Different Approaches to Disaster Resilience of Urban Settlements of Developing and Developed Countries: A Comparative Case Study on Yalova vs Cologne

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Abstract

This paper outlines a disaster resilience model for urban settlements with a comparative analysis of two cities: Yalova/TURKEY vs Cologne/GERMANY. After examining different disaster characteristics of various countries, both developing and developed, some common features and local specifics relevant to disaster mitigation are identified. Such common features and local specifics provide a starting point for designing a model for disaster resilient urban settlements. This model sets out guidelines for disaster mitigation, including standards, criteria, and building codes for disaster-prone settlements. On the basis of such guidelines, proposals are formulated for short-, medium-, and long-term strategies and policies.

The model focuses on the physical resilience of urban settlements rather than on social, political, administrative, etc. structures. Nevertheless, such structures must be taken into account since multi-dimensional functions interact in an urban settlement. The model distinguishes between risk factors of an urban settlement and elements of resilience. The model offers a checklist of possible actions rather than a detailed and comprehensive guidebook. Though based on a standard checklist, the model proposes different approaches for developing and developed countries, respectively. It is designed in a hierarchical structure from macro policies to implementing measures. The variables used in the model and the checklist can conveniently be updated to changing conditions of urban settlements over time. Multi-dimensional features and prospective methods of the discipline of city planning are reflected in the model.

The application of the model is discussed with a view to Yalova and Cologne, respectively. This comparison suggests different priorities for strengthening disaster resilience in developing and developed countries, respectively. Although Turkey is not a developing country, it presents typical features of developing countries due to its rapidly increasing population. Germany is a typical developed country with a shrinking population. Thus, Cologne typically represents the relevant features of developed country settlements while Yalova reflects those of developing country settlement.

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1. Introduction

Recently, natural disasters with devastating effects on human settlements have proliferated. In light of this fact, this paper will present a disaster resilience model for urban settlements. Since urban settlements are densely populated and constructed habitats of men, they a priori represent high natural disaster risks. Unless new planning strategies integrated with disaster mitigation approaches are applied to the urbanization process, natural disaster risks remain unacceptably high in urban settlements. In the model main principles, policies, strategies, and standards are set out to guide disaster prone urban settlements in the disaster mitigation process. As another notable point, this model sets out two different approaches to lessen the hazardous effects of natural disasters on urban settlements.

2. A Model on Disaster Resilience of Urban Settlements

This model is aimed at maintaining physical resilience of urban settlements rather than strengthening social, political, administrative, etc. structures. However, since an urban settlement is a space in which multi-dimensional functions interact, other relevant issues such as political, administrative, economic, and social are also taken into consideration to support the physical resilience of urban settlements. The disaster resilience model is structured with a view to correlations between disaster mitigation stages and the procedure of spatial planning in various scales.

The model has two main parts, namely risk factors of an urban settlement and elements of resilience. Risk variables are classified as natural disaster variables and urban settlement variables are taken into consideration in drawing the risk profile of an urban settlement. Total disaster response capacity, coping capacity, policies, and instruments of disaster resilience of an urban settlement are assessed in the part of “Elements of Resilience” (see also fig. 1). As “Figure 1” shows, the parts of the model interacts each other to adapt to the dynamic features of the urban settlement concerned or those of the natural disaster threatened the urban settlement.

The model is designed as a checklist of actions rather than as a detailed and comprehensive guidebook. This checklist of actions and recommendations can be easily modified to urban settlements of both developing and developed countries in light of the relevant set of priorities. The model is designed in a hierarchical structure from macro policies to implementation details through the headings set out below:

A-Risk Factors (of a Settlement)

A-1 Potential Impacts

For a certain urban settlement, the characters/features, magnitude and range of the natural disasters as well as the frequency, the occurrence time, the duration of disasters, and the type of disasters should be determined by considering recorded

historical data. Depending on historical damage reports of natural disasters, future potential hazard estimations should be calculated. Natural hazards are parts of potential impacts of natural disasters. Although the proposed model aims at maintaining the physical resilience for urban settlements prone to natural disasters, in this study, the theme of the model is earthquakes. In the case of earthquakes, ground shaking, surface faulting, liquefaction, landslides, tectonic deformation are all features of natural hazards (Melching & Pilon, Eds.2006). In addition to these hazards, the potential impact of earthquakes cover environmental, technological, social, political, and infrastructure risks as well as economic risks (Munich Re Group, 2004). A risk assessment study for an urban settlement prone to earthquakes should be prepared by considering each feature of potential earthquake impacts. Furthermore, such a risk assessment study can be enriched by long-, medium-, and short-term impact analyses. Following a detailed risk assessment study, efficient solutions can be produced for earthquake resilience.

A-2.Vulnerabilities

In light of the aforementioned potential impacts, a vulnerability analysis should be prepared with respect to each feature of an urban settlement namely, the site of the settlement, the ground survey of the settlement, the planning standards and criteria of the settlement, land-use, population density, the population profile and public awareness for disasters, the construction density and quality of the settlement, the quality in urban infrastructure & services, economic profile of the settlement. In order to facilitate a vulnerability analysis for an urban settlement, the vulnerable physical elements of urban settlements are grouped at three scales (macro, meso, micro) in accordance with the scales in spatial planning. At each level, useful questions are recommended to relevant authorities and other responsible bodies for assessing physical vulnerability.

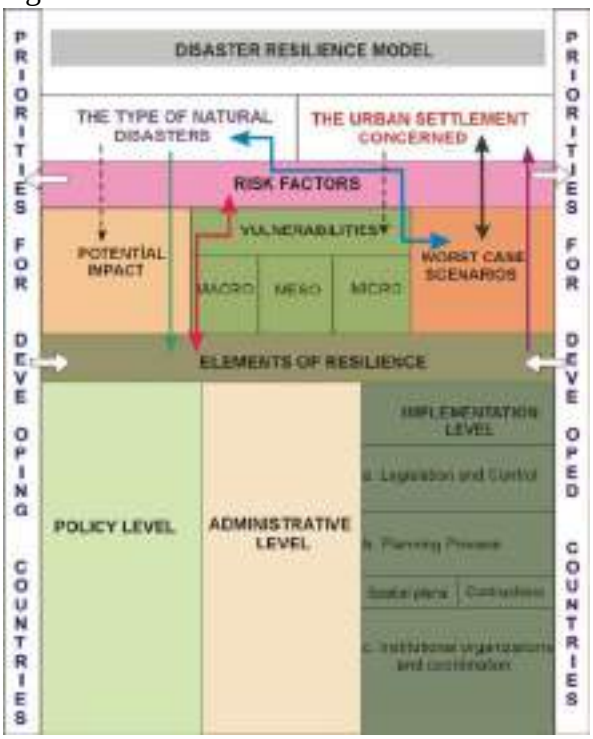
A-3. Worst Case Scenarios

In order to be prepared for the future natural disasters, the administrative body or disaster management authorities of the urban settlement should prepare various alternative disaster management plans and programs based on possible destructive natural disaster scenarios. These scenarios should be designed by the participation of disaster experienced executives, technical experts, academics and members of other scientific institutions, representatives of search and rescue teams and relief organizations, NGOs, other public interest groups, the Media. The worst case scenarios should lead participants (such as disaster experienced executives, technical experts, academics and members of other scientific institutions, representatives of search and rescue teams and relief organizations, NGOs, other public interest groups, the Media) to answer the following questions in the case of materialization of the scenario:

- What are major lessons learned?
- What are priority topics?
- What are challenges in terms of institutional, financial, organizational, administrative, and political capacities and capabilities?

- If possible, what are the results of SWOT Analysis in terms of local coping capacity?
- What short-, medium-, and long-term solutions can be generated?

Figure 1. A Disaster Resilience Model for an Urban Settlement



Source: Own source.

B-Elements of Resilience

B-1.Policy Level

At the policy level, urban policy-makers and governors, mayors, and relevant local administrative officers as well as agents of the central governments who are in charge of local development policies should design an effective disaster mitigation approach with a view to disaster resilience. As already mentioned, unless new planning strategies together with disaster mitigation approaches are applied to the urbanization process, urban settlements will remain exposed to high and probably increasing natural disaster risks. Some main principles, policies, and strategies are proposed to guide disaster prone urban settlements on disaster resilience. The elements of the disaster resilience policies should be analyzed with a view to the question of ***"What makes the urban settlement disaster resilient?"*** The policy instruments available for designing a disaster resilience process should be determined by the guidance of the following questions:

- What particular features of the urban settlement imply risks and challenges for a disaster resilience policy?
- Which elements of the coping capacity of the urban settlement are supportive of a disaster resilience policy?

- What long-, medium- and short-term approaches can be envisaged towards improving disaster resilience of the urban settlement?
- What processes and instruments are available in implementing disaster resilience policies?
- What (potential) side-effects of disaster resilience policies and measures must be taken into account?

However, development trends and policies of countries may create further undesired results on and vulnerabilities of urban settlements. While this model serves to both developing and developed countries, it is useful to emphasize that developing countries should pay more attention on generating policies to reduce environmental degradation. In this context, the vulnerability of urban settlements in developing countries should be evaluated on the basis of interactive relationships of intensity of disasters, environmental degradation, and side-effects of disaster resilience policies & activities. On the other hand, in developed countries, various approaches and methods are available with a view to protect the environment such as policy instruments for sustainable urban settlements and EU Strategic Environmental Impact Assessment Directive (SEA, 2001/42/EC; European Parliament & European Council, 2001). Hence, developed countries should integrate these instruments into disaster resilience programs of urban settlements.

In general, policy designers and decision makers of the urban settlement should pay attention on negative effects of disaster response and mitigation activities as well as general development policies and settlement strategies on urban environment and space. In this respect, the following questions will provide guidance to policy designers and decision makers of the urban settlement:

- What are the possible sources of environmental contamination and damages in the urban settlement during the disaster response activities?
- What types of disaster response activities can give damage to the urban space in terms of disorder and distortion?
- What are the possible sources of environmental contamination and damages in the urban settlement as a result of disaster mitigation activities?
- What types of disaster mitigation activities can give damage to the urban space in terms of disorder and distortion?
- What are the possible sources of environmental contamination and damages in the urban settlement as a result of general development policies and settlement strategies?
- What types of general development policies and settlement strategies can give damage to the urban space in terms of disorder and distortion?

In the light of the above questions, the preparations of some key documents are strongly recommended to build effective disaster resilience policies. These are the macro scale disaster mitigation map, macro scale spatial policy document which outlines national-wide policies and approaches towards mitigating the disasters, local scale disaster mitigation map and spatial policy document including relevant local details should be prepared. An efficient resilient policy should be constituted with the

participation and sharing knowledge of central governmental institutions, local authorities, NGOs and community-based organizations as well as private sector representatives, academic and research institutions, search and rescue teams, disaster assistance organizations, and media (ISDR, 2003).

B-2.Administrative Level

One of the pre-requisites of an effective disaster management is a well-organized administrative structure as well as institutional organization and coordination. In case of problems and inefficiencies in the administrative structure and institutional organization the following questions would be helpful to designate problem areas and to find effective solutions out:

- Is there any conflict or gap among the responsibilities of various institutions in terms of disaster mitigation, preparedness and response? If yes, the following criteria will provide guidance to the reorganization of tasks and responsibilities among institutions:
  - ✓ Historical background of an institution (age and experience)
  - ✓ Field of experience in terms of disaster mitigation (response, preparedness, recovery, mitigation)
  - ✓ Financial and technical capacity and capability
  - ✓ Institutional performance in case of disasters (overall assessment of institutional capacity as well as capability of intercommunication and coordination of relevant institutions and organizations)
- Are responsibilities efficiently shared by relevant institutions? Is there any overloaded or below capacity worked institution? Is there any institution which misfit to its field of work?

B-3. Implementation Level

Implementation level can be divided under three subtitles namely, legislation and control, planning process, and institutional organization & coordination.

B-3.1. Legislation and Control

To sustain disaster resilient urban settlements, relevant spatial planning instruments should be supported by effective legislation, controlling mechanisms and processes as well as dynamics of institutional and public awareness. In terms of effective legislation the following principles are recommended. Unless the existing legislation satisfies the following principles, the new legislation should be design with respect to these principles:

- ✓ A macro scale disaster frame law should be prepared.
- ✓ All disaster related-legislations of the country should be brought in line with this macro scale disaster framework law.
- ✓ Controlling mechanism and processes should be described and clarified through execution of the legislation.
- ✓ Controlling processes and measures towards increasing institutional and public awareness play integral roles in implementing a disaster resilience policy.

- ✓ Public and institutional awareness facilitates to build disaster resilience policies which implement relevant spatial planning standards and methods and foresee adequate disaster preparedness measures.

B-3.2. Planning Process

Spatial plans are important to prepare a base for a disaster resilient urban settlement. For the disaster resilience, using multi-dimensional planning instruments and integrated process of spatial planning into disaster mitigation will be beneficial. Disaster mitigation techniques should be included in the preparation process of a spatial plan; more specifically, the process should include the i) preparation of analysis maps, ii) preparation of a synthesis map by inserting data of analysis maps, iii) preparation of a spatial plan based on a synthesis map. It is possible to insert disaster/earthquake mitigation techniques and approaches into these steps of spatial plan preparation process as follows:

- ✓ Preparation of a land-use map
- ✓ Preparation of various layers of analysis maps
- ✓ Preparation of vulnerability analysis maps of different land-uses with respect to the records of previous disasters/earthquakes
- ✓ Preparation of disaster/earthquakes risks maps (hazard map + analysis map of spatial distribution of vulnerable physical elements)
- ✓ Preparation of spatial plans of the urban settlement in various scales.
- ✓ Preparation of a micro zoning map denoting i.e. safe zones, zones where buildings are permitted subject to adherence to special technical standards, and building prohibited zones.
- ✓ Preparation of a risk mitigation plan including an evacuation plan and an urban transformation action plan in the case of emergency.

As integral parts of spatial planning process, building plans and construction process should also serve to earthquake resilience. The recommended strategies and instruments serving to earthquake resilience of buildings are stipulated as follows:

- ✓ Preparation of existing building stock analysis in terms of quantifying the amount and likelihood of losses that buildings may suffer in future earthquakes.
- ✓ The recommended analysis should be prepared according to different indicators, such as function of the building, construction style and materials of the building, other relevant technical construction details of the building, height of the building, age of the building, soil ground analysis of the building (Meskouris, Kuhlmann, Mistler, 2003). This analysis should also be prepared for other types of construction elements such as storage areas, terminals, bridges, dams, viaducts, etc.
- ✓ Preparation of feasibility analyses of various alternative programs aimed at reducing the possible loss in future earthquakes (FEMA, 2004)
- ✓ Designing earthquake resilience action programs in cooperation with building insurance and building permit authorities and their procedures.

B-3.3. Institutional Organization & Coordination

The effective institutional organization and coordination is a significant issue in terms of implementation of disaster resilience on the urban settlement. All disaster mitigation plans and programs need to be prepared in the pre-disaster period, and they need to be coordinated under one single authority. In this context, the following key questions should be answered to find an effective coordinator institution:

- Is there an institution in charge of coordinating all disaster mitigation activities and programs in the urban settlement?
- If yes, does this institution work effectively?
- If not, what are the shortcomings of the existing coordinating institution?
- Is the existing institution able to overcome such shortcomings or is a new coordinating institution required?

After clarifying the position of coordinating institution, the dynamics of the institutional structure in terms of coordination and organization should be determined. In this study, the main elements of institutional coping capacity are determined as (i) risk perception, (ii) institutional awareness, and (iii) organizational administrative, technical, financial structures and equipments.

As already mentioned, though based on a standard checklist, the model will include the different approaches for developing countries and developed countries, respectively. In this part, these different approaches are clarified in terms of different priorities of developing and developed countries. The following topics are stipulated to provide guidance to developing countries with respect to their priorities in terms of disaster resilience:

- ✓ Survival of citizens
- ✓ Provision of shelter, security, and some basic goods and services for survival of citizens
- ✓ Organizing public campaigns and well-attended public training programs to teach citizens how to apply self-survival techniques
- ✓ Considering the limit of financial resources, strengthening of super- and infrastructure starting from centers of provision of essential services
- ✓ Prevention of environmental degradation and protection of natural resources

For developed countries, the following issues are recommended as priorities:

- ✓ Strengthening of super- and infrastructure
- ✓ Building effective disaster/earthquake insurance system for both buildings and infrastructure
- ✓ Designing the new program and process to provide earthquake/disaster resilience in provision of main services and utilities, such as electricity, telecommunication, energy and drinking water pipelines as well as emergency service units
- ✓ Building and developing the capacity of airway transportation modes and vehicles for disaster response
- ✓ Enhancing civil initiatives and community based organizations with a view to increase public awareness on disasters

The priorities above should always be taken into consideration while each part of model is applied on the concerned urban settlement. However, these priorities will provide more guidance in the part of "Element of Resilience" rather than "Risk Factors" due to the structure of check list in terms of potential impacts and vulnerabilities. In the part of "Element of Resilience", the way of applying policies and other relevant instruments is much more important than types of policies and instruments applied on the urban settlement. In this respect, above priorities will provide guidance to the relevant authorities to reach efficient results.

3. A Comparative Case Study of Yalova/TURKEY and Cologne/GERMANY with Reference to Different Approaches towards Disaster Resilience

3.1. Yalova and Cologne as Typical Examples of Different Priorities

This model sets out two different approaches to lessen the hazardous effects of natural disasters on urban settlements. From the perspective of a city planner, it is possible to distinguish between urbanization processes and urban settlements in developing countries and/or population increasing countries on the one hand and developed countries on the other hand. Such distinction will lead to two different approaches in the disaster mitigation process in different urban settlements. Even the main concerns of these two approaches are different. Thus, the proposed model offers two different sets of priorities with respect to developed and developing countries, respectively, while the main body of the model remains intact. The model should be applied in accordance with the relevant priorities of the concerned urban settlement.

Although Turkey is not a developing country, it has some crucial features similar to those developing countries, such as a rapidly increasing population, agglomerations around urban settlements, and economic difficulties. On the other hand, Turkey has similar features with developed countries in terms of know-how on disaster mitigation. It is very interesting that Turkey has advantages over Germany in terms of more comprehensive disaster legislation, a compulsory earthquake insurance system, and more integration of disaster mitigation issues into the spatial plans. Yet Germany performs well in running relevant processes, such as compliance with spatial planning standards and building codes. Hence, Turkey can build on her success in process planning in terms of disaster resilience as well as planning and construction activities to support disaster mitigation.

In this frame, a comparative case study has been carried out with a focus on Yalova and Cologne. Yalova is one of the cities affected by the 1999 earthquakes in Turkey. Cologne is a city in Germany which has significant earthquake risks due to its seismic background and existing settlement conditions. Since Yalova experienced high intensity earthquakes in 1999[2], the proposed model is updated and detailed in

[2] These particular earthquakes are internationally known as the *1999 Izmit and Duzce, Turkey earthquakes.*

light of local experiences in Yalova. Both cities were analyzed with reference to their seismic backgrounds, existing spatial planning and disaster mitigation activities as well as institutional coping capacity and problems. Subsequent to the analyses of these two cities, the earthquake risk assessments of the cities were performed. It should be noted from the outset that the risk assessment of Yalova will be quite different from that of Cologne in view of the significant experience of the 1999 earthquakes in Turkey. However, this difference creates an opportunity to test the proposed model enriched by the local experiences of Yalova on Cologne which has not yet experienced a devastating earthquake despite of its high seismic risk. Another opportunity through the testing process is to denote different priorities of the aforementioned cities as representatives of developing and developed countries.

3.2. Principle Findings of the Case Studies

Since the proposed model itself focus on the physical resilience of an urban settlement, the whole test results denote physical strengths and weaknesses. These results may pave the way to develop earthquake resilience in Cologne and Yalova.

The model building part mainly relies on lessons learned from the 1999 earthquakes in Turkey while the details are enriched by the case study of Yalova. In light of the model testing as well as personal experience of the author[3], the overall assessment was performed by using the SWOT analysis method (Alarslan, 2009). The 1999 earthquakes gave rise to reviewing the entire disaster mitigation system in Turkey in light of the lessons learned. Many initiatives and ongoing studies on legislation, institution-building, insurance, and quality control look promising for disaster resilient settlements. On the other hand, there are some threats regarding these initiatives due to instable institutional structure, budgetary constraints, lack of public awareness as well as inadequate organization and coordination (The Turkish Ministry of Public Works & Settlement, 2004). With reference to the different approaches set out in the proposed model, it is suggested that Turkey should follow the priorities of developing countries. Although Turkey is not a developing country, it has some crucial features similar to those developing countries, such as a rapidly increasing population, agglomerations around urban settlements, and economic difficulties.

As a result of the model testing, the key findings are formulated to provide guidance building disaster resilience of Yalova. The risk in the settlement of Yalova can be reduced by building awareness of hazards as well as designing and building of all infrastructure and superstructure with a view to decreasing vulnerability (BECT, 2000). For an earthquake, many authorities and citizens are already aware of the hazard of a certain magnitude. However disaster awareness and improvement processes are still complicated in such a country with an increasing population like

[3] The author of this paper worked in Yalova as well as other cities affected from 1999 earthquakes in the disaster mitigation projects of the Turkish Ministry of Public Works & Settlement. She is stil an advisor of the Municipality of Yalova in the UN Campaign of “Resilient Cities”.

Turkey. Because of the multitude of institutional responsibilities for relevant public services such as planning and infrastructure works, the awareness of disasters is not always sufficient to prevent the next disaster hazard. With this shortcoming in mind, measures towards lessening vulnerability can be grouped under three headings, namely “Site and Location of Buildings”, “Construction Quality and Design”, and “Control and Monitoring”.

Figure 2. The City of Yalova

Source: http://www.yalova.gov.tr/yalova_resimler/ana.htm

In sum, Turkey still needs to develop effective institutional organizations and coordination structures, well planned processes of construction control, application of relevant spatial planning standards, a more comprehensive disaster insurance system as well as public awareness. In the light of the relevant priorities recommended by the aforementioned model, Yalova will have an opportunity to be resilient in the next shake of an earthquake.

As a result of testing the model on Cologne, the strengths, weaknesses, opportunities and threats (SWOT) were outlined in terms of risk factors and elements of resilience with a view to priorities of developed countries. The model facilitated to generate useful and effective approaches, methods, and instruments for further earthquake resilience activities. In this respect, the proposed model is an instrument providing guidance to the local authorities as well as to policy- and decision-makers of Cologne by asking them some key questions and proposing some studies in response to their

answers. However, due to time constraints on the study, the confidential nature of some data, and the hesitation of some authorities to give genuine answers to questions on earthquake risks, the proposed model could not be entirely completed on the basis of information received from authorities. Rather, the model was supplemented according to data collected via interviews and questionnaires in Cologne (Alarslan, 2009, pp.334-475).

Figure 3. The city of Cologne

Source: http://www.bezreg-koeln.nrw.de

According to the results of the above SWOT analysis, Cologne is one of the well-planned and properly constructed cities in Germany. In spite of its big potential earthquake impacts, Cologne has not yet experienced any severe earthquake. In this respect, Cologne has the advantage of being able to prepare many worst case scenarios involving earthquakes and generate effective solutions before it faces with a severe earthquake. Many projects and programs leading to earthquake resilience are inevitable for Cologne when the above weaknesses are taken into consideration. In order to enhance the earthquake resilience of Cologne, some studies should be organized at the level of Federal Government and the State of North Rhine-Westphalia, namely a macro scale disaster mitigation map and a macro scale spatial policy document. At the local level, with respect to the aforementioned weaknesses, earthquake hazard and vulnerability analyses should be prepared first. In cooperation with relevant spatial planning and disaster-related authorities, an earthquake micro zoning map and a risk mitigation plan should also be prepared. In terms of building and infrastructure qualities, the existing standards, procedures and potential studies as well as earthquake insurances should be reviewed and synthesized into an integrated process. Another significant issue to be taken into consideration ought to

be building a relevant institutional organization to support all these studies and programs. Institutional capacity and organization should include not only disaster preparedness and response but also disaster mitigation and recovery activities and programs. New institutional restructuring or reorganization should provide opportunities to integrate disaster mitigation techniques into spatial planning methods. The ultimate issue in terms of earthquake resilience of Cologne is institutional and public awareness. Without working to develop effective institutional and public awareness on earthquake risk, the efforts to build up Cologne's earthquake resilience will remain futile until the event of a significant earthquake.

4. Conclusion

The proposed model of disaster resilience can be modified according to the different features of the concerned urban settlement as well as characteristics of the natural disaster which threaten that urban settlement. If applied correctly, the model will provide guidance towards a disaster resilient urban settlement. The success of the model depends on the willingness and openness of the relevant authorities to apply it. In the meantime, the checklist form of the model provides an opportunity for further development. Experience from applying the model to different urban settlements prone to various disasters can add further questions or modify the existing one. To have a potential for dynamic development, the proposed disaster resilience model can provide long-term guidance to urban settlements.

A comparative case study is a useful tool to facilitate the model building. The cities of the comparative case study reflect the typical particularities of developing and developed countries. This provides an opportunity to visualize the priorities recommended for developing and developed countries in the model. While test results of Yalova reflect the threat on buildings and survival of citizens, those of Cologne denote a need for the more comprehensive disaster mitigation method than the existing one.

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