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# Using the Scorecard Approach to Measure Seismic Social Resilience in Nablus, Palestine

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**Abstract.** Social vulnerability helps to explain why communities experience the consequences of an earthquake differently, even though they are subjected to similar levels of ground shaking. The differential impacts of an earthquake can be a consequence of social vulnerability and, for this reason, it is a critical element for fostering mitigation plans and developing policies to reduce earthquake risk. Measuring resilience is not an easy task and, in this study, is performed through the Scorecard Approach. The latter is a self-assessment and participatory tool that measures resilience with qualitatively derived information at two different urban levels: population and local administration. The case study is the city of Nablus in the Palestinian region which is not only affected by seismic events but also by political conflicts. The provided results enable the resilience assessment of different districts of Nablus concerning several themes of disaster risk reduction. These will help to better understand how different variables – such as gender, age, educational level, monthly income and membership neighbourhood influence the vulnerability assessment.

**Keywords:** Vulnerability, Resilience, Palestine, Scorecard Approach.

## 1 Introduction

During the assessment of seismic risk, a great deal of effort is usually dedicated to the analysis and evaluation of the hazard and physical vulnerability components, supported by the deep knowledge and research in the engineering seismology and earthquake engineering fields. Nevertheless, for a more comprehensive evaluation of urban risk, it is increasingly becoming clear the important role played by the community during extreme events. Populations have different capacities to prepare for an event, react in different manners and recover from damages disproportionately, if they occur [1]. The evaluation of all these aspects, combined with the physical dimensions of a disastrous event, will lead to the overall assessment of urban risk. Certainly, earthquake safety begins with the compliance to the technical and engineering rules to build safe structures. However, great emphasis should also be placed on fostering disaster resilient communities. Indeed, a resilient population can better withstand adversity and recover more quickly when earthquakes occur. Resilience, as defined by the United Nations International Strategy for Disaster Reduction (UNISDR), is “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover

from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions” [2].

It is not simple to both measure and develop plans to enhance the resilience of communities, which is crucial not only to assess the starting conditions of the community, but also, as a first step in disaster risk management. Knowledge of gaps and vulnerable factors leads communities to the enhancement of their capacities to respond to and recover from an event. Different techniques can be employed to give a measure of resilience: selection of variables highly connotative for the society [3], computation of indicators and indices [4] or participatory processes, as the one used in the present research. The Scorecard Approach is a self-evaluation tool empowering city stakeholders to quantitatively assess risk and resilience parameters based on qualitatively derived information at multiple levels [5]. This methodology was applied for the first time as a pilot study in Lalitpur [6], Nepal, in 2014, and a year later in the Quito (Ecuador) as case study for South America [7].

This paper describes the application of this approach to the Palestinian context within the activities of the EC-funded research project SASPARM 2.0 (Support Action for Strengthening PALEstine capabilities for seismic Risk Mitigation). This project promotes the training of scientists, practitioners, students, citizens, stakeholders and increases the awareness of the seismic risk concept in the city of Nablus (see Fig. 1).



**Fig. 1.** The West Bank and Nablus 8

A consortium of three institutions manages the project: EUCENTRE (European Centre for Training and Research in Earthquake Engineering) and IUSS (Institute for Advanced Study) in Pavia (Italy), and ANNU (An-Najah National University) in Nablus (Palestine). One of the major outcomes of the SASPARM 2.0 initiative is the development of an integrated seismic risk model for Palestine, based on a state-of-the-art hazard model and in-situ collected vulnerability and exposure data [9,10]. The city of Nablus, the first Palestinian city to join the UNISDR’s *Making city resilient campaign*, constitutes the case study area for the implementation and calibration of the model.

## **2 Sources of social vulnerability in Palestine**

Palestine is exposed to various natural hazards including earthquakes. The entire region around Palestine faces ongoing small to mid-scale disaster risks and a large-scale urban disaster is potential [11]. Specifically, the seismic risk is associated with the tectonic plate boundary in the Jordan Valley known as the Dead Sea Transform (DST). Historical records show that major earthquakes have caused severe damage and many hundreds, and sometimes thousands, of fatalities. The most recent earthquake (ML 5.2) took place on February 11, 2004 [12]. The possibility of a major destructive earthquake is part of all contingency plan scenarios [13].

The vulnerability conditions of Palestine can be classified as high to very high, driven by the following issues: access restriction, population fragmentation, infrastructure, physical, social and economic vulnerabilities. All these sources increase the consequences of a disaster event. Therefore, measures need to be planned and put in action to reduce the risk impact on population and exposed assets. The negative factors that mainly affect the population are the movement restrictions due to the checkpoints, barriers and permit requirements placed on Palestinians. These current political restrictions greatly constrain the potential for economic and job growth in Palestine, generally, and in Nablus, in particular. Moreover, economic restrictions, globalization and poor labour laws have also negatively affected employment and made the cost of living too expensive for Palestinians to have healthy, sustainable lives [8]. The restrictions are not only delineated in movements setting, but even concern the work permit requirements, which prevent Palestinian population from freely working within the West Bank and Israel.

For all these reasons, Palestinian communities are subjected to policies make them more vulnerable in case of an earthquake strikes. Moreover, the territorial fragmentation leads to controlled access to land, water, gas, electricity and other resources. These kinds of resources are of crucial importance during an emergency state and negatively affect the management of a seismic crisis due to lack of independence and self-sustenance.

Social structures also constrain livelihoods and sharpen the social vulnerability. In Nablus, local traditions and customs prevent some women from publically entering the work force. Some women work, but only informally as street vendors during holidays or as shop workers at home [8]. Despite that, changes are in place; young women in the labour force remind us that society is moving towards their acceptance [8]. In the light of such evaluations, the present research takes into consideration the gender distribution as a variable that would affect vulnerability. Indeed, the new active role of women could lead the community to a more resilient capacity and to a faster reaction and recovery from disasters.

## **3 Methodology for social vulnerability assessment**

Social vulnerability assessment can be performed with different methods. The most commonly employed tool makes use of composite indicators, such as Human

Development Index, Environmental Sustainability Index, Prevalent Vulnerability Index (sum of Exposure and Susceptibility, Socio-Economic Fragility and Lack of Resilience) and Social Vulnerability Index [14]. The indicator is a quantitative or qualitative measure derived from observed facts that simplifies and communicates the reality of a complex situation [15]. Social vulnerability indicators are potentially powerful tools because they summarize complexity and provide quantitative metrics to compare places and track progress [16]. Moreover, these indicators are relatively easy for non-experts to interpret. Although indicators are increasingly recognized as useful tools for policy-making and public communication, because they can be used as performance measures, they can be misleading if poorly constructed or misinterpreted. Furthermore, indicators can lead to overly simplistic and inappropriate conclusions if dimensions of resilience are ignored because difficult to measure or just simply unknown. The good quality of an indicator lies in the accessibility to information that are representative of the local knowledge, condition and context. Often, this kind of data is not accessible or not available from publically databases (national censuses). As such, for the Palestinian particular context, the design of targeted surveys is preferred with respect to the above-mentioned methodology.

### **3.1 Scorecard Approach**

Palestinian areas are largely affected by difficulties and lack of data, which are not often representative of the reality. A proper questionnaire, the so-called Scorecard Approach, is a good alternative method, mostly for its participatory characteristic. This approach describes better the context because it is adapted to the Nablus situation and citizens are the main actors of the assessment because the population directly replies to the proposed questions.

The purpose of the Scorecard Approach is to build a tool that can capture the key functional and organizational areas for urban resilience. The concept of resilience has found its way into disaster risk management as mentioned in the Hyogo Framework for Action (HFA) [17], which establishes the goal of “building resilience in nations and communities”. More recently, even the United Nations started the campaign for urban disaster reduction with the banner “Making Cities Resilient”. The UNISDR defined the so-called 10 Essentials, representing a set of indicators in the form of a checklist by which resiliency can be measured [18]. The Scorecard Approach encompasses the ten essentials into six key dimensions that mainstream Disaster Risk Reduction (DRR) into planning and decision-making processes (see Fig. 2). The dimensions and the related main questions are summarized in Table 1.

The implementation of the Scorecard Approach in Nablus required a preparatory process to capture the local context into the design of the indicators (questions) and targets (answer schemes). The questionnaire preparation benefits of academia feedback, in particular from the Opinion Pools and Survey Studies Center of ANNU. In this way, the development and implementation of the initial Scorecard Approach have been carried out in a collaborative effort between the European and Palestinian Institutions, leading to the final questionnaire, subsequently spread among population and the local administration.



Fig. 2. Key dimensions of urban resilience 5

The challenge of the approach is the self-assessment of the population able to understand its own vulnerability and identify opportunities for resilience enhancement.

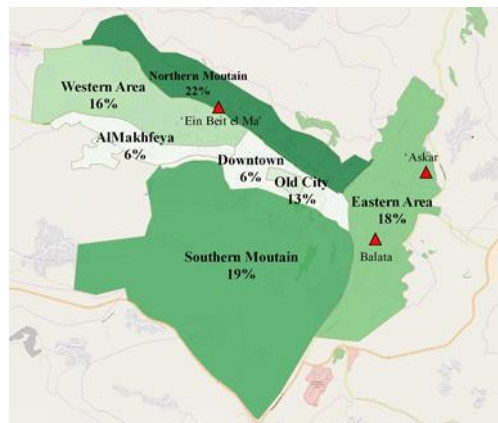
Table 1. Six Dimensions/Themes of Scorecard Approach

Dimensions/Themes	General Questions
Awareness & advocacy	What is the level of awareness and knowledge of earthquake disaster risk?
Social capacity	What are the capacities of the population to efficiently prepare, respond and recover from a damaging earthquake?
Legal and institutional arrangements	How effective are mechanisms to advocate earthquake risk reduction in your quarter?
Planning, regulation and mainstreaming risk mitigation	What is the perceived level of commitment and mainstreaming of DRR through regulatory planning tools?
Emergency preparedness, response and recovery	What is the level of effectiveness and competency of disaster management including mechanisms for response and recovery?
Critical services and public infrastructure resiliency	What is the level of resilience of critical services to disasters?

Moreover, the results will enable local policy makers and communities to establish priorities for more in-depth analysis, allocate funds and develop emergency and disaster management programs more effectively. Even though the case studies in Lalitpur and Quito foresaw local workshops to have the opportunity of interaction between population, representatives of the Municipality and experts in the development of the approach, this exchange was not possible in Nablus for safety reasons and even for language constraints. In order to overcome these challenges, the questionnaires were translated in Arabic and university students were properly trained to support the filling in of the questionnaire. The questionnaires were spread in different areas of Nablus and the population was involved in an active way.

## 4 Case-study results and discussion

For the purpose of this study, Nablus city was divided in seven main neighbourhoods: Old City, Southern and Northern Mountain, Downtown, AlMakhfeya, Western and Eastern Areas (see Fig. 3). The city also includes Palestinian refugee camps (Balata, 'Askar and 'Ein Beit el Ma' – red markers in Fig. 3), including 6% of participants, mostly located in the Northern Mountain, Western and Eastern Areas [19].



**Fig. 3.** Questionnaires distribution in Nablus

The total number of collected questionnaires was 526, out of which 433 were filled by general population and the remaining 93 by local administration staff. When compared to the previous initiatives (e.g. the Lalitpur case-study 6 that featured 43 participants in the workshop), the sample size in Nablus was much larger. The absence of a specific seminar may have led to error in the questionnaire's completion, however, it is expected that it is balanced by a large number of collected questionnaires.

The gender distribution of the respondents is homogeneous: 51% male and 49% female, whereas the local administration features a higher percentage of men (56%). Preliminary quantitative measurements were performed regarding age, educational level and monthly income, as shown in Figures 4 to 6. Respondents' ages range mostly between 20 and 30 years (53%) whilst a non-negligible percentage (27%) is between 30 and 40 years old (**Error! Reference source not found.**). This information is closely correlated to the educational level (**Error! Reference source not found.**), particularly when referring to university students (38%) and bachelor degrees (27%). Very aggregated answers were obtained for the monthly income (**Error! Reference source not found.**): about 47% of respondents declared 1500 – 3500 NIS (1NIS = 0.26USD), 17% stated about 0 – 1500 NIS whilst 18% did not answer at all.

### 4.1 Score system

A scheme of answers was established to track progress on the mainstreaming of risk reduction. The answers were defined by using five main scores, from 1 to 5 20:

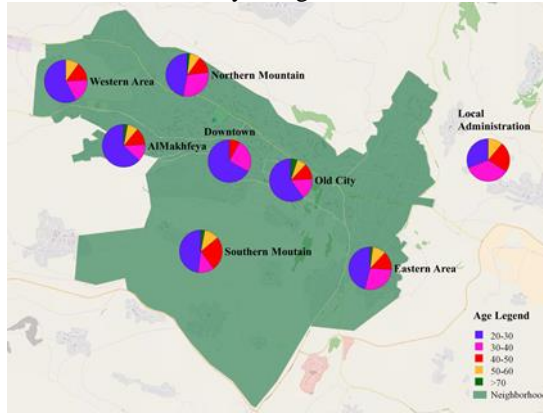


Fig. 4. Age distribution

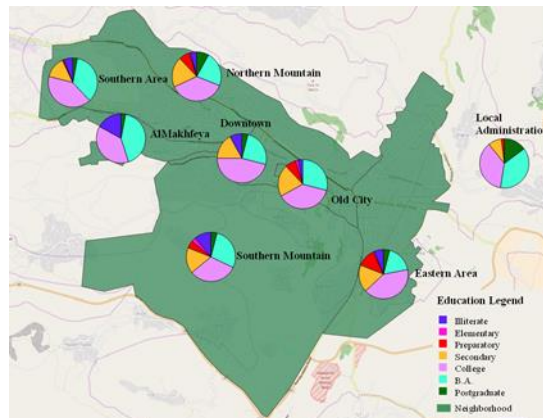
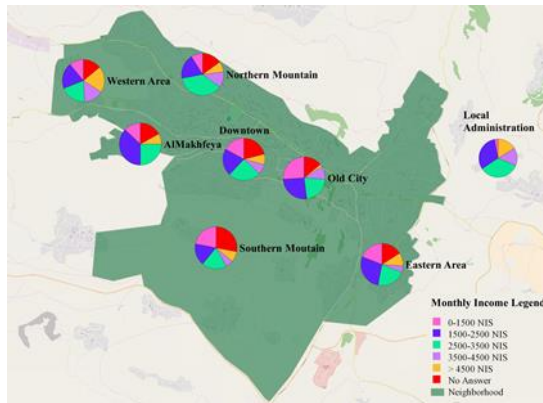


Fig. 5. Education level distribution





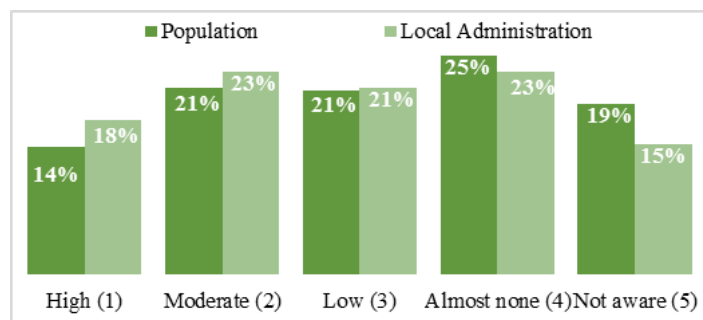
**Fig. 6.** Monthly income distribution

1. **High:** “Full integration”. This level refers to a situation where risk reduction is fully absorbed into planning and development processes as well as core services. This level describes a situation where DRR is “institutionalized”. However, this is not to suggest that an optimum level of attainment has occurred: there is still a need for further progress.
2. **Moderate:** “Engagement and commitment”. The level refers to a high level of engagement and commitment to DRR. However, the policies and systems have not been fully established yet.
3. **Low:** “Awareness of needs”. This level refers to an early stage of awareness. The institutions may have activities and dedicated efforts for preparedness, however these initiatives are simply limited to response. This level is expected not to result in risk reduction in the long term and vulnerability is expected to increase.
4. **Almost none:** “Little awareness”. There is no institutional policy or process for incorporating risk reduction within the functions and operations of the organization. The probable result is a great vulnerability and high losses in the future.
5. **No awareness.** Population is not aware or informed of any kind of processes and municipality does not act to address problems. In some cases, there is an adverse attitude and adverse institutional culture towards adopting measures to reduce risk. The not-awareness implies a high level of vulnerability and lack of resiliency.

Six of the total 39 questions had less possible answers, which led to just three corresponding scores: 1 (High), 4 (Almost none) and 5 (Not awareness). The different scheme for those 6 questions was adopted to render the questionnaire easier to understand by the Palestinian citizens.

#### 4.2 Global and detailed results per theme

The global results for population and administration staff, divided by score, are shown in Fig. 7. Most of the answers belong to the range of “moderate” to “almost none” awareness for both groups. Moreover, the mean scores per theme show a similar trend for the citizens and the municipality representatives (see Fig. 8).



**Fig. 7.** Scores distribution

The population mean scores range between 2.7 and 3.6, the latter being found for the theme of “Planning, Regulation and Mainstreaming Risk Mitigation”. As expected, the local administration group exhibits a lower score *i.e.* demonstrates a better perception of risk, its management and reduction with respect to the citizens. However, the difference is not so remarkable, which means a low level of resilience even in decision making bodies.

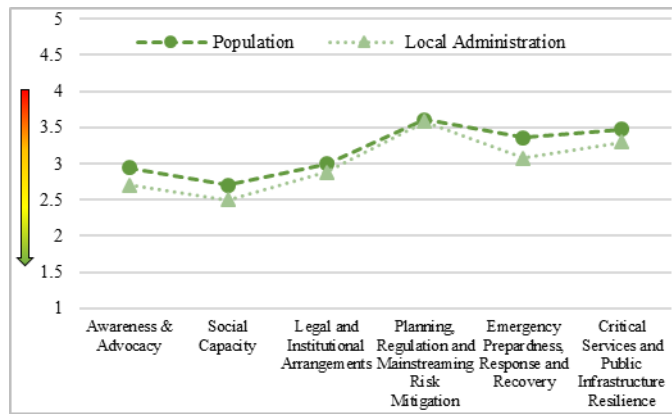


Fig. 8. Mean score distribution per theme

**Error! Reference source not found.** illustrates the distribution of answers for all the questions of each theme. The highest scores for the population group belong to the “Emergency preparedness, response and recovery”, “Planning, regulation and mainstreaming risk mitigation” and “Legal and Institutional Arrangements” themes. For the latter two themes, the mean score for local administration group shows three higher peak values (q3.1, q4.1, q4.2).

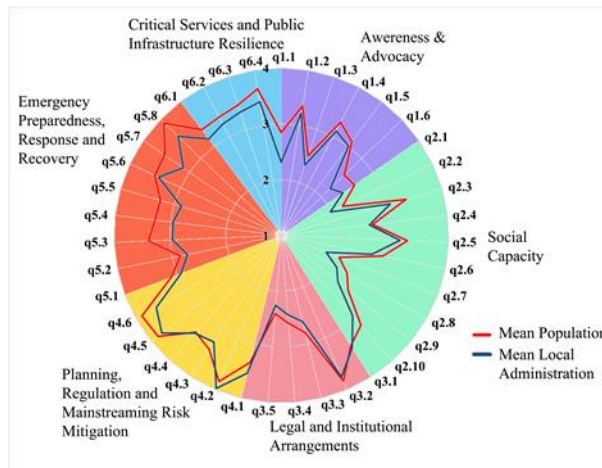


Fig. 9. Answers distribution per each question

There are seven peak scores denoting particularly high vulnerability:

- “Emergency preparedness, response and recovery” – recovery and food provision (q5.8);
- “Planning, regulation and mainstreaming risk mitigation” – availability of safety areas for both citizens and administration (q4.1, q4.2) and availability of insurance (q4.5, q4.6);
- “Legal and Institutional Arrangements” – existence of ordinances and regulation for earthquake safety and risk reduction (q3.1, q3.2).

The highest vulnerability levels were denoted for questions related to retrofitting measures, plans for emergency and repair/replacement, laws and regulatory framework. These themes are likely too technical and require deep knowledge in risk management that often lacks at the administration level as well. In addition, “Emergency preparedness, response and recovery” questions were generally related to the availability of human force, funds and material resources, such as shelters and food 21. Population and local administration agree that the provision of shelters and food is essentially lacking for a post-earthquake emergency (q5.8).

#### 4.3 Normalized resilience index

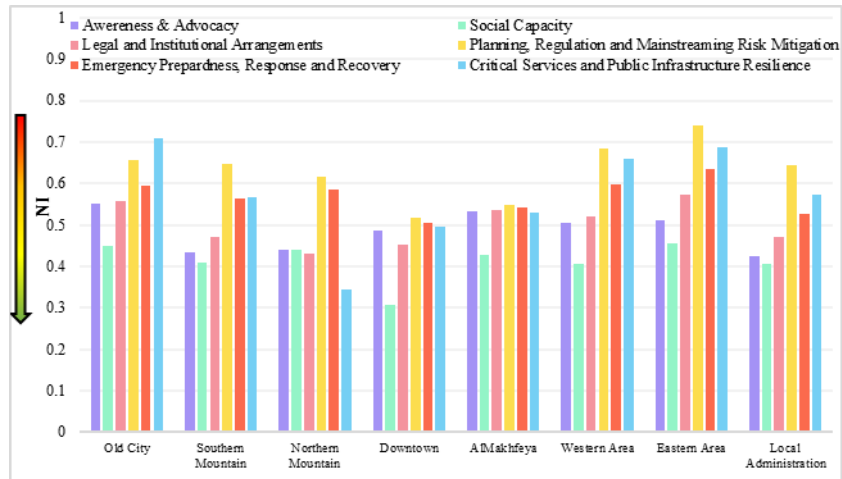
A linear max-min normalization has been computed per theme and per neighbourhood according to Eq. 1. The Normalized Index,  $NI_{i,j}$ , is the score of the neighbourhood  $i$  and theme  $j$ ; max corresponds to the maximum score for the theme (5); min corresponds to the minimum score for the theme (1); and avg corresponds to the average of the participants’ results per neighbourhood.

$$NI_{i,j} = \frac{avg_i - \min_j}{\max_j - \min_j} \quad (1)$$

By using this normalized scale (illustrated in **Error! Reference source not found.**) general considerations among themes have been performed. Furthermore, the comparison of results coming from the different neighbourhoods and the local administration group has been carried out. As for the absolute score, values close to 0 represent very high resilience whereas values close to 1 represent very low resilience (almost none).

The results in **Error! Reference source not found.** denote a low resilience level for “Planning, regulation and mainstreaming risk mitigation”, “Critical services and public infrastructure resilience” and “Emergency preparedness, response and recovery”, with the local administration group exhibiting peaks of 0.64, 0.57 and 0.53, respectively. When evaluating the percentage of results by ranges of resilience (Table 2), the most representative range from local administration and population corresponds to a “low-almost none” level of resilience. Indeed, most of indices vary between “low” (75%) and “almost none” (21%). In this context, it is relevant to prioritize “Planning, regulation and mainstreaming risk mitigation”, “Critical services and public infrastructure resili-

ence” and “Emergency preparedness, response and recovery” topics in order to improve the capacity of the city and of local administrators to respond to, react and recover from emergency state.



**Fig. 10.** Normalized scores

**Table 2.** Percentage of answers by ranges of resilience

	Ranges of resilience	Percentage of answers
High	0.0 – 0.1	0%
	0.1 – 0.2	0%
	0.2 – 0.3	0%
Moderate	0.3 – 0.4	4%
	0.4 – 0.5	33%
Low	0.5 – 0.6	42%
	0.6 – 0.7	17%
Almost none	0.7 – 0.8	4%
	0.8 – 0.9	0%
Not Aware	0.9 – 1	0%

#### 4.4 Statistical dependence of variables

Further statistical post-processing of the data has been performed to assess which variables have a higher effect in the citizens’ answers. MANOVA (multivariate analysis of variance) was employed, as it allows to analyse data involving more than one dependent variable at a time. MANOVA allows testing hypotheses regarding the effect of one or more independent variables on two or more dependent variables [22]. In this particular

study, the dependent variables were the questions of each theme, whereas the independent variables were the neighbourhoods, gender, age, educational level and monthly income. The results are illustrated in Tables 3 to 5.

It is evident that the neighbourhood variable plays a major role in all the themes (the largest is the circle, the more the variable affects the theme – Table 3). Furthermore, the membership neighbourhood has a strong influence on the topics in combination with educational level variable (Table 4).

**Table 3.** MANOVA results with single variable

	Neighbourhood	Gender	Age	Education	Income
Awareness & Advocacy	●●●	●	●	●●●	●●
Social Capacity	●●●			●●●	●
Legal and Institutional Arrangements	●●●	●			
Planning Regulation	●●●			●●●	
Emergency Response	●●●			●	
Critical Services	●●●				

**Table 4.** MANOVA results with two variables

	Neighbourhood+ Education	Income+ Gender	Income+ Education	Income+ Neighbourhood	Neighbourhood+ Gender
Awareness & Advocacy	●●●	●	●		
Social Capacity	●●●		●	●	
Legal and Institutional Arrangements					
Planning Regulation	●●●				●
Emergency Response	●				
Critical Services	●				

A smaller relevance can be observed in neighbourhood – gender combination for “Planning, Regulation and Mainstreaming Risk Mitigation” theme and in neighbourhood – income for “Social Capacity” (**Error! Reference source not found.**). On the other hand, educational level, which plays an active role in increasing awareness towards disaster risk, demonstrates a significant influence on the respondents in three topics only (**Error! Reference source not found.**). The education level is very repre-

sentative when combined with just neighbourhood, as mentioned before (**Error! Reference source not found.**). The couple education – monthly income has influence in two cases: “Awareness & Advocacy” and “Social Capacity” (**Error! Reference source not found.**). This confirms how educational empowering in association with socioeconomic status increases the level of awareness, knowledge about risk and recovery potential 23.

Moreover, a non-negligible interdependence has been observed between educational level, income, age and gender (**Error! Reference source not found.**), even if specific to the “Awareness & Advocacy” theme. This result instead denotes how the ability of people to understand information, access to recovery and resources depends on a combination of several variables.

**Table 5.** MANOVA results with three and four variables

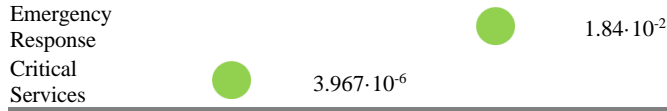
	Education + Income + Age	Education+ Income + Gender	Education + Income + Neighbourhood	Education + Income + Gender + Age
Awareness & Advocacy	●	●		●
Social Capacity			●	

Furthermore, following the estimation of the most relevant variables, linear regression analyses have been computed and tested through ANOVA to find the model that best explains each theme 24. ANOVA computes the analysis of a variance table for different linear model fits and tests whether the more complex model with two or three independent variables is significantly better or not with respect to a simpler one with just one independent variable. In addition, the validity of the model has been verified considering if the variance of the residuals was constant across the indices, that results in points distributed around the mean (Homoscedasticity - Constant Variance), and the examination of normal distribution of the residuals (normality of errors).

According to **Error! Reference source not found.**, the analysis on linear models performed with ANOVA agrees with the MANOVA results. The reported p-values in **Error! Reference source not found.** were used to check the level of significance for the several tested models. The smaller the p-value, the stronger the relationship is between dependent and independent variables.

**Table 6.** Linear models per theme tested through ANOVA

	Neighbourhood	p-value	Neighbour- hood+ Education	p-value	Education	p-value
Awareness & Advocacy			●	$6.36 \cdot 10^{-3}$		
Social Capacity			●	$2.79 \cdot 10^{-4}$		
Planning and Regulation					●	$1.61 \cdot 10^{-6}$



Three themes are well correlated with neighbourhood in combination with educational level factor. “Planning, Regulation and Mainstreaming Risk Mitigation” relates highly to educational level and “Critical Services and Public Infrastructure Resilience” with neighbourhood. The only exception concerns the “Legal and Institutional Arrangements” topic. It is not driven by any of the examined variables and models. This is probably due to that fact that this topic is at a very underdeveloped stage in Palestine.

## 5 Conclusions

Nablus city is facing the theme of disaster risk management and reduction only from the last decade, many times based on the collaboration between local researchers and European institutions. The presented methodology is useful to evaluate the status, gaps and current achievements of key resilience dimensions in the city. The Scorecard Approach provides a useful diagnosis tool and denoted, for this particular case, a low level of resilience of the city and lacking strategies in DRR.

Training will help the dissemination of guidelines and policies for fostering good habits in risk prevention and preparation. Indeed, several activities have been and will be developed in Nablus and in Palestine to contribute to the enhancement of the capacity of the cities to respond to earthquake events. Great effort is dedicated to the youngest layers of the population, who will be the new generation of civil protection volunteers and will implement future processes of vulnerability mitigation measures.

However, in the light of the questionnaires’ responses, improvements should be foreseen, especially in local centres for emergency response and plans. In order to assure informed decisions, results about risk scenarios and planning should be communicated in an appropriate language to the population, promoting effective systems of information for disaster risk management. Moreover, society should be involved in the decision processes through mechanisms of participation. On the other hand, local administrators’ results show a low capacity of the administration staff itself in risk management. For this reason, administration should strengthen the regulation for the implementation of seismic requirements of public infrastructure and propose incentives for the private one. In addition, special training for municipality personnel could be a key measure for improvement of the society resilience.

The performed assessment will enable local policy makers and communities to establish priorities for more in-depth analysis, to allocate funds and to develop emergency and disaster management programs more effectively. The development of the “citizens’ science” will be possible only with the strong synergy and collaboration between stakeholders, policy makers and society, aware on the importance of the prevention in the development of urban resilience strategies.

## Acknowledgements

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