms" and V.10 "Real estate value of agricultural lands", which represent the economic value of rural landscapes, and the indicator V.09 "Real estate value of buildings", which provides an economic value of the quality of urban landscape (urban central areas). In addition, the indicators V.05 "Arrivals", V.06 "Nights spent" and V.07 "Accommodation capacity" are also effective indicators of the landscape economic value. Among the landscape values, the areas of natural, historical-cultural and scenic importance (indicators V.01 "Ecological network elements", V.02 "High-quality agricultural areas", V.03 "Sites of cultural interest" – which refers to the so-called "invariants"<sup>9</sup>, as identified by the PTP – and V.04 "High-quality scenic views") have been obviously considered.

Table 2 describes the subsystem of the indicators of value. According to the methodology illustrated in the previous sections, the value indicators have been calculated for each of the 29 Municipalities situated along the "Asta dell'Adige". The results have then been normalised and aggregated into a synthetic index of value. Figure 1 shows, for each Municipality, the disaggregated synthetic index of value, thus highlighting the contribution of the single value indicators (V.01-V.10) with respect to the overall index.

### 4.2 The indicators of pressure

In consideration of the issues highlighted by the Provincial Law 17/2010 (art. 11.2) with regard to the location of GLAs, the subsystem of pressure indicators pays particular attention to the emissions of pollutants from road traffic (indicator P.04) and the dynamics of land consumption. Land consumption refers not only to the current territorial impact of urban areas (indicator P.01) but also to the propensity to extend these areas, as envisaged by Local Urban Plans (indicators P.05 "Index of urban growth" and P.06 "Index of loss of natural, semi-natural and agricultural areas"). Moreover, the dynamics connected to the hydrogeological danger and risk (indicators P.02 and P.03) have been assessed, with

<sup>9</sup> That is "the territorial elements that constitute the distinctive characteristics of the territorial environment and identity, in as much as they are stable configurations or ones whose modifications proceed slowly and they deserve to be protected and enhanced in order to guarantee balanced and sustainable development in the evolutionary processes that are foreseen and promoted by the instruments of territorial planning" (PTP, sec. 8).

**Table 1 - The main data sources considered for the definition of the indicators of value and pressure**

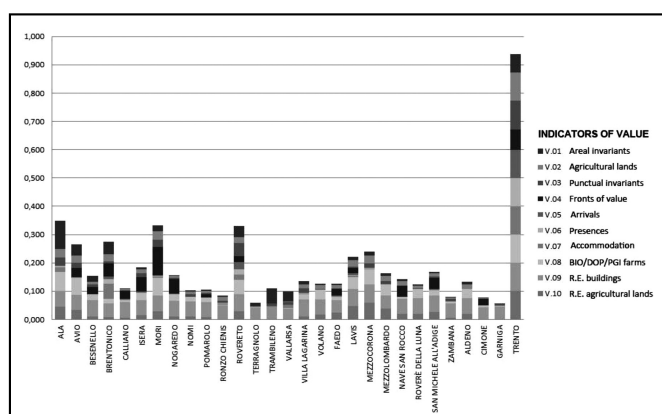
Indicators	Categories	Data source
Value	Agriculture	ISTAT - National Institute for Statistics
	Tourism	APT Statistical Service
	Real Estate Market	National Real Estate Market Observatory - Revenue Agency Observatory of Agricultural Prices (Exeo)
	Natural and Cultural Heritage	PTP (Provincial Territorial Plan)
Pressure	Soil consumption	APT Land Use Map and Planned Land Use Map
	Pollution	APT Agency for Environmental Protection
	Hydrogeological risk	APT Public Water Use Plan

**Table 2 - The subsystem of the indicators of value**

Indicators of Value	Description
V.01 Ecological network elements	M ecological network elements [ha] /AA ecological network elements [ha]
V.02 High-quality agricultural areas	M high-quality agricultural areas [ha]/AA high-quality agricultural areas [ha]
V.03 Sites of cultural interest	M sites of cultural interest [no]/AA sites of cultural interest [no]
V.04 High-quality scenic views	M high-quality scenic views [no]/AA high-quality scenic views [no]
V.05 Arrivals	M arrivals [no] /AA arrivals [no]
V.06 Nights spent	M nights spent [no] /AA nights spent [no]
V.07 Accommodation capacity	M beds [no]/AA beds [no]
V.08 BIO/DOP/PGI farms	M BIO/DOP/PGI farms [no]/AA BIO/DOP/PGI farms [no]
V.09 Real estate value of buildings	M real estate value of buildings [€/sq m] / AA max real estate value of buildings [€/sq m]
V.10 Real estate value of agricultural land	M real estate value of agricultural land [€/ha] / AA real estate value of agricultural land [€/ha]

M= Municipality; AA= Total surface of the 29 "Asta dell'Adige" Municipalities.

particular reference to the territorial impacts of those areas with a high degree of hydrogeological danger and risk deriving from extreme events, such as flood and landslide phenomena.



**Figure 1 - Disaggregation of the indexes of value**

Table 3 describes the subsystem of the indicators of pressures.

As for the subsystem of the indicators of value, the synthetic index of pressure has been calculated for the 29 Municipalities situated along the "Asta dell'Adige". The results have been normalised and then aggregated into a synthetic pressure index. Figure 2 shows, for each Municipality, the disaggregated synthetic index of pressure, thus highlighting the contribution of the single pressure indicators (P.01-P.06) with respect to the overall index.

Figure 3 shows the results of the synthetic indexes of value and pressure for each Municipality, according to seven classes of intensity (very low, low, moderately low, medium, moderately high, high, very high).

### 4.3 The value/pressure ratio

A final index has been calculated in order to aggregate the overall results obtained in the Municipalities in terms of

**Table 3 - The subsystem of indicators of pressures**

Indicators of pressure	Description
<b>P.01</b> Urban areas	M urban areas [ha]/AA urban areas [ha]
<b>P.02</b> High-danger hydrogeological areas	M high-danger hydrogeological areas [ha] / AA high-danger hydrogeological areas [ha]
<b>P.03</b> High-risk hydrogeological areas	M high-risk hydrogeological areas [ha] / AA high-risk hydrogeological areas [ha]
<b>P.04</b> Traffic pollution	M emissions of macro-pollutants from traffic (NOx, PM10, COV, CO) [ton/year]/AA emissions of macro-pollutants from traffic (NOx, PM10, COV, CO) [ton/year]
<b>P.05</b> Index of urban growth	M urbanized ex-natural, semi-natural and agricultural areas[ha] / M urbanized areas [ha]
<b>P.06</b> Index of loss of natural, semi-natural and agricultural areas	M urbanized ex-natural, semi-natural and agricultural areas [ha] / M natural, semi-natural and agricultural areas [ha]

M= Municipality; AA= Total surface of the 29 "Asta dell'Adige" Municipalities.

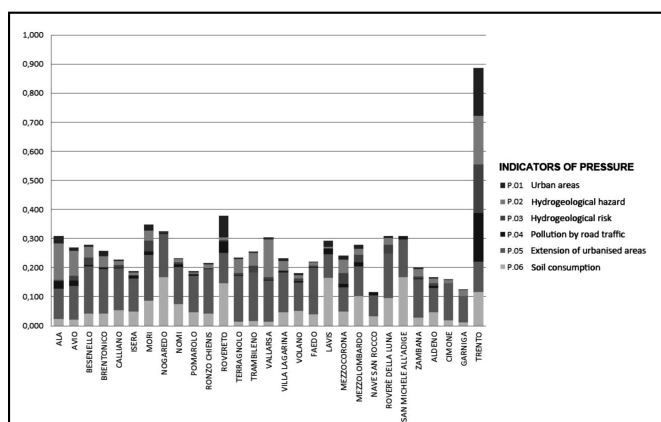
values and pressures and to produce more specific results. The index value/pressure has been calculated for all the 29 Municipalities, according to the formula (2) in Section 3. The value/pressure ratio makes it possible to clearly highlight the state of the landscape within the Municipalities, indicating those Municipalities where pressures prevail (negative numbers) and those where values prevail (positive numbers).

## 5. RESULTS AND DISCUSSION

The results of the evaluation analysis carried out in the 29 Municipalities situated along the "Asta dell'Adige" show that in this area landscape pressure factors predominate. The value/pressure ratio (see Table 4) gives an effective picture of this situation. There are in fact very few Municipalities where values are higher than pressures (this is the case of Nave San Rocco, Trento, Ala, and Brentonico), as well as there are few Municipalities where

values, even if lower than pressures, reach similar levels compared to those of pressure, thus shaping a sort of "balance" between values and pressures (this is the case of Avio, Mezzocorona, Isera, Mori, Rovereto, Aldeno, and Lavis). It is, therefore, a territorial area that, despite the presence of significant landscape values, bears today high pressures that have significantly affected – or that risk to affect – local landscape quality.

If we look more closely at the results of the landscape pressure index and we focus in particular on the contribution that the individual pressure factors (indicators P.01-P.06) make to the overall index (Figure 2), we can see as urban phenomena and, in particular, dynamics of urban growth (P.05) and land consumption (P.06) play a significant role. In fact, all Municipalities present a high propensity to extend their urbanized area (P.05), not only in the main urban centres but also in small-sized centres (this is the case, for example, of Terragnolo, Faedo, Trambileno, and Besenello). These urban growth dynamics have a higher impact in terms of land consumption in those Municipalities where natural, semi-natural and agricultural areas have already been largely sealed by previous urbanization processes. This is generally true for the Municipalities hosting the main urban centres: data highlight important processes of land consumption (P.06) in Lavis, Rovereto, Trento, Mezzolombardo, and Mori. Here, and in particular in Trento, Rovereto, Mori, and Lavis, the overall share of urban areas (P.01) is higher than in other contexts and pollution is at its height (high level of road traffic emissions – P.04 – first of all in Trento, but also, in Rovereto, Lavis, Avio, Mezzolombardo, Mori, and Mezzocorona). Finally, as far as landscape pressures connected to the hydrogeological danger and risk are concerned (P.02 and P.03), we can note as the danger related to landslide phenomena plays a significant role in defining the overall pressure index in Trento, Vallarsa, Ala,



**Figure 2 - Disaggregation of the indexes of pressure**

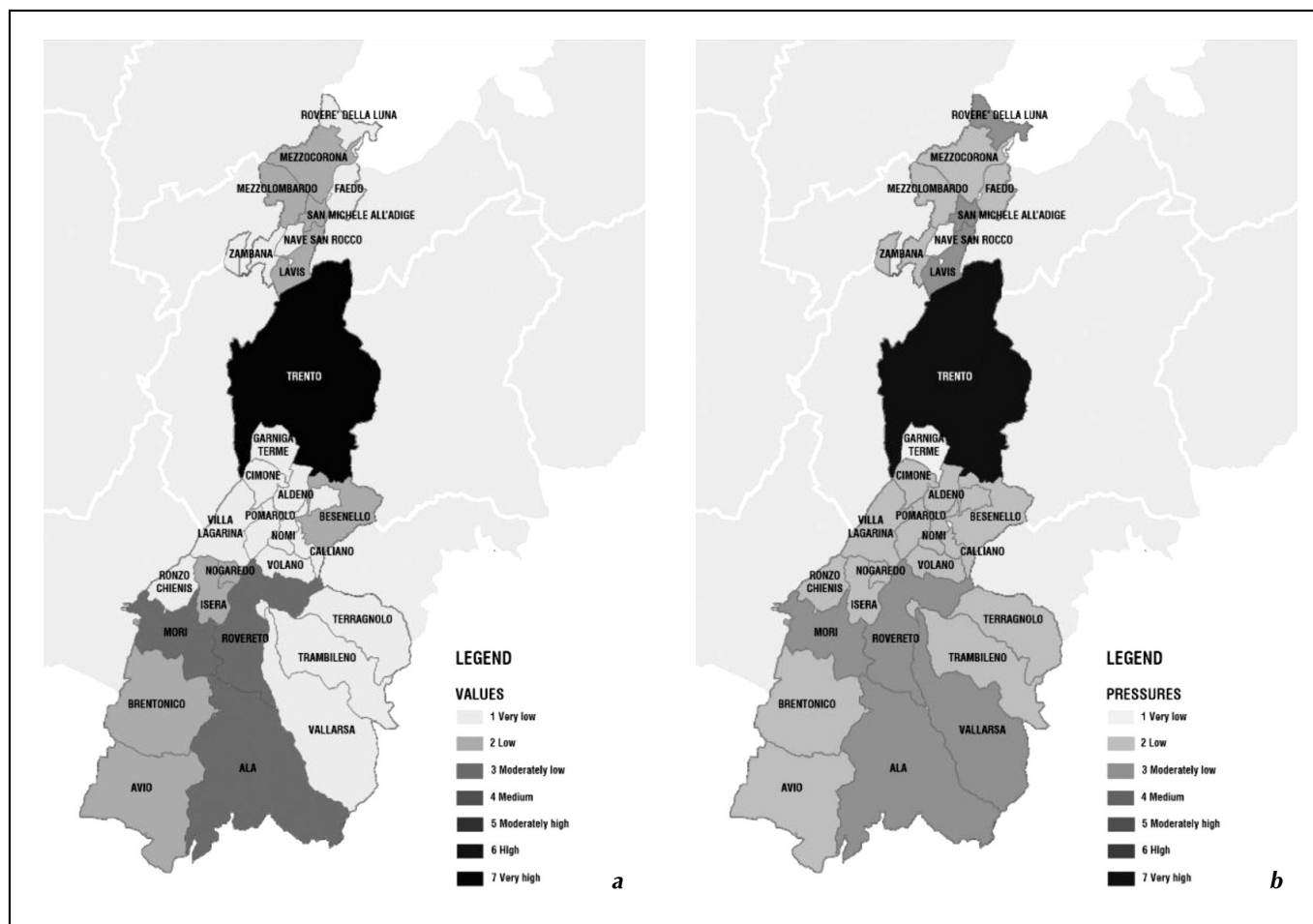


Figure 3 - Synthetic indexes of value (a) and pressure (b) in the "Asta dell'Adige" territorial area

Avio, Terragnolo, and Mezzocorona. On the contrary, the impact of the hydrogeological risk is generally lower (we can note high values only in Trento, Mori, Mezzocorona or Mezzolombardo since they are quite densely populated areas)<sup>10</sup>.

With specific reference to the landscape value index (Figure 1), we can see that agricultural areas represent the main source of landscape values, not only in ecological and scenic terms (V.02) but also in economic terms (V.08 and V.10). Trento, Mori, Mezzocorona, Ala, Avio, Brentonico, Lavis and Rovereto are the Municipalities with the highest presence of high-quality agricultural areas (V.02). It is not by chance that these same Municipalities tend to present the highest real estate value of agricultural

land. These data show that high-quality agricultural areas (i.e. those areas characterized by a high agrobiodiversity and scenic quality) are crucial economic resources, important factors for territorial enhancement. That is reflected also in the high number of BIO/PDO/PGI firms situated in these territories.

Within the synthetic value index, a significant role is also played by the real estate market value of residential areas (this is referred to the central zone of urban settlements). This value is homogeneous in all the 29 Municipalities, with slightly higher values in the main urban centres, such as Rovereto or Lavis, to attest the average high quality of the urban centres situated along the "Asta dell'Adige". An important exception is the provincial capital: Trento presents a much higher real estate market value if compared to the other Municipalities, connected not only to the architectural value of its urban fabric but also to the concentration of urban and regional services.

On the other hand, the influence of tourism – arrivals (V.05), nights spent (V.06) and accommodation capacity (V.07) – on the synthetic value index is very low, to attest

<sup>10</sup> It should be recalled that the hydrogeological risk is represented by the hydrogeological danger in its relationship with the value of the elements present in the area (e.g. people) and with the vulnerability of the same elements (connected to their exposure to the calamitous event).

**Table 4 - Results of the values/pressures ratio in the 29 municipalities**

VC	Municipalities	VALUE/PRESSURE RATIO
VC 10 <i>Vallagarina</i>	Ala	0.060
	Avio	-0.007
	Besenello	-0.289
	Brentonico	0.034
	Calliano	-0.352
	Isera	-0.011
	Mori	-0.023
	Nogaredo	-0.347
	Nomi	-0.384
	Pomarolo	-0.282
	Ronzo Chienis	-0.436
	Rovereto	-0.068
	Terragnolo	-0.594
	Trambileno	-0.397
	Vallarsa	-0.508
Villa Lagarina	-0.260	
Volano	-0.174	
VC 13 <i>Rotaliana-Konigsberg</i>	Faedo	-0.275
	Lavis	-0.137
	Mezzocorona	-0.008
	Mezzolombardo	-0.262
	Nave San Rocco	0.104
	Roverè della Luna	-0.431
	San Michele all'Adige	-0.295
Zambana	-0.426	
VC 15 <i>Val d'Adige</i>	Aldeno	-0.118
	Cimone	-0.357
	Garniga	-0.393
	Trento	0.027

the poor tourist vocation of these territories. Here again, Trento is an exception, since it is characterized by high values, in terms of arrivals, nights spent and accommodation capacity, compared to the other Municipalities. Rovereto too is a consolidated tourist destination, although less attractive than the provincial capital and characterized by a shorter average stay.

In many Municipalities, there is a significant presence of areas of high natural (V.01), historical, cultural (V.03) and scenic value (V.04). Ecological network elements (V.01) are particularly widespread in the Municipalities of Ala, Trento, Trambileno, Brentonico, Avio, Rovereto and Vallarsa, that include several Natura 2000 Sites – SACs (Special Areas of Conservation) and SPAs (Special

Protection Areas) – and Provincial Natural Reserves. Sites of cultural interest (i.e. archaeological, architectural and artistic goods, V.03) are mainly concentrated in the Municipalities of Trento and Rovereto, thanks to the high historical-artistic value of their historical centres. Finally, agricultural landscapes are the main scenic heritage of the territories located along the “Asta dell’Adige”. This is a further confirmation of the strategic role played by agricultural activities in this context. The High-quality scenic views (V.04), as identified by the PTP, are in fact mainly situated in the agricultural valley floors and along the cultivated slopes of the Municipalities of Brentonico, Mori, Isera and Nogaredo, as well as in the Municipality of Trento, Nave San Rocco and San Michele all’Adige.

Finally, it is worth mentioning the exceptional nature of the Municipality of Trento within the whole “Asta dell’Adige” context. As clearly shown in Figure 3, Trento almost always presents the highest landscape values and pressures and is also characterized by a homogeneous distribution of the different pressure and value factors with respect to the synthetic indexes (Figures 1 and 2). This is a unique case within the “Asta dell’Adige”, due to the fact that Trento is a real urban and regional pole, almost equally affected by all the dynamics, positive and negative, we analysed and evaluated through the indicators in this study.

## 6. CONCLUSIONS

The results of the evaluation analysis carried out in the 29 Municipalities situated along the “Asta dell’Adige” showed a highly valuable but fragile landscape since it is exposed to important factors of pressures.

From a territorial resilience perspective of resilience, the possible construction in this area of an GLA with a sales area higher than 10,000 sq m does not seem desirable, because it is an indisputable source of further impacts on the landscape and makes it difficult to pursue, retrospectively, strategies of sustainable development. On the contrary, alternative development strategies may be considered, firstly focusing on the enhancement of the environmental asset and the cultural heritage, as well as the agricultural activities which produce several benefits.

In line with the outcomes of the evaluation analysis, in September 2017 the Provincial Council approved the Resolution no. 1552/2017 concerning the possible localization of new GLAs with a sales area higher than 10,000 sq m (<http://www.delibere.provincia.tn.it>, BUR No. 40 of October 3, 2017; the study here presented is a Resolution’s technical annex). The Resolution stated that, also on the basis of the evaluation analysis implemented by DIST, no GLAs have to be located on the provincial territory, promoting a retail development that focuses on the enhancement of the historical centres and of a balanced territorial development. The Resolution thus is a



significant endpoint in the evaluation process undertaken by DIST in 2011, which was oriented from the very beginning toward the construction of policies (Alexander, 2009; Khakee *et al.*, 2008; Lichfield *et al.*, 1998; Lichfield, 1996; Guba and Lincoln, 1989) and conceived as a support for choices through the definition of values (Hejnowicz and Rudd, 2017; Archibugi, 2006).

The proposed system of indicators proved to be suitable for understanding landscape complexity according to a transparent and easily repeatable and replicable model (Giordano *et al.*, 2016). This study represents one of the

potential experimentations of numerical indexes for landscape evaluation to support planning aimed at territorial resilience. Further studies could integrate the proposed approach with dynamic mathematical models (Monaco *et al.*, 2006; Assumma *et al.*, 2016) in order to examine future scenarios and time frames from a long-term perspective. Moreover, minimum and maximum threshold values within the system of indicators considered could be identified. These thresholds would be useful to obtain absolute indexes to study the Trentino case in a greater detail and to compare it with different territorial systems.

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