

# RESILOC trials – feasibility study of the full-fledged trial in Tetovo, Bulgaria

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**Abstract.** Project RESILOC (Resilient Europe and Societies by Innovating Local Communities) aims at studying and implementing a holistic framework of studies, methods and software instruments (tools) that combines the physical with the less tangible aspects associated with human behavior with the purpose of identifying new strategies for improving on the processes of preparedness of local communities against any kind of hazards, either planned or unplanned. Within RESILOC's framework, local communities of various types and with varying identities - one of which is the village of Tetovo, Bulgaria - participate in an attempt to better understand their own level of resilience against natural hazards.

This article presents an assessment of the trial taking place in Tetovo as part of the RESILOC project activities. The assessment is conducted through a feasibility study focusing on the added value of the RESILOC tools for Tetovo to increase the resilience of this local community, especially in view of wildfires and snowstorms as the natural hazards typical for the community. The results from the assessment can be used to estimate the potential the RESILOC tools have in supporting communities like Tetovo with little (strategic) decision making and control capacities when it comes to risk reduction and disaster management. The feasibility study is also used to support the practical trial in the community of Tetovo.

**Keywords:** Resilience, Tetovo, Natural hazards, Trial, RESILOC.

## 1. Introduction

Resilient Europe and Societies by Innovating Local Communities (RESILOC) is a project funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 833671. As the project name suggests, the overall goal of RESILOC is to identify new strategies for improving on the processes of preparedness of local communities against any kind of hazards, either planned or unplanned.

The concept of a local community is defined in the RESILOC Glossary of Terms [1] as “the people living in, serving or responsible for a particular small area, especially of a country”. Local communities are further characterized with the possibility to “share common values, interests, and needs” besides sharing common geographical aspects. The RESILOC glossary of terms further reads that community resilience “refers to the capacities of local communities as complex systems involving the actions and interactions of [actors and structures] to mitigate, withstand, and recover from the impacts of a disaster or emergency, as well as to adapt or transform themselves to be less vulnerable to future disasters or emergencies”. The two definitions serve as the basis for applying the RESILOC scientific framework, including studies, methods and software instruments (hereafter “tools”) to communities of varying sizes, autonomy statuses and identities. This setup is to be validated during the RESILOC trials that are taking place in the project lifetime. One of the RESILOC trial communities is the village of Tetovo, which is part of Ruse Municipality located in northeast Bulgaria (hereafter “Tetovo community” and “community of Tetovo”).

The present article is divided in the following chapters. Section 1.1 sets the stage by introducing the community profile of Tetovo and the natural hazards that are most relevant for it. It also briefly describes the RESILOC scientific framework, emphasizing the RESILOC software instruments as they enable the community resilience assessment during the trials. It describes the trial phases. Chapter 2 consists of a feasibility assessment of the Tetovo trial among three dimensions, namely conceptual feasibility, technological feasibility and strategic feasibility. Each of these dimensions is examined via community feedback, RESILOC researchers’ observations and publicly available administrative data. The data is after further analyzed with qualitative SWOT analysis [2, 3]. The article concludes in Chapter 3 with main takeaways and lessons identified.

### **1.1. Tetovo and the RESILOC framework**

Tetovo is a village that is part of Ruse Municipality in the Region of Ruse situated in the northeastern part of Bulgaria. Tetovo is the only village from among the four RESILOC trial communities. The other three are Gorizia (Italy), Catania (Italy) and West Achaia (Greece).

Tetovo is one of several villages with similar dimensions in Ruse Municipality. These are Smirnenski, Hotantsa, and Glodjevo. The total area of Tetovo is around 74 km<sup>2</sup>, its landscape consists mostly of planes. In 2022, the population of Tetovo was 1736 people [4], which makes it the second largest village in Ruse Municipality. In terms of economic development, Tetovo is a typical rural community, with the largest employer in agriculture being the local agricultural cooperative. The cooperative is also the one actor who heavily depends on the natural ecosystem of Tetovo. The territory of Tetovo presents several critical assets, such as the irrigation dam in immediate proximity to Tetovo and Municipal Route II-23 connecting Tetovo to the larger communities of Ruse to the west and Kubrat to the east. The dam guarantees a significant reserve of fresh water available for agriculture. The volume of the dam is

44,000 m<sup>3</sup>. The high-voltage electricity routes providing electricity to Tetovo and the protected natural area of “Ludogorie”, part of which is in the territory of Tetovo, are other critical assets.

To assess and work on the community’s resilience, the RESILOC project employs a scenario-based approach to exploring several hazards [5]. Since it is a predominantly rural community, there are two particularly relevant natural hazards identified by Tetovo community members at the beginning of the RESILOC project, namely snowstorms and wildfires. Earthquake hazards are also relevant for the region, but the community emphasized snowstorms and wildfires at the time. Based on a hazard scenarios analysis performed in 2020 using the Australian Institute for Disaster Resilience likelihood and impact typology [6], both snowstorms and wildfires are classified as an almost certain to happen hazard with moderate impact on the community of Tetovo.

The outcome of the RESILOC approach towards assessing resilience is the conceptual Dimensions, Indicators and Proxies framework (hereafter “DIP framework”) [7]. The framework operationalizes resilience allowing its measurement over space and/or time, so as to support comparison against a baseline state of the community [8].

To model the concept of resilience, the DIP framework consists of six dimensions: disaster risk reduction (DRR), economic, environmental, governance, infrastructure and social. The number of dimensions follows common practice in resilience research, where modelling usually includes between three [e.g. 9] and seven [e.g. 10] dimensions. In each dimension of the DIP framework, there are between 7 and 17 indicators derived from literature. For example, the governance dimension includes indicators such as “citizens’ participation” or “accountability, transparency and ethical conduct”; the social dimension includes indicators like “community engagement” or “social connectedness”; the infrastructure dimension includes indicators such as “transport routes redundancy”, “water access” or “energy grid access for individuals”. For each indicator there are example measurable proxies. To name a few, the framework allows for the indicator “transport routes redundancy” to be measured by the proxies “percentage of people with access to alternative transport routes”, “number of land transport routes to enter/exit the community”, “number of water transport routes to enter/exit the community” and/or “number of air transport routes to enter/exit the community”. The proposed list of indicators and example proxies in the DIP framework can be found in D3.1 – RESILOC Resilience Indicators [7].

In terms of measurement, the DIP framework offers a hybrid methodology, i.e., it allows for using both quantitative and qualitative approaches embodied in the indicators and proxies. The advantage of this approach lies in the ability to combine/replace objective data with expert estimations for the preset indicators and proxies and for indicators and proxies that the community may wish to additionally include in its resilience assessment. In this sense, the RESILOC platform and other tools, with the underlying DIP framework, can be regarded as open systems that allow for expansion/adaptation depending on the community’s current needs. The framework is viewed in more details in the following chapter.

The final element framing the trials is the procedure they are to follow. The RESILOC trials are constructed under an adapted version of the Trial Guidance Methodology [11], originally developed by the DRIVER+ project<sup>1</sup>. The trials consist of two phases – capacity building phase and full-fledged trial phase. Each phase includes stages that are further broken down in specific steps to be completed in each trial site. The steps are divided into trial and validation steps, the latter being internal assessment points marking a trial milestone. The work presented here builds on data derived from the capacity building phase and serves as a stepping stone for the full-fledged trial that will take place in Tetovo, the result of which will be a Local Resilience Strategy.

A specific feature of the RESILOC trials is that they are enabled by voluntary Local Resilience Teams (LRTs). The role of the LRT is double in that they (1) communicate the local community needs and requirements and conduct the resilience assessment with the RESILOC tools on behalf of the community during the trials and (2) bring the culture of “resilience” closer to the community employing the resources available as part of RESILOC. The LRTs consist of local community actors with varying roles and expertise, for example local authority representatives, emergency and DRR experts, civil society organization representatives, citizens). The LRT in each of the trial communities is unique in their composition, which is determined by available capacity, decision making structure and community needs. In Tetovo, the LRT is two-layered consisting of a core team (up to 6 members) and an extended team (20-25 members). The feasibility assessment presented here is based on feedback collected from the core LRT during the first two stages of the capacity building phase, in which the LRT’s was upskilled to work with the DIP framework and the data for the full-fledged trial was collected. The feedback from the core LRT is combined with RESILOC researchers’ observation on site and publicly available administrative data.

## **2. Feasibility assessment of the Tetovo full-fledged trial**

The background information presented above is further detailed in each of the following three sections of the chapter. The first section discusses the conceptual feasibility of the trial, the second its technological feasibility and the third – the strategic feasibility, which is aligned with the overall goal of the RESILOC project. Conclusions are then used to create the SWOT analysis in the final section of the chapter.

### **2.1. Conceptual feasibility**

The conceptual feasibility of the full-fledged trial is viewed in terms of the DIP framework’s (perceived) appropriateness for the community of Tetovo.

As mentioned above, there are six dimensions in the DIP framework, namely DRR, economic, environmental, governance, infrastructure and social. The framework

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<sup>1</sup> <https://www.driver-project.eu/>

provides a list of ready-made indicators and proxies that are derived from existing literature, but it also allows for introducing new indicators as well as new proxies depending on community specificities. In this sense, the DIP framework is structure, but also agent dependent.

Below is a summary of the number of indicators and proxies derived from literature per dimension:

- Disaster risk reduction (DRR) – 13 indicators, 55 proxies.
- Economic – 9 indicators, 32 proxies.
- Environmental – 17 indicators, 58 proxies.
- Governance – 8 indicators, 30 proxies.
- Infrastructure – 16 indicators, 60 proxies.
- Social – 7 indicators, 25 proxies.

During the first trial stage in the capacity building phase, the LRT members were introduced to the RESILOC DIP framework in a workshop format. Table 1 below gives a summary of the results on the framework’s conceptual feasibility assessment operationalized through three anonymous survey questions touching on the following three topics: the framework’s ability to describe the resilience of a community, its appropriateness for assessing the resilience of Tetovo and its complementarity to existing resilience evaluation approaches in the community/used by authorities. The scale that is used is a five-point one (from +2 to -2, in line with the RESILOC validation approach) and the total number of respondents are 6 members of the Tetovo LRT.

**Table 1.** DIP framework - conceptual feasibility evidence from Tetovo.

	+2	+1	0	-1	-2
Ability to describe resilience	1	4	1	0	0
Appropriateness for Tetovo	0	6	0	0	0
Complementarity	2	4	0	0	0

Results from the assessment show LRT members have a balanced positive perception of the DIP framework. They note that from the point of view of the hazard scenarios for Tetovo (snowstorms and wildfires) the framework covers the specific needs of Tetovo. Moreover, they think that working with the hazard scenarios makes the understanding of the framework easier.

On the other hand, LRT members recognize that not all indicators and proxies are applicable to the community of Tetovo and that they need to be discarded altogether or adapted accordingly in order to meet the community’s needs. In terms of complementarity with other approaches, participants were the most optimistic, with one of them noting that the RESILOC framework and broader approach reminds them of the instruments that the military use for planning (during the discussions they mentioned the mathematical optimization method used for strategic operations research [12]).

The observation conducted during the workshops confirms the results reported by the LRT members in the discussions. The first interaction with the theoretical DIP framework is the slowest one, that is, users need time to get acquainted with the terms used and the framework's hierarchical structure.

## 2.2. Technological feasibility

The RESILOC approach resembles that of using scorecards [13] to assess community resilience. However, RESILOC's main advantage to the scorecards is that it is more dynamic and flexible. This dynamism is enabled by the RESILOC inventory and its interface – the RESILOC platform<sup>2</sup> – which provide communities with the opportunity to take “snapshots” of their resilience at different times. The RESILOC platform is a cornerstone of the project trial activities in all trial locations.

The RESILOC platform is accompanied by two more information technology tools: (1) the RESILOC application<sup>3</sup> enabling the use of surveys and remote sensing for collecting proxy data in the communities and (2) a sentiment analysis interface operating with aggregated publicly available Twitter data. Since Twitter is not among the popular social networks in Bulgaria and there is one more Tetovo community located in North Macedonia, the use of the sentiment analysis interface is not feasible for the full-fledged trial in Tetovo, Ruse Municipality. On the other hand, the RESILOC app is a mobile and desktop application, which is used in Tetovo to collect information on proxies, the information for which cannot be obtained from administrative sources or expert estimation.

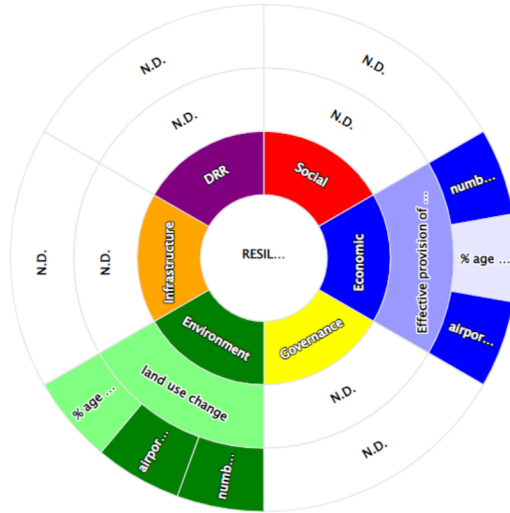
The use of the RESILOC platform by a community consists of users selecting already existing indicators and proxies or creating new ones. After this is done, the indicators and proxies are tied to a specific hazard scenario. In the scenarios, a proxy configuration process is required in order for the resilience assessment to be complete. This entails (1) determining a proxy's relevance (from 0 to 100), (2) its direction (positive or negative), (3) its target minimum and maximum values and (4) its current value. An example assessment<sup>4</sup> visualized through the RESILOC platform is shown in Fig. 1 below.

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<sup>2</sup> Accessible here: <https://resiloc1.di.uoa.gr/auth/login>

<sup>3</sup> Available for download here: <https://play.google.com/store/apps/details?id=si.ijs.e6.resilocApp>

<sup>4</sup> This figure is not a real assessment for the community of Tetovo and has only illustrative purposes.



**Fig. 1.** Example assessment of local community resilience with the RESILOC platform

Employing the RESILOC tools at full capacity is both agent and structure dependent. While language is not an obstacle as the platform supports multiple languages, it is essential for users to have basic information technology skills. In order to use it as a sensing software, the RESILOC app also requires a smartphone on which to be installed.

The minimum skills for RESILOC platform use is screens navigation and work with pop-up windows. Additionally, regardless of information technology skills, training for the platform (and app) users is needed before they start operating with it. On the other hand, a large part of the work with the platform consists of configuring the proxies with both current and target data.

Proxy target data can be derived both from available estimations found in literature and from expert estimations depending on local context. The same applies for current data that feeds in the assessment. The RESILOC platform allows for indicators to be quantitative or qualitative, while the proxies can be expressed in absolute or relative terms, or be binary [14]. The relative ones are preferred as relative expression makes their assessment insensitive to community size and allows for temporal and spatial comparisons.

A validation of the data collection requirements for the assessment and platform use was also conducted in a workshop format during the first stage of the capacity building phase before the full-fledged trial in Tetovo. The results are presented in Table 2 below.

**Table 2.** Data collection - technological feasibility evidence from Tetovo.

+2	+1	0	-1	-2
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Data collection process appropriateness	4	0	0	0	0
Data format appropriateness	0	4	0	0	0
Easiness to collect data	2	2	0	0	0

As one of the workshop participants<sup>5</sup> put it, “it is absolutely essential [to have the data] in order to work with the system”. Participants perceived that collecting administrative data would be easier compared to collecting data in the field. They also straightforwardly noted that part of the data may not be available, nor are at all collectable. In that sense, even if one indicator or proxy is appropriate for resilience assessment, it will need to be discarded from it due to lack of data.

The observation during the workshops confirms the results reported by the LRT members within the discussions. The participants had no issues with understanding the format required for the data to be entered in the RESILOC platform. However, they were very skeptical with respect to collecting some data at the community level. By the Eurostat nomenclature, Tetovo is a community below NUTS 3 level and specific publicly available statistical data is quite scarce. For example, in the 2011 census in Bulgaria there is aggregated data on the total number of houses, blocks of flats, villas, etc. in the villages of Ruse Municipality, but there is no such data at the individual village level that is publicly available [15].

### 2.3. Strategic feasibility

The third feasibility dimension to be explored is the strategic one. The purpose of RESILOC is to enable the identification of new strategies for improving the processes of preparedness of local communities against any kind of hazards. This is why the intended outcome of the full-fledged trials is a Local Resilience Strategy co-created between the LRT and the broader community. The strategy should be based on the outcome of the resilience assessment in the RESILOC platform, which shows the identified gaps in community resilience.

The strategy in each of the trial communities will consist of a plan for maximum improvement of community resilience. However, in the case of Tetovo, this strategic planning may be hindered at the community level, because the village does not have full administrative capacity, i.e., the Tetovo Town Hall (as any other town hall in Bulgaria) acts almost exclusively under the auspices of the Municipality of Ruse (as any other municipality in Bulgaria) [16]. The LRT in Tetovo is aware of this limitation, as is evidenced by their responses to two validation questions touching upon the strategic dimension (see Table 3 below).

**Table 3.** DIP framework - strategic feasibility evidence from Tetovo.

<sup>5</sup> There were five participants in the workshop, four of whom completed their anonymized questionnaire.



	+2	+1	0	-1	-2
Usability of the DIP framework by the community of Tetovo	1	3	0	0	0
Usability of the DIP framework by Ruse Municipality and its services	2	2	0	0	0

With respect to the usability of the DIP framework by Ruse Municipality and its services, the participants<sup>6</sup> mention that assessment outcomes can be used for future strategic planning. This is due to a large extent to the fact that in Ruse Municipality not only do local authorities have more power compared to the Town Hall in Tetovo, but also because all emergency services are located in Ruse. This finding, however, does not impede the Local Resilience Strategy building in Tetovo that will take place during the full-fledged trial phase, as it can be substantiated by developing soft measures and/or improving lobbying efforts in the greater municipality among others. Moreover, efforts contributing to the strategic dimension are already present in the Tetovo capacity building phase, as it includes practitioners from the Municipality of Ruse.

### SWOT analysis

The final section in this chapter is dedicated to indicating what the strengths, weaknesses, opportunities and threats are that lie in the intersection between the general RESILOC approach and the full-fledged trial to be carried out in the Tetovo local community in Bulgaria. The available evidence suggests that conceptually, technologically and strategically, the RESILOC approach to assess local community resilience as applied in the Tetovo trial has a balanced array of strengths and weaknesses, but the opportunities it offers outweigh the threats it may bring.

#### Strengths.

- The RESILOC approach is more dynamic and flexible compared to some existing approaches (e.g. scorecards) because it can be used by communities of different scales at different points in time.
- With its composition of a local authority representative, DRR experts and civil society organization representatives among others, the Tetovo (core) LRT is capable of completing the trial process according to the trial script.
- Objective data can be combined with expert estimations, which makes data sources diverse and at times interchangeable.

<sup>6</sup> There were five participants in the workshop, four of whom completed their anonymized questionnaire.

- The RESILOC approach stimulates dialogue among experts with different backgrounds that do not always exchange information with each other in day-to-day operations.

#### **Weaknesses.**

- Basic level of information technology skills is a prerequisite to operate with the RESILOC tools.
- Local language availability should be ensured in order not to impede participation based on foreign-language knowledge.
- (Stable) Internet connection must be present to operate the RESILOC tools.
- Proxy data may not be available, nor at all collectible.
- Data collection may be resource consuming (especially in terms of time).
- Strategic decision making in Tetovo is with little efficiency.

#### **Opportunities.**

- Proxies and indicators should be adapted whenever necessary to meet the local context.
- Proxy data can be collected from stakeholders through the RESILOC app without the need for face-to-face interactions, which can lead to a significant reduction in data collection efforts.
- Local Resilience Teams should include an appropriate mix of stakeholders, so that access to administrative data that is not otherwise available is collected.
- Local communities that otherwise do not have access to resilience assessment tools, nor usually think and act in strategic terms have the opportunity to shift their mindset with the RESILOC framework and tools.

#### **Threats.**

- The lack of data may skew the resilience visualization and, thus, diverge strategic efforts.
- If local language translations of all items in the platform (incl. dimensions, indicators and proxies) are not available, this may dissuade local community representatives from using the RESILOC tools.
- The lack of local capacity to analyze existing gaps may compromise strategic efforts.

### **3. Conclusion**

This article provides preliminary evidence from the capacity building phase of the RESILOC trial in Tetovo, on one hand, to assess the feasibility of the full-fledged trial planned for the second phase of the trial activities in Bulgaria and, on the other, to assess the feasibility of the RESILOC approach to communities that have

characteristics similar to Tetovo. Feasibility is examined by taking a look into the conceptual, technological and strategic dimensions. The conclusions of the LRT members in Tetovo are balanced, but more optimistic than not – the Tetovo full-fledged trial and the use of the RESILOC framework and tools in similar settings can bring significant added value to the community. However, in order for this to be achieved, some adaptation efforts by the LRT and mindfulness of the weaknesses and threats need to be present.

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