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-Araştırma Makalesi-

Resilience Through Participatory Planning for the Integrated Ecological Risks in Düzce*

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Abstract
This study aims to develop an integrated spatial planning methodology with a participatory planning approach for building resilient settlements against complex ecological risk factors. Düzce Province is selected as a case study because of its complex ecological characteristics as witnessed many times in past. The methodology consists of four phases. (1) The first phase of the methodology joins the ecological planning aims. In the (2) second phase, ecosystem services (ES) integrated land suitability maps was produced by combining natural hazard risks and landscape vulnerabilities with the risk of degradation of valuable ES. The (3) third phase, is participatory risk governance approach, which consists of three components namely, (a) risk communication, (b) risk assessment, (c) risk management that conducted between the local and regional stakeholders within the multi-scale approach. In the (4) fourth phase, comprehensive outputs for spatial risk mitigation was provided by the integration of ecological risk synthesis and participatory planning findings. Results show that participants prioritized earthquake, landslide, and flood as the highest natural hazard risks and erosion, habitat vulnerability, and water infiltration as the highest ecological vulnerability risks respectively. Results of risk governance analysis show that, at macro-scale, central government institutions have the highest responsibility predominantly for proactive roles. At meso-scale local institutions of central governance have mainly reactive responsibilities. Thus, this integrated ecological risk assessment methodology can contribute to the decision-making process of ecological risk mitigation plans in a more comprehensive way through a multi-spatial and temporal scale approach. Moreover, this method can be applied in other provinces. However, in order to disseminate the results of participatory risk governance at provincial level, participation level and diversity should be increased in future studies.

Keywords: integrated ecological risk, ecosystem services, ecological resilience, participatory planning, Düzce province

Düzce İli’nde Bütünleşik Ekolojik Risklere Karşı Katılımcı Planlama ile Dirençliliğin Sağlanması

Öz
Bu çalışmanın amacı, kompleks ekolojik risk faktörlerine karşı dayanıklı yerleşimler oluşturmak için, katılımcı bir planlama yaklaşımı ile bütünleşik ekolojik planlama metodolojisi geliştirmektir. Düzce ili, geçmişte birçok kez karşı karşıya kaldığı ekolojik risk özelliklerinden dolayı örnek çalışma alanı olarak seçilmiştir. Metodoloji dört aşamadan oluşmaktadır. Metodolojinin ilk aşamasında (1) kavramsal olarak ekolojik planlama amaçları birleştirilmiştir. İkinci aşamada (2) doğal tehlikeler ve peyzaj hassasiyetlerinden doğan riskler ile değerli ekosistem servislerinin (ES) bozulma riskleri birleştirerek, ES ile bütünleşik yerleşime uygunluk haritaları oluşturulmuştur. Üçüncü aşama (3) olan katılımcı risk yönetişimi yaklaşımı ise; (a) risk iletişimi, (b) risk değerlendirmesi ve (c) risk yönetimi olmak üzere üç bileşenden oluşmaktadır. Dördüncü aşamada ise (4), ekolojik risk analizi ve katılımcı planlama bulgularının çoklu mekânsal ve zamansal ölçek yaklaşımına göre bütünleştirilerek, dayanıklılığın sağlanması için kapsamlı çıktılar elde edilmiştir. Risk değerlendirme sonuçlarına göre, katılımcılar doğal tehlikeler arasından sırasıyla deprem, heyelan ve sel riskini ilk üç sırada değerlendirirken, peyzaj hassasiyetleri arasında erozyon, habitat kırılganlığı ve su geçirgenliği risklerini önceliklendirmiştir. Risk yönetimi analiz sonuçları ise, makro-ölçekte, merkezi yönetim kurumlarının ağırlıklı olarak proaktif rollerde en yüksek sorumluluğa sahip olduğunu

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göstermektedir. Orta-ölçekte ise merkezi yönetim taşra teşkilatları temel olarak reaktif sorumluluklara sahiptir. Sonuç olarak, geliştirilen bu bütünleşik ekolojik risk azaltma metodolojisi çoklu mekansal ve zamansal ölçek yaklaşımı ile ekolojik risk azaltma planlarının karar verme sürecine daha kapsamlı bir şekilde katkıda bulunabilecektir. Ayrıca bu metot, başka illerde uygulanabilir ve yaygınlaştırılabilir. Ancak, katılımcı risk yönetişimi sonuçlarının il düzeyinde yaygınlaştırılabilmesi için gelecek çalışmalarda katılım düzeyi ve çeşitliliği artırılmalıdır.

Anahtar kelimeler: bütünleşik ekolojik risk, ekosistem servisleri, ekolojik dirençlilik, katılımcı planlama, Düzce İli

1. Introduction

Today the influence of increasing risk factors for cities is a global phenomenon. Characteristics of these risks are diversifying with their impacts on social (insecurity), political (injustice), economic (inequity), ecological (resource depletion and climate change) and technological ways. Also defining and understanding the dynamics of risks is getting more and more complex due to their sizes, changing natures and their interconnectedness with each other (GRR, 2017). As one of the risk factors group, ecological and natural hazard risks, such as climate change, loss of biodiversity, depletion and degradation of resources, pollution, and increase in extreme weather conditions, floods and degradation of natural resources have become one of the most important vulnerability factors on human settlements. As the result of the anthropogenic era, widespread consequences of emergent ecological risks have non-linear impacts on social and economic dimensions, which is known as *systemic risks* (IRGC, 2018). Such diverse and intricate features of risks create unpredictable threats on the socio-ecologic systems and make them vulnerable and incapable to unexpected risks.

Associated with the increased risk factors, resilience is a rising research realm and approach in the planning science since the beginning of 21st century. Therefore, the resilience approach efforts to understand and organize the relationship between people and nature, which are complex and connected systems (Folke et al., 2004). The basic attributes of resilience correspond to the targets of sustainability, provides a holistic, systemic and relational perspective for preventing and taking action to alarming global changes on vulnerabilities of socio-ecological systems (Schipper & Langston, 2015). Additionally, the resilience approach provides a new and holistic perspective in the planning science for methodological studies and policy development. It enables taking into account local and global scales at the same time, examines the multi-dimensional relations of social-economic-ecological-governmental issues (Scott, 2013). Correspondingly, the focal aim of building resilient settlements is to prevent unexpected surprises against external risks and continue to provide goods and services (i.e. Ecosystem Services) that support quality of life (Walker & Salt, 2006).

Therefore, with the growing attention of community and the increase of natural risk susceptibility in the 21st century, natural hazard risk management and mitigation concepts have gained more importance in the literature of sustainability and resilience paradigms. International policies have also been influenced in this direction in order to be able to cope with the unpredictable outcomes of risks and create more resilient socio-ecological systems. In this sense, as stated in the UN-International Decade for Natural Disaster Reduction Program (IDNDR, 1999) natural hazard risk management have been emphasized through the importance of prevention, preparedness and mitigation policies by taking action before risks occur, and by supporting proactive rather than reactive approaches (Mileti & Noji, 1999). Within this perspective of risk mitigation, hierarchical, static and reactive risk management methods have been switched to cyclical, dynamic and active risk management models (Balamir & Orhan, 2012). In support to this perspective, as stated in the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015) which is underlined the necessity of comprehensive and participatory approach to recognize risk perceptions and concerns in a community in order to address risk factors correctly. In this way, it will be possible to develop appropriate spatial development decisions to mitigate the broader consequences of integrated ecological risks.

Thus, while in one hand the resilience literature efforts to understand risk factors in a complex way and additionally international risk mitigation policies develop a more participatory and dynamic approach, on the other hand in the ecological planning literature natural hazard risk management and ecology based vulnerabilities have been studied separately in general. Moreover, a participatory planning approach into either ecological or natural hazard risk management is another gap in the literature to overcome the complex nature of risks arising from natural hazards or ecological vulnerabilities (Tezer, Uzun, et al., 2018). Due to diverse ecological risk factors and its adverse effects on human settlements, integration of ecological planning approach in spatial planning has an emergent role in order to mitigate the complex natural risk factors. Therefore, the purpose of this study is to develop an integrated ecological planning methodology with a participatory planning approach for building resilient settlements against complex ecological risk factors. Also taking advantage of the resilience approach which gives a systemic way of understanding the complex socio-ecological systems in multiple-scale and multiple-time periods will contribute to understanding the risks and defining governmental responsibilities.

2. Integrated Ecological Risk Mitigation Approach and Supporting Ecological Resilience

In this framework, this research will outline the context of integrated ecological risks and the role of participatory decision-making process for the enhancement of ecological resilience with the case of Düzce Province, which is representing diverse ecological assets and vulnerabilities, natural hazards and multi- stakeholder management structure. The novelty of the study will be analyzing the ecological risks in an integrated way with ES and empowering it with the participation tools for ecological risk assessment and risk governance with a resilience approach. Thus, it will provide a contribution to the literature on ecological planning and resilience planning. The methodology consists of four phase in order to improve comprehensive spatial risk mitigation background to be utilized for spatial plans as shown in the Figure 1*.* The comprehensive explanations of each phase are presented below.

2.1. Phase 1: Integration of Ecological Planning

The basic streams of ecological planning can be grouped under three main research fields. The first one is related to natural risks and vulnerabilities. McHarg's "Design with Nature" titled book is a prominent source for this area (McHarg, 1969). In this book, ecological risks and vulnerabilities were evaluated with geographic, morphological and physical characteristics of land. After as Beatley (1998) expressed, the scope of ecological planning expanded through the interaction between man and the environment in the context of sustainability. He outlined two principles to be considered in the ecological planning context. One of them stated as human settlements should not be harmful to the environment and the other is to take measures against natural risks (Beatley, 1998). Subsequently, the last one is related to mapping and the integration of ecosystem services into spatial planning (Albayrak, 2012; Burkhard, Kroll, & Müller, 2010; Costanza & Groot, 1998). Within the framework of ES, the benefits that people derive from nature have been studied under three main topics in terms of provisioning, regulating and cultural services. According to these three streams in the ecological planning literature, there can be extracted two main aims of ecological planning. As one of them is mitigating the risks coming from nature which is related to ecological risk factors, and the other is utilizing the benefits of nature that can be referred to as ecosystem services (ES).

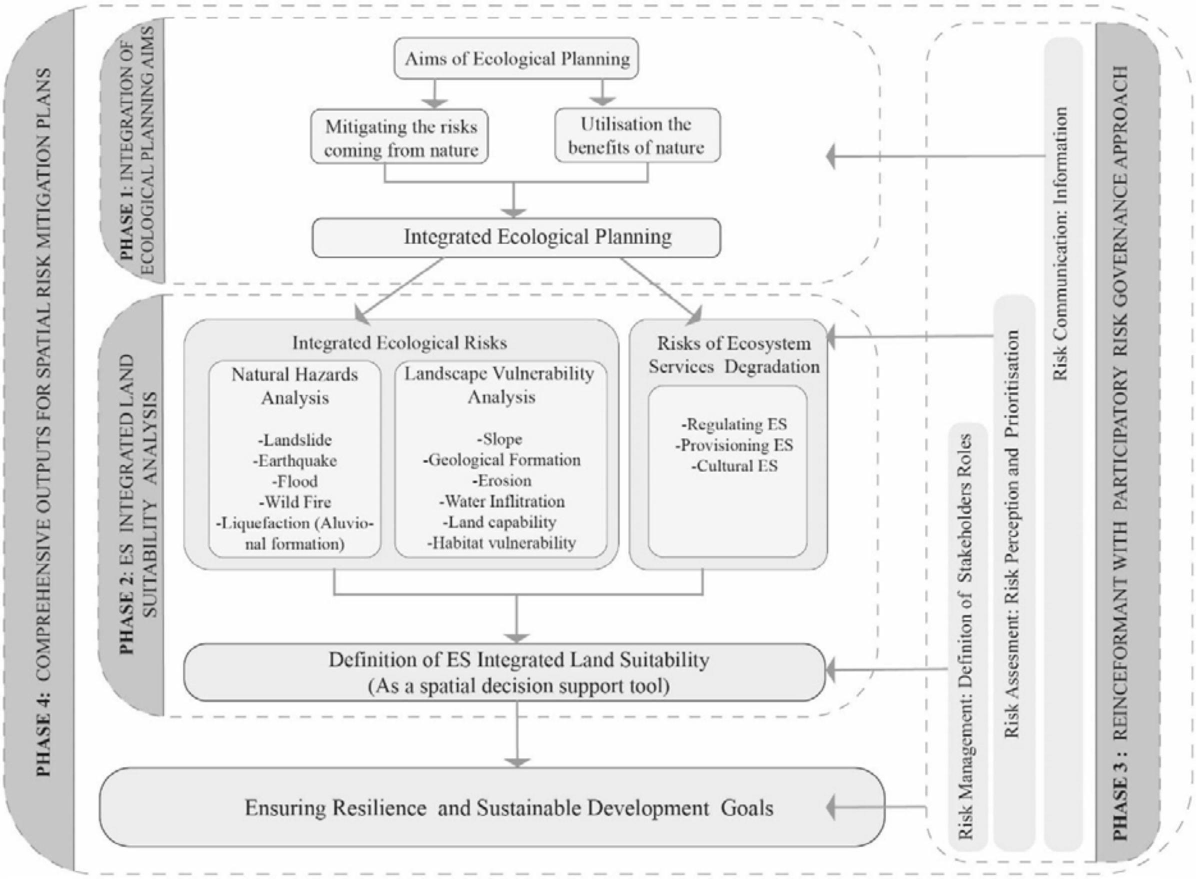

Figure 1. Conceptual research methodology.

However, the three streams of ecological planning mentioned above have generally been dealt with separately in the literature so far. Whereas, the resilience planning context requires an integrated and comprehensive way of examining ecological risks (Sobiech, 2012). From this point of view, in order to be utilized for spatial decision making as a preliminary goal for building resilient and sustainable settlements, the research methodology combines the risks and the benefits coming from nature by integrating the ecological planning aims.

2.2. Phase 2: ES Integrated Land Suitability Analysis

Integrating the two aims of ecological planning, as the mitigation of natural risk factors and utilization the benefits of nature enables to integrate the three group of ecological risks, (1) natural hazards and (2) geo/ecological/landscape vulnerabilities with the (3) risks of pressures on ES. In the second phase of the methodology, in order to develop an integrated ecological planning approach, firstly there will need to analyze each ecological risk factor in a detailed way. Therefore, firstly ecological risk factors will be explained theoretically in this section. Subsequently, after analyzing each risk factor, as the end product of this phase, ES integrated land suitability maps will be produced by superposing each layer of risk. The method of the ES integrated Land Suitability Analysis will be explained in section 3.1 in a more detailed way.

As stated (Figure 1), one of the ecological risk group is (1) *natural hazard*, which is defined by UNSIDR (2016) as a potentially dangerous natural phenomenon that can cause injury or loss of life, property and infrastructure damage, and disruption of social and economic activities. In addition, the impact of disasters varies depending on the types of natural hazard, geographical land cover, density of the population and infrastructure conditions

(Sutanta, Rajabifard, & Bishop, 2010). The second group of ecological risk is (2) natural/*landscape vulnerability*, which is one of the main and primary methods in the history of ecological planning practice. Landscape vulnerability analysis superposes the critical features of the land such as; slope ratio, geological conditions, infiltration levels, flood areas, land capability classes, habitat vulnerability, and erosion areas. The superposed maps interpret the most vulnerable and risky zones that unsuitable for urban development areas (McHarg, 1969). The last group of ecological risks is the (3) *degradation of the ES.* ES represent the benefits human populations derive directly or indirectly, from ecosystem functions (Costanza & Folke, 1997; MEA, 2003). Burkhard et. al. (2010) define ecosystem services as “the contributions of ecosystem structure and function in combination with other inputs to human well- being”. As an example, forests may supply timber and wood fiber, support nutrient recycling and soil formation, regulate climate by absorbing carbon dioxide, provide and regulate water resources and attract people for recreation and tourism. Also in the international legislation context, according to the European Union Biodiversity Strategy Action 5, calls on the Member States to determine and map the status of ecosystems and ES for sustainability, taking necessary measures and restoration practices (EU, 2013). Within the ES approach, cross-scale interactions and multi-scale assessments are important prerequisites for identifying benefits/products/processes that are provided from ecosystems, that might contribute the decision-making and policy making process for the protection of natural resources (MEA, 2003). In addition to this, according to Galic et al. (2010) for the spatial-temporal identification of the key ES and service providers, a collaboration of scientists, authorities, industry and other stakeholders is necessary.

ES approach is a complex way of understanding human and nature interaction. Such as regulating service of ES have a critical role on the natural risk mitigation by water flood regulation, erosion control, climate regulation etc. Degradation of valuable and critical ES will directly or indirectly lead to the reduction of the benefits that people derive from the nature, and will trigger other related risk factors that will cause a decrease in quality of life and affect human well-being (MEA, 2003). In this sense, it is important to understand the natural risks coming from nature in one hand and to analyze the exponential effects of losing critical ES in other hands in order to mitigate integrated ecological risks. In the scope of this study, two important roles of ES were emphasized in the context of ecological planning which is the protection of the highly valuable ES in order to enable the utilization the benefits of nature, and identification of the regulating services of ecosystems for ecological risk mitigation.

2.3. Phase 3: Strengtheningt with Participatory Risk Governance

Participatory planning approach has regained international significance in the planning discipline, at UN Rio Conference on Environment and Development, Local Agenda 21 (UN, 1992). The main purpose of the participatory planning is developing and sharing knowledge between the related actors in order to develop more sustainable, efficient and permanent spatial plans. In the context of ecological risks, in order to be prepared for oncoming environmental problems, participatory planning aims to provide consensus and partnership on development policies and environmental policies, through the participation of, organizations, NGOs, and communities at international, regional, sub-regional level (Duxbury & Dickinson, 2007). However, decision-makers and institutions tend to syntheses and analyze the spatial risks solely based on the spatial data, or developed a risk governance model based on a single risk factor, such as flood or earthquake risk (Henrich, McClure, & Crozier, 2015; Thaler & Levin-Keitel, 2016; Wehn, Rusca, Evers, & Lanfranchi, 2015). This procedure can create limitations and problems, such as taking non-rational decisions, form unsustainable plans and generate inconsistent solutions. For this reason, it is essential to take into account the risk experiences, perceptions, assessments, and considerations of the relevant actors in the integrated ecological risk mitigation and management plan through the participatory planning approach (Galantini, 2018).

The participatory approach has been studied in the risk mitigation literature within the risk governance framework (Renn & Klinke, 2014). The risk governance framework, which is defined as the management of the wide effects of the risks in an integrated way, combines risk communication, risk assessment, and risk management steps, which were examined individually in the previous studies (Sellke & Renn, 2010). International Risk Governance Council (IRGC, 2006) has developed a Risk Governance Framework, in order to evaluate in what way human settlements defines the risks, how they react to risks and how stakeholders can be integrated into the process efficiently. According to risk governance framework some of the highlighted topics are; to bring together different groups of actors in risk policy decisions and practices, to evaluate risk perceptions of individuals and groups, and to identify socio-cultural risk concerns (Sellke & Renn, 2010). Based on risk governance literature, in this study three components of participatory risk governance included as the steps of (a) risk communication, (b) risk assessment and (c) risk management**.** The first step**,** *risk communication* started from the first phase of the project, in order to deliver adequate knowledge to relevant actors. In the second step, *risk assessment* of stakeholders is conducted by the AHP method, which includes risk perception and prioritization analysis. At the last step, *risk management* dissemination conducted with stakeholders' roles definition according to results of risk assessments by the multi-scale method in accordance with the resilience approach. Following in this chapter, the theoretical background of each step of risk governance will be explained in a more detailed way.

Step (a): Risk Communication: There are different levels of participation in participatory planning. Arnstein (1969) identified eight different levels of participation from the minimum level (no attendance) to the highest level (where the participants took decisions). The initial participation level has been identified with getting right and objective information at the right time. Delivering information is essential for participant's decision-making process, in order to achieve successful results of risk assessment (Giupponi, Mysiak, & Sgobbi, 2008). Therefore, before starting risk assessment workshops, there is needed enough time for delivering adequate knowledge to the participants. Besides that, risk communication process can provide diverse results between participants on both sides. Such as increasing awareness, learning from local knowledge and experiences, empowering the community by facilitating to see weaknesses and strengths, enabling different interest groups to understand each other and to develop innovative solutions and synergies in the community (EU-WFD, 2000; Natarajan, 2015).

Step (b): Risk Assessment: risk perception and prioritization; One of the most important roles of the participatory planning method is the contribution of the community risk assessment in reducing spatial risks. Researchers have admitted that simply looking at environmental exposure and risk sources is not enough because it has not been able to elicit different human response strategies and the consequences of disasters (Bohle, 2001). Therefore, *participatory risk assessment* is being examined as part of a multi-disciplinary method approach in terms of strengthening the community, generating knowledge, being a tool for negotiating local decisions, and identifying and mitigating disaster risks (Pelling, 2007). On the other hand, integrating scientific and local knowledge within risk mitigation methods that encourage knowledge exchange and two-way dialogue is a difficult yet important task (Cadag & Gaillard, 2012). *Risk Perception* as defined by Slovic (1987) refers to people's intuitive and subjective evaluation of the riskiness of an activity or event. Risk perception is believed to affect people's preparedness for responses and recovery from disasters, which is important for developing effective risk communication strategies (Miceli, Sotgiu, & Settanni, 2008; Spiekermann, Kienberger, Norton, Briones, & Weichselgartner, 2015). Without a good understanding of how people assess risks associated with the various aspects of disasters and their management, well-intended policies and measures may be ineffective or even lead to undesired results (Grothmann & Reusswig, 2005). If community planners and disaster managers ignore the local community, then they decrease their chance of providing reasonable solutions to disaster-related problems (Pearce, 2003).

Step (c): Risk Management: Definition of stakeholders roles with multiple scale; The systems-approach perspective of resilience theory provides a new and comprehensive method for risk management studies, which helps to categorize the source of risks in a systematic way according to spatial scale of impacts and in relation with time scale of risk occurrence (IRGC, 2018). Similarly, the importance of multi-spatial and temporal scale assessment of socio-ecological systems has been emphasized in the MEA (2003) as a critical tool for the understanding boundary of the ecological risks and causality of the effects. As it can be seen in Table 1, according to intensity or impact of the risk factor, such as mild, moderate and severe, affected spatial scale of a system will be differentiated respectively as micro, meso and macro scale. This is also related to the time of risk occurrence as fast, medium and slow. More importantly, the systemic classification of risks according to their spatial effects and temporal occurrence will provide comprehensive information for risk management during the building of the system's resilience (Béné, Headey, Haddad, & von Grebmer, 2015) As an example, against a mild risk factor, systems reaction will be stable and can persist its functions. Thus, in order to develop the system’s absorptive capacity there will need to take humanitarian interventions in short-terms. As another example, against a moderate risk factor, the system will respond in a flexible way and system behavior will perform with incremental adjustments. Thus, in order to build system resilience, there will need to develop the systems adaptive capacity with the mid-term projects. Correspondingly, against a severe risk factor, the system will not continue its functions and it will change and transform. Thus, there will need long-term development programs to increase the system's transformative capacity. From this perspective, in the participatory risk management process, while defining the roles of stakeholders, classifying the risks according to their time and spatial scales, and categorizing the stakeholders’ roles according to their level of responsibility will provide systemic perspective and results. By understating and analyzing the complex nature of ecological risks management with multi-scale approach, more interconnected and interrelated-solutions can be made in the process of developing resilience policy measures towards ecological risk mitigation.

Table 1. System resilience and system reactions due to different impact or intensity of risk factor (adapted from Béné et al. (2015)

RISK FEATURE			SYSTEM REACTION		SYSTEM RESILIENCE	
Intensity or Impact of Risk Factor	**System’s Spatial Scale**	**Risk Occurrence Time-scale**	**Degrees of Responses**	**System Behavior**	**Developing System Capacity**	**Policy Measures**
Mild	Micro	Fast	Stability	Persistence	Absorptive Coping	Short-term humanitarian interventions
Moderate	Meso	Medium	Flexibility	Incremental Adjustment	Adaptive	Mıd-term projects
Severe	Macro	Slow	Change	Transformational	Transformative	Long-term Development Programs

2.4. Phase 4: Comprehensive outputs for spatial risk mitigation

In the fourth phase of the methodology, findings of each phase will be combined in order to contribute decision-making process of ecological risk mitigation planning in a more comprehensive way and to fulfill the aims of resilience and sustainable development goals. Additionally, it is significant to emphasize the participation of stakeholders in this process will enhance the community resilience through the awareness raising and risk governance. The integrated and participatory ecological risk mitigation process is the unique output of this research study. The fourth phase of the methodology will be explained in detail in chapter 3.3. after the description of each phases' findings.

3. Research Results of Case Study Düzce

The main reasons for the consideration of Düzce Province as a case study area, is due to the diversity and richness of the ecological assets, as well as the natural hazards and ecological vulnerabilities that associated with the structure and landscape qualities of the region. Düzce province had been exposed to diverse natural hazards (earthquake, floods, erosion) many times in its history, which had resulted in the changes and transformations of the social, economic and ecological structures. The whole province both rural and urban areas experienced severe loss of lives and properties, numerous spatial land uses have lost their functions (Düzce Governorship, 2011). Especially after the 1999 Düzce Earthquake, Düzce gained its province status. Under the view of disasters experienced in Düzce Province, severe damage or loss of many critical facilities and public services has proven the necessity to integrate risk management with the spatial development process. Düzce province has 377,610 population (TÜİK, 2017) and has eight districts, which are City Center, Akçakoca, Cumayeri, Çilimli, Gölyaka, Gümüşova, Kaynaşlı and Yığılca within the Province boundaries. When population density is considered, City Center, Cumayeri, and Çilimli districts have the highest population density; and Akçakoca, Gölyaka, and Yığılca have the lowest population density (TÜİK, 2017). The economic structure of the city is based on tourism, agriculture and industry. Akçakoca district is located along the shore of Black Sea, and there are touristic facilities and vacation houses. The main agricultural activities in the province are hazelnut cultivation in the north part and other agricultural activities in the central part.

3.1. Results of ES Integrated Land Suitability Assessment

Integrated ecological risk maps of Düzce Province were produced by analyzing and synthesizing three groups of spatial information, the natural hazard maps, geological and landscape vulnerability maps and ES maps (Figure 2). Detailed explanations of the ES integrated land suitability analysis shown in Figure2 were described in the article titled as "Ecosystem services-based multi-criteria assessment for ecologically sensitive watershed management" (Tezer et al., 2018a). In the Düzce Province, Integrated Natural Hazard Maps have been taken into consideration as landslide, earthquake, flood, wildfire and liquefaction. In the natural hazard analyses, there had been used the data of geological fault line, river flood zones, wildfire sensitivity zones and data of alluvial/soil formation used as erosion and liquefaction risk zones. Within the context of Integrated Natural/Landscape Vulnerability Analyses; geomorphological (slope) and geological formation analysis, erosion, water infiltration, land capability, and habitat vulnerability analysis were included. In the third group of spatial ES maps were examined under three classes as provisioning services (14 ES), regulating services (11 ES) and cultural services (6 ES) with the total number of 31 ES.

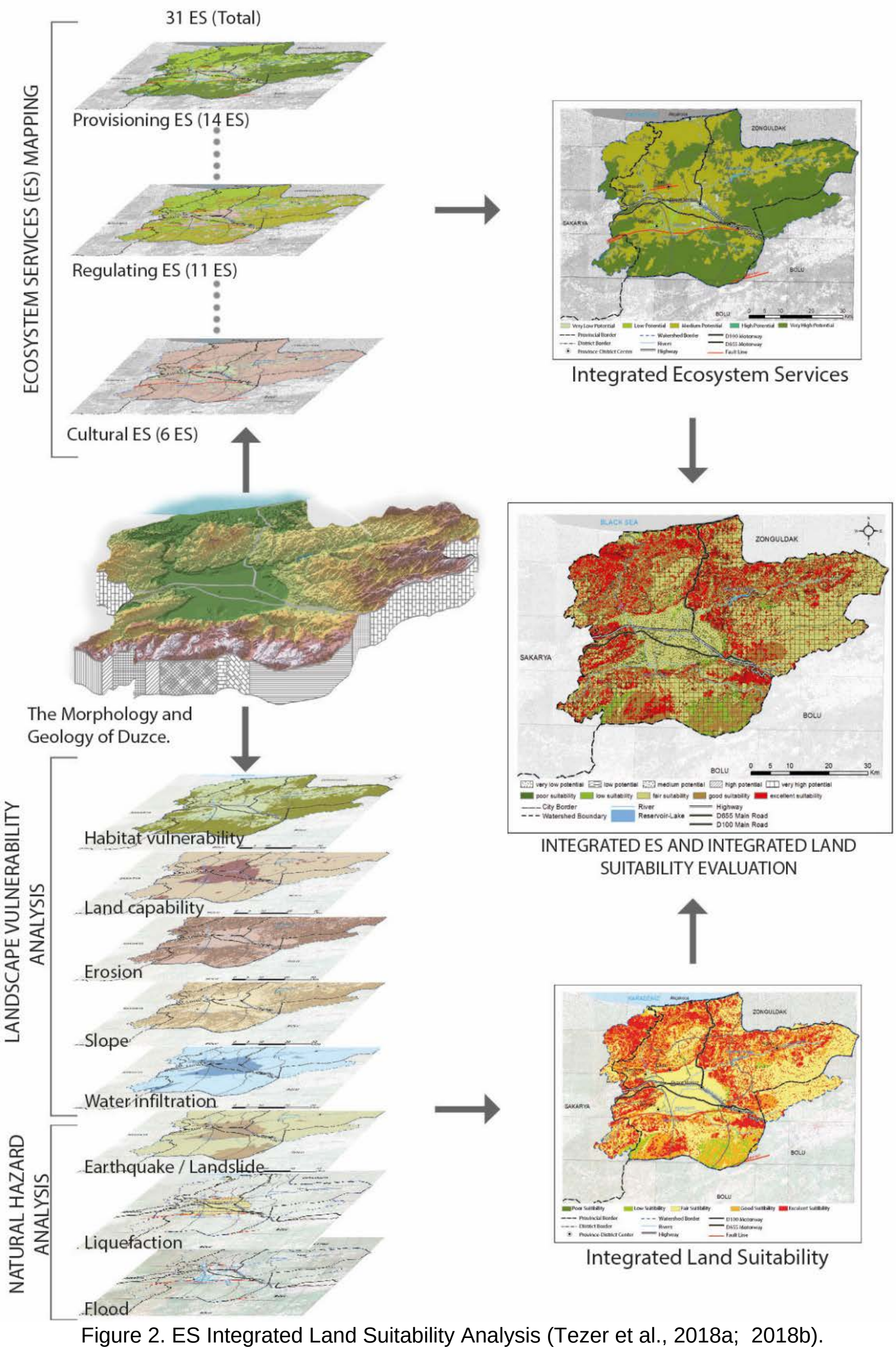

Figure 2. ES Integrated Land Suitability Analysis (Tezer et al., 2018a; 2018b).

These spatial maps were analyzed as in the methodology used by Burkhard et al. (2010). The method consists of an land use/ land cover based ES matrix approach. In the matrix land-cover types are linked to each ES, that gives the relevancy of service provision potential, flow and demand (Tezer et al., 2018a). The potential of the land cover types has been analyzed by a scale from 1 to 5 (Burkhard, 2010). As the final step of the second phase, ES Integrated Land Suitability Analysis (Figure 2) had been developed by combining (spatially superposing) the ecological risks (risks resulting from natural hazards and landscape vulnerabilities) and integrated ES assessment (including 31 ES). Thus, there had been accomplished the aim of integrated ecological assessment approach which can be used as a strategic decision support tool in spatial planning (Figure 1). The proposed method has the potential to indicate the areas with high levels of ecological risks in terms of both avoiding natural hazards and the degradation of ES. Based on this, by using this methodology it will be possible to prevent the ecological vulnerabilities and degradation risks and to achieve the sustainability of ES. ES integrated land suitability analysis can help the decision makers to determine the policy measures to be taken within the scope of ecological planning, and to achieve resilience towards ES and their sustainable development.

3.2. Results of Participatory Risk Governance

In this research, the participatory risk governance approach had three objectives as; risk communication, risk assessment, and risk management. Participatory risk governance process was conducted through one pre-meeting plus two focus group workshops. The first pre-meeting within the framework of risk communication was conducted with the key stakeholders from Düzce Provincial Directorate of Environment and Urbanization, and Düzce Provincial Directorate of Disaster and Emergency Management Authority (AFAD). The pre-meeting was enabled us to get in contact with relevant stakeholders who were already involved and working on issues related natural hazards and risks, ES, and spatial planning and it provided to get related information about the spatial characteristics of Düzce Province. Moreover, the main contribution of the risk communication was fostered mutual knowledge exchange by delivering results of the research project, and ensured participation of the stakeholders for these prospective workshops. Following that, relevant stakeholders, such as participants of administrative institutions, non-governmental organizations and academic institutions were invited to the first focus group workshop via mails, calls, and e-mails. This workshop had two sessions. During the first session, which was held after the preparation of the geological and ecological risk analysis and synthesis of the integration, the preliminary outcomes of the scientific research were introduced and presented to the participants. The second session, on the other hand, was designed to explore the assessment of stakeholders' risk perception via activities of questionnaires and round-table discussions. After obtaining the results of the risk assessment analysis, second focus group workshop was held for defining the responsibilities of the relevant institutions via questionnaires again, and through panel discussions. Results of the two focus group workshops are explained in detail below.

Results of the Risk Assessment ; the first focus group workshop was held in the Düzce in order to analyze the evaluations of ecological risks by the stakeholders. The total number of participants was 25, and they had different professional backgrounds. Almost half of them (48%) were technical personnel, and most of the participants (60%) reported that they had been working for less than 10 years. In the analysis, Analytical Hierarchy Process (AHP) method was used for the stakeholder' evaluations. In order to set priorities and solve decision problems, AHP necessitates the formation of a hierarchical structure which involves the goal, criteria, and alternatives (Saaty, 2001). Accordingly, in this study, the goal was to identify the ecological risks that would likely be caused by natural hazards and vulnerabilities. Though, stakeholders had not prioritized ES, because of its complex understanding of human and nature interactions. In the workshop, the theoretical knowledge of ES were introduced by delivering information about three values of ES as regulating, provisioning and cultural. Within this context, AHP criteria were set as "the size of impact area", "the frequency of occurrence" and "the magnitude of effect"; and each criterion was assigned equal priority. The alternatives, which were likely to cause ecological risks, lied at the bottom of the hierarchy. These alternatives for the natural hazards consisted of earthquake, landslide, flood, erosion, wildfire, and drought. The AHP model was built by means of the Expert Choice software. Results of this dynamic sensitivity analysis demonstrated that, among the natural hazards, the earthquake was ranked (39.7 %) as the most important natural hazard that would likely to have the highest risk both in terms of the size of the impact area and of the magnitude of the effect, whereas landslide was ranked (22%) as the second natural hazard that would likely to have the highest risk in terms of the frequency of occurrence. Following that, flood risk was ranked (19.1 %) in the third and wildfire was ranked (12.4 %) in the fort place. Drought was ranked (6.9%) as the last natural hazard which would cause the least risk. On the other hand, the alternatives that were likely to have impact on the landscape vulnerability in terms of the criteria set forth before included erosion, habitat vulnerability, land capability, and water infiltration. Results of AHP showed that, erosion (30.2%) was found to be the most important ecological vulnerability in terms of the three criteria, followed by habitat vulnerability (25.7%). Subsequently, water infiltration (22.2%) and land capability (22.0%) were considered landscape vulnerabilities for causing risks in almost equal importance.

Results of the Risk Management Evaluations**;** following the risk assessment process, second focus group workshop was held in the Düzce in order to define the roles of institutions among highest three risk factors and additionally three group of ES. Invitations for the workshop were sent to central governance and regional level institutions, local institutions of central governments, research institutions and institutes, professional organizations and non-governmental organizations, and local government institutions. Nineteen stakeholders participated the questionnaire. Fourteen of the participants were from the local institutions of central governments; four of them from local government and one of them were from the regional level institution. At the beginning, the participants were informed about the ecological risk factors under three groups and nine in total; as first group natural hazards (earthquake, landslide, and flood), second group ecological vulnerabilities (erosion, habitat vulnerability, water infiltration) and the third group ES's (regulating, provisioning, and cultural). Following, participants were asked to rank the relevant institutions or organizations roles and contributions according to their importance in the relevant field of responsibilities. Responsible institutions were grouped under three scales, as related to the multi-scale approach of resilience (Table 2). Under the macro-scale; international institutions, regional level institutions and central governance institutions were grouped. At meso-scale, local institutions of central governance and research and development ınstitutions were grouped. In addition, at the micro-scale, local governance, NGO's, professional organizations, local community, and Headman were grouped. Likewise, the field of roles and responsibilities were defined through two categories as proactive (before the occurrence of risk, that concerns risk management) and reactive (after the occurrence of risk, that concerns crisis management). In the first group proactive roles and responsibilities defined as policy development, legislation, planning and risk management, financing, research & development, and training. In the second group reactive roles and responsibilities defined as, problem management, technical support, providing equipment, providing personnel, improvement, and intervention.

Table 2, Aggregated frequency distributions of the proactive and reactive roles of institutions at multi-scales, defined by the participants for the total of nine ecological risk factors

Highest / Highly / Medium / Low / Lower / Lowest	ROLES-RESPONSIBILITIES /INSTITUTIONS	Macro Scale			Meso Scale		Micro scale		
		International Institutions	Regional Level Institutions	Central Governance Institutions	Local Institutions of Central Governance	Research & Development Institutions	Local Governance	NGO's and Professional Organisations	Local Community and Headman
PROACTIVE (risk management)	Policy development	0	0	141	16	4	3	0	3
	Legislation	0	0	159	6	0	1	0	0
	Planning and risk management	0	1	113	43	1	0	1	0
	Financing	0	1	142	19	0	5	0	0
	Research and development	0	3	79	20	61	0	4	0
	Training	0	0	57	61	27	8	9	0
	Sum of Proactive Roles	0	5	691	165	93	17	14	3
REACTIVE (crisis management)	Problem management	0	0	64	90	2	1	0	0
	Technical support	2	0	63	73	14	5	7	0
	Providing equipment	0	0	59	72	0	29	1	0
	Providing personnel	0	0	48	102	0	9	1	0
	Intervention	0	0	39	111	0	9	4	0
	Improvement/ financing	0	0	57	97	0	3	4	0
	Sum of Reactive Roles	2	0	330	545	16	56	17	0
	Total	2	5	1021	710	109	73	31	3

The results of questionnaire analysis on risk management were represented at Table 2, as aggregated frequency distributions of the proactive and reactive roles of institutions at multi-scales, which was defined by the participants, for the total of nine ecological risk factors. Based on the table there can be interpreted that, at macro-scale central governance institutions have the highest role and responsibility distribution, additionally mostly found in the proactive roles; such as legislation, policy development ,and financing. Following that, in the second place at meso-scale local institutions of central governance take place, and highly responsible for reactive roles as providing personnel, intervention, and improvement. It can be also seen that at the micro-scale, local level of institutions have low-level of responsibilities. Among the frequency distribution of roles at micro-scale, local governance has relatively high responsibility for the role of providing equipment. Furthermore, another contribution of the findings can be interpreted as the identification of the collaborative roles among the institutions. Such as, for the roles of training, problem management, technical support, providing equipment and improvement, both of the institutions of central governance and local institutions of central governance can collaborate. Additionally, for the research and development role, central governance institutions and research & development institutions can cooperate. Also for the role of training and technical support, research & development institutions can work together with the local governance and NGOs and professional organizations.

3.3. Comprehensive Outputs for Integrated Ecological Risk Mitigation

The last phase of the methodology integrates the findings of each phase, in order to achieve comprehensive outputs for integrated ecological risk mitigation. Based on the results obtained from spatial integrated ecological risk analyzes and participatory risk assessment analyzes the most important natural hazards were determined as earthquakes, landslides, and floods in the Düzce Province. The most dangerous landscape vulnerabilities were determined as erosion, habitat vulnerability, and water infiltration, respectively. According to participatory risk management findings, central governance institutions have the highest responsibilities for proactive roles at the macro-scale, while the local institutions of central governance are highly responsible at the meso-scale for reactive roles. However, the local level institutions have a low level of responsibilities at the micro-scale.

Table 2. Developing systems resilience capacities with multi spatial and temporal scale approach against the integrated ecological risks

	MULTI SCALES		
	MACRO SCALE	**MESO SCALE**	**MICRO SCALE**
SPATIAL SCALES	National-Regional Level	Düzce Province	Districts-Neighborhoods
TIME SCALE	Long-term	Mid-term	Short-term
SYSTEMS CHANGE	Slow	Moderate	Fast
INSTITUTIONS	International Institutions Regional Level Institutions Central Governance	Local Institutions of Central Governance Research and Development Institutions	Local Governance NGOs and Professional Organizations Local community and Headman
POLICY MEASURES	Policy development	Strategies- Projects	Actions - Humanitarian interventions
DEVELOPING SYSTEM CAPACITIES	Developing transformation capacities with long-term international/ national policies	Developing adaptation capacities with mid-term strategies at province level	Developing coping capacities with short-term actions at district level
INTEGRATED ECOLOGICAL RISKS **(1) Natural Hazards:** Earthquake, Landslide, Flood **(2) Landscape Vulnerabilities**; Erosion, Habitat vulnerability, Water infiltration / (3) Degradation of **Ecosystem Services;** Regulating, Provisioning, Cultural			

In the project, there were aimed to build resilient settlements against integrated ecological risks in Düzce province. Within this purpose, to combine ecological risk mitigation and resilience approaches, comprehensive outputs categorized by multi-spatial and temporal scales. In order to build the resilience of the system, the multi-spatial and temporal scale assessment approach will help to understand the risks in a systemic way and to improve the system's capacity by the distribution of responsibilities of the stakeholders at different scales. Consequently, Table 2 represents a comprehensive and systemic perspective of resilience approach for the integrated ecological risk mitigation. According to Table 2, it can be specified that in macro-scale (at the national and regional level) central governments can develop policy measures to improve the transformation capability of the system in the long term, in cooperation with international and regional institutions. Also in the meso-scale (at the Düzce Province), local institutions of central governance can develop mid-term strategies to improve the change and transformation capacity of the system, jointly with the research & development institutions. At the micro-scale, short-term action plans can be prepared at the neighborhood level to increase the capacity of the system in order to cope with ecological risks in cooperation with local authorities and NGOs and professional organizations.

4. Discussion and Conclusion

The main purpose of analyzing spatial ecologic risks is to integrate geomorphological, geological and ecological data to develop an integrated land-use suitability assessment model , which is widely used in spatial development plans as a decision support tools. The innovative approach proposed in this study is the development of ES integrated land-use suitability analysis, which is different from the traditionally used geological land-use suitability analysis. In this methodology, taking into account integration of natural hazards and landscape vulnerabilities analysis with the potential of ES enables a holistic content that takes into account both the risks associated with the nature and the sustainability of the benefits supported by nature. In addition, the integration of ecological risk factors analyzes with participatory risk governance approach provides holistic contributions to risk mitigation studies. From this point of view, the main results obtained in the research can be listed as;

- Introducing the main objectives of ecological planning,
- Definition of integrated ecological risks,

- Developing comprehensive spatial analysis and synthesis within the context of integrated ecological risks,
- Combining the participatory risk governance approach with integrated ecological risk analysis,
- Integrating risk mitigation studies with resilience approach by developing a multi-spatial and temporal scale
- approach,
- Enabling risk awareness and mutual learning by risk communication,
- Including ecological risk perception and prioritizations of relevant stakeholders with risk assessment,
- Including relevant stakeholders definition of institutional responsibilities according to proactive and reactive
- roles with risk management,
- And ultimately, developing an integrated risk mitigation methodology and create inputs to spatial planning in order to ensure the sustainable development goals and resilience settlements.

In general, the results of the project are expected to contribute to the theoretical and practical aspects of ecological planning, risk management and mitigation studies in the context of establishing urban sustainability and resilience. It is also considered that through participatory planning approach, it will contribute to the planning policies related to mutual learning and capacity building at the local level. Moreover, it is thought that the innovative approach produced in the project can be extended in other settlements. On the other hand, in the participatory planning process, inability to ensure public participation and the inadequacy of the distribution of participating institutions and the low level of participation can be considered as the main constraints. This situation also impedes the dissemination of participatory planning analysis results. In future studies, it should be aimed to increase and expand the level of participation. For this, it will be possible to benefit from the advantages offered by digital technologies. In addition, in the future studies in order to develop more accurate and effective risk mitigation plans, during the analyses of spatial integrated ecological risk, consideration of the quantitative data of such characteristics as impact area, frequency of occurrence, and magnitude of the effect, will help to classify systemic risks on a multiple spatial and temporal scale.

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