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„How Can Different Stakeholders in Turkey Prepare for Natural Disasters by Acquiring Knowledge on the Use of Space Technology?"

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1. Introduction

International Day for Natural Disaster is celebrated on October 8. For the first time, this day was celebrated according to the resolution of the UN General Assembly of December 22, 1989 as part of the International Decade for Natural Disaster Reduction (1990-1999) to raise general awareness of disaster risk reduction. Protecting the population from all kinds of disaster-related hazards and disasters is one of the most priority areas for many states of the world. Sudden-onset emergencies show that natural disasters transcend borders and harm people regardless of their origin or status. In recent years, the risk of natural disasters accompanied by climate change, floods, mudflows, earthquakes, droughts and fires, has been increasing.

Since humanity lives in a constant interplay with an environment that is specific to certain regions of our world, we as humans are constantly affected by these environmental 'norms and rules'. Human-environment relationships have always been and still are characterized by complex interrelations of social and natural conditions on different levels. These interrelations are highly dependent on the nature of existing and ever-changing environments that have a direct influence on society, especially on people who are living in the areas of high natural disasters frequency areas. Depending on geographical location and conditions certain social norms and behaviors have been developed in order to minimize risks on environmental influences (e.g. global climate change, earthquakes, magnitude of floods) (Mattissek and Sakdapolrak, 2016, p. 3).

Floods, volcanic eruptions, earthquakes, tornadoes — every year, these and other catastrophic events take down human lives and bring destruction in many parts of the globe. For many centuries, scientists have been trying to capture not only the regularities of

emergence of such cataclysms but also their cyclical nature in order to find ways of predicting and preventing catastrophic events. At the same time, the question of the “correct” way of dealing with natural risks and with competing demands and priorities is by no means clear. (Mattissek and Sakdapolrak, 2016, p. 3).

Interest in the natural risks of both the past and the present is fueled by the fact that an inevitable part of any forecast is an analysis of the occured natural disasters in the past. For many centuries, scientists have been trying to capture not only the regularities of emergence of such cataclysms but also their cyclical nature in order to find ways of predicting and preventing catastrophic events.

In this paper, I will focus on connecting the dots between the environment and nowadays society, and the ability of the latter to learn from the past events (earthquakes, in this particular case) that have been damaging their socio-economic stability.

This paper analyses socio-ecological challenges and resilience steps with the focus on using space technologies for seismically active regions of Turkey. The following is the research question based on the information obtained from expert interviews:

"How can different stakeholders in Turkey prepare for natural disasters by acquiring knowledge on the use of space technology?"

2. Resilience

Social vulnerability is expressed in the interplay between external risks to which a person or household is exposed and internal defenselessness, that is, the lack of means to cope with the risks. “Vulnerability is thus defined in relation to risk exposure and management as well as the interplay of internal and external factors” (Mattissek and

Sakdapolrak, 2016, p. 10). However, no matter how vulnerable the event is, humans have developed the skill of accommodating to its current environment. The term “resilience” plays an important role here.

“While social vulnerability is primarily looking for defects and deficits, resilience research is essentially about strengthening the creativity, potential and capacities of vulnerable actors in order to enable resilient transformations in their living conditions. Compared to social vulnerability, the concept of resilience emphasizes the coupling and interdependence of social and ecological spheres, both of which cannot be viewed independently of one another”. (Mattissek and Sakdapolrak, 2016, p. 10).

In my view, resilience can be described as a complex set of activities needed to overcome and readjust to the effects caused by catastrophic events (e.g. tsunamis, floods, earthquakes). Resilience is an environment-social capability to recover and learn from “past mistakes” in order to minimize the risks, and further adapt to post-catastrophic circumstances. Moreover, resilience is needed not only to survive adverse living conditions and stressful situations, but also to reshape actual problem-solving techniques, and further advance their potential.

Skills that can be learned such as coping strategies to post-catastrophic events are of high value to resilience that is situation-specific in every case. Still, I think one of the key requirements for resilience are knowledge transfer, social institutions assistance, provision of adequate resources, and further dynamic adaptation. All of them cannot be viewed independently of one another.

The nature of resilience will play an important role in this paper. My studies will focus primarily on the seismically active regions such as Turkey that has issued its

nation-wide earthquake strategy and action plan. However, before analysing it, it is crucial to define the crux of earthquakes as a whole.

3. The Nature of Earthquakes

Earthquakes are underground violent shaking and vibrations of the Earth's surface caused by natural events, mainly tectonic processes. In some places on Earth, earthquakes occur frequently and sometimes achieve great power, disrupting the integrity of the soil, destroying buildings and causing human casualties. The number of earthquakes recorded annually on the globe amounts to hundreds of thousands. However, the overwhelming majority of them are weak, and only a small fraction reach the degree of disaster.

Earthquakes occur as a result of vibrational motions of the lithosphere — its compression in some regions and expansion in others ((Wald, n.d.) They can have direct consequences, such as considerable damage to buildings from shaking, and secondary impacts, such as triggering landslides, fires, and tsunamis. According to the UCGS's article the types and extent of impacts usually depend on local conditions where the earthquake takes place (n.d.).

Damage to the structures and buildings depends on their strength and the strength of the earthquake. Building damage is also greatest in areas of soft sedimentations, and multi-storey buildings tend to be more frequently damaged than smaller ones. Buildings can be designed to resist most earthquakes, and this practice is increasingly applied in earthquake-prone regions.

The nature of the impact mainly depends on where the earthquake occurs: whether it is mainly urban or rural, densely populated or sparsely populated, highly developed or

underdeveloped area. And in this regard, it is important to understand the ability of the infrastructure to resist such shocks.

Even small fluctuations of tectonic plates may affect the water level which means that after a weak earthquake, the sea level can considerably rise and lead to tsunamis or a series of frequent waves. Tsunamis and earthquake ground shaking differ in their damage potential. Ground shaking causes destruction mainly in the earthquake epicenter while tsunamis can lead to a full destruction both locally and at very distant locations.

4. Earthquakes: Turkey

Turkey is located in one of the most seismically active regions in the world. Historically, earthquakes are among the most common hazards in this region. Due to its geological, topographic and climatic characteristics, Turkey often faced many different dangers and threats, but it managed to accumulate significant achievements and experience in the fight against earthquakes and other natural phenomena since the creation of the republic in the 1920s. In the aftermath of the 1950s, massive internal migration and a rapid industrialization process created cities that are critically vulnerable to all natural, technological, environmental, and human-made threats (Aksel, 2012, p. 42) Earthquakes occupy a leading position in the ranking of these risks.

The most devastating flood in Turkey since 1900 occurred in 1998. (Aksel, 2012, p. 6) Over a million people were affected and more than $ 1 billion in damage was caused. Floods in 2006 caused nearly $ 400 million in damage, other floods in 2009 hit about $ 600 million (Turkey Risk Profile, 2015: 112). A violent earthquake with a minimum magnitude of 7.4 is currently predicted in the media in the near future (Seidler, 2018). These unpleasant forecasts are forcing society to prepare for the upcoming earthquake, because this is the only

way to minimize the risk in the most sensible way. Robert Glasser, UN Secretary General for Risk Reduction, shared:

> "Thanks to technological progress made in the past few years, geospatial information at the right scale and definition can be made available and provides critical elements to better understand exposure to disaster risk due to natural and human made hazards. It can also assist in ensuring a risk-sensitive approach to development planning to avoid the creation of new risk " (Singh, 2017).

4.1 Turkey: National Earthquake Theory and Action Plan

A correct description of the seismic risks in a country, region or local scale requires that one should determine the probabilities of magnitude, frequency and possible location of earthquakes caused by active faults, as well as patterns of weakening of ground movements at a distance and the influence of local geology in this movement. (National Academy of Sciences, 2011, p. 133)

The first step in determining the risk of an earthquake is the exact establishment of a hazard in a country, a region of local proportions (Gülcan, 2012, p. 22). At the next stage, the exposure of assets to hazard and their impairment when exposed to different levels of soil movement is determined, which leads to the risk of losses. Models designed to eliminate or reduce risk over an extended period of time are then developed and put into action. For these reasons, maps reflecting the results of earthquake hazard analysis are the main steps in an effective seismic safety program.

Paleoseismological studies should be conducted at selected sites. Paleoseismological studies are necessary to establish fault parameters (such as location, time period, magnitude, repetition period, maximum correlation of the length and magnitude of the fracture, displacement magnitude) of faults that have been identified on MTA maps for the recent geological past (approximately the last 10,000 years), so that it is possible to predict their future activity with greater reliability for assessing seismic hazard.

Risk reduction strategies and mitigation plans for earthquake risk reduction processes will be prepared. Since 2000, legal amendments concerning provincial special administrations and municipal laws entrusted these levels of administrations with the task of preparing contingency and emergency plans in order to protect against natural disasters, especially earthquakes, and to reduce their consequences. Thanks to this action, preparation and implementation of procedures, methods and approaches will be implemented for the real purposes of preparing a risk reduction strategy and prevention planning.

One of the main goals of earthquake risk management is to create safer and more liveable settlements with earthquake-resistant construction. The most effective way to achieve this goal is to review settlement plans in accordance with the requirements of the main risks, strictly comply with the Seismic Code and other relevant technical documents, as well as to identify risks in existing settlements and buildings before the necessary actions are taken to make them more capable of resisting earthquakes. Before determining the building inventory and its seismic vulnerability, it is necessary to identify the number and typology of existing buildings. Assigning a unique identification number to all buildings and including all basic information about the building (for example, type of construction, number of floors, year of construction, number of residential units, total area, coordinates, etc.) This will help increase computing power and facilitate insurance applications. A quick examination of all

existing buildings headed by schools and hospitals, using a simple method to complete their risk classification, is a priority in relation to mitigation measures that must be taken before future earthquakes occur and decisions regarding buildings that are considered to be risky.

Priority areas for the design and construction of earthquake-resistant buildings should be identified and related projects should be encouraged and supported.

In the interest of large-scale renovation of the construction fund, the promotion and support of standardized construction projects for earthquake-resistant and economical buildings is an important component for urban renovation, which has become a real alternative to reduce earthquake losses.

The current seismic design code must be updated and revised in accordance with Eurocode 8 (Ilki and Celep, 2012, p. 368).. The activities of the commission to update and revise the seismic code will be carried out continuously. It is necessary that the code of the earthquake project be up-to-date and revised in accordance with modern advances in earthquake engineering, as well as with lessons learned from earthquakes in Turkey. To fulfill this function, it is important to create a commission consisting of researchers with experience in this field, supported by experts from government agencies and institutions, and to ensure the continuity of the commission.

Methods should be developed, standardized and implemented to assess seismic safety and modernization of buildings based on Turkish technology for the construction of bridges, viaducts and transport networks, as well as distribution systems for underground or underground power lines (pipelines, natural gas lines, electrical networks and communication systems). , etc.).

Maintenance training should be provided for the workforce in the construction industry. It is necessary that the range of professional programs in which students study on

natural disasters, especially earthquakes in engineering and / or architectural schools of universities, as well as in vocational schools, be reviewed in accordance with current requirements, scientific achievements in the field of earthquakes. science and natural disasters so that programs can be reviewed as needed. Separate fundamental courses on earthquake and natural disaster science, which were previously offered as optional courses, should now become necessary topics and / or new elective courses should be developed (Meita at al., 2012, nd).

A vital requirement to achieve reduction of earthquake losses is to ensure that technical professional groups involved in physical investments can trade with adequate technical know-how and that all practices are carried out under professional technical supervision and that damage to third parties caused by faulty sales are under warranty. It is considered necessary that professional liability insurance and related legislation be developed and expanded. In addition, professional liability insurance should be mandatory for key specialists in this field.

5. Theories

Modernization is always closely related to change and progress. In this context, a question arises in the room: is a change an improvement? Most would probably agree, but change is not always positive. In his work "The Passing of Traditional Society" Lerner uses the countries Turkey, Iran and Jordan to describe Modernizing the Middle East that technical progress can destroy many things in the long term. The striving for globalization and development can tear traditional societies apart with their structures relatively easily. Numerous historical events also show us the consequences of the promising modernizing

behavior. Daniel Lerner describes the concept of modernization as a process that entails social restructuring. An adjustment to the four phases he described: urbanization, literacy, media presence and political participation is required (Lerner, 1966, p. 60). Successful modernization requires a break with existing traditions. “People need to be mobile, empathetic and participatory for development” (Kumar, 2011, p. 9). In the early 1960s, Theodore Schultz and Gary Becker developed human capital theory. The theory still serves as a guideline in the educational policy of powerful actors, such as the World Bank or the OECD (Langthaler, 2015, p. 34).

Human capital theory is described as an economic concept in which (education) education is understood as capital and investments in (education) education capital can be justified on the basis of economic cost and benefit analysis (Maringe, 2015). Human capital theory implies that the so-called human resource - the investment in human capital - in the form of better education improves qualifications and labor productivity. This enables higher wages. At the same time, the development of labor productivity leads to technical progress, which increases economic growth in the long term. It is interesting that the American-Soviet race to the moon played such an important role in terms of educational policy. The reason for this was the Sputnik shock when the Soviet Union launched the first satellite into space on October 4, 1957. This led to the so-called Sputnik shock in the USA and Western Europe, the fear of technological underdevelopment towards the Soviet Union. This situation was the beginning of the discussion on social inequality in the education system (Erler, 2007: 21). On the one hand, the technological and economic competition was a question of prestige and, on the other hand, a question of survival in the Cold War. The global confrontation in the Cold War inevitably prevented cooperation and the exchange of technical information. This only ended in the summer of 1975 when a Apollo-Soyuz mission was organized after years of

negotiations. For years, however, it remained an exception until the joint construction of the Russian-American space station, the ISS in 1998 (Stöver, 2011: 1f).

6. Space technologies in disaster management activities

The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), in its resolution entitled “Space at the turn of the millennium: the Vienna Declaration on Outer Space Activities and the Development of Human Society”, recommended that activities under the United Nations Program The United Nations Space Applications has encouraged the joint participation of Member States in it, both regionally and internationally, with an emphasis on the development of knowledge in developing countries. One of the areas of activity that should be given special attention was the control of natural disasters. The use of Earth observation satellites and other space technology allows solving important and unique tasks at all stages of disaster management: mitigation of natural disasters, preparedness for natural disasters, organization of assistance in case of natural disasters and liquidation of their consequences (CEOS, 2015, p. 10). In many developed and even developing countries, such solutions are already being used as an integral part of disaster management.

To expand the use of space technology in disaster management in developing countries and countries with economies in transition, the Office for Outer Space Affairs of the Secretariat has organized five regional workshops on the use of space technology in the field of natural disaster management under the United Nations Program on Space Applications the participation of specialists in this field and representatives of space agencies that have already developed technological solutions, based bathing using space technology, as well as those

responsible for organizing disaster management and the use of space technology in developing countries (UNOOSA, n.d.)

The holding of such regional workshops is the first step towards adopting an integrated approach, the ultimate goal of which is to ensure the appropriate incorporation of space applications in a sustainable manner as part of operational disaster management programs around the world through the development and implementation of relevant pilot projects (Haubold et al., 2012, p. 2).

The following objectives were considered as specific objectives of the Workshop: a) raising the level of awareness among managers and decision-makers in the field of disaster management about the potential benefits and cost-effectiveness of using space technology; b) providing a forum where it will be possible to determine the needs of the region and organizational structures in terms of the nature of the information and communication support needed to deal with specific natural disasters, and the level of meeting these needs with the help of space technology; c) the development of a regional action plan that will help consolidate networking between national and regional institutions and identify possible partnerships between two or more institutions, which will subsequently identify pilot projects to further clarify the use of space technology for disaster management, taking into account the situation in each country; and (d) strengthening the established RESAP (Regional Space Applications Program for Sustainable Development) network to promote the development of regional cooperative mechanisms for disaster management through the use of space technology.

7. Committee on the Peaceful Uses of Outer Space

In its resolution 54/68 of 6 December 1999, the General Assembly endorsed the resolution entitled “Millennium Space: Vienna Declaration on Outer Space Activities and the Development of Human Society” 2, and urged, inter alia, the organizations of the United Nations system, take the necessary measures to ensure the effective implementation of the Vienna Declaration. The Vienna Declaration contains a number of recommendations, including a recommendation calling for the creation of an integrated global system based primarily on international cooperation, to take measures to mitigate and prevent natural disasters, as well as provide assistance in this regard, especially in international scale, based on Earth observation, communications and the provision of other services in the space field and the widest possible use of existing potential and filling gaps in the global satellite monitoring.

As part of the International Strategy for Disaster Reduction, the United Nations Educational, Scientific and Cultural Organization is focusing on creating a culture of preventive measures to mitigate natural disasters and reduce the vulnerability of populations at risk. UNESCO deals with the assessment and reduction of risks of geological origin (earthquakes, tsunamis, volcanic eruptions and landslides), and also promotes the study of meteorological risks (storms, floods, prolonged drought and desertification). UNESCO also promotes the dissemination of information, training, the exchange of data and experience between countries and communities in order to apply geospatial knowledge and experience in decision-making processes in order to promote policies and measures to ensure sound land use planning and management. and construction, as well as contribute to the development of

disaster prevention and preparedness plans, including the application of warning systems both locally and in the global arena.

The Charter on Cooperation in Ensuring the Coordinated Use of Space Objects in the Event of Natural Disasters or Man-Made Disasters (also referred to as the "International Charter on Outer Space and Major Disasters") allows countries that have experienced a natural disaster or man-made disaster to receive information products based on satellite imagery , in support of ongoing disaster reduction activities (UNOOSA, n.d.). The following institutions are parties to the charter: European Space Agency (ESA), French National Space Research Center (CNES), Canadian Space Agency, Indian Space Research Organization, and United States National Oceanic and Atmospheric Administration.

8. Availability of information and technology

There are a number of technologies with which it would be possible to obtain data for use in disaster management: remote sensing technologies (satellite imagery and aerial photography), which provide data on the terrain, land cover, etc. ; IR laser technologies used to obtain height data on elements of the natural landscape and buildings; ground-based topographic survey instruments, which make it possible to prepare maps of the boundaries of land plots and other landscape elements, and finally, Internet products and services that provide access to data, information and information, their distribution and exchange of data, information and knowledge in real time.

Space technology plays an important role in minimizing the negative impact of natural disasters. Satellite imagery, providing real-time information over a wide area and space technologies such as telecommunications, global navigation satellite systems,

geographic information systems and web technologies, can be used to prevent, prepare, assist, reconstruct, warn and monitor at various stages of disaster management.

Space technologies are becoming increasingly vital to today's disaster management efforts. Earth observation satellites (EO) provide images at different wavelengths that help you quickly map at all stages of the disaster management cycle: reducing potential risks in a given area, disaster preparedness, responding immediately to a disaster event, and recovery efforts after that. Global navigation satellite systems (GNSS), such as the Global Positioning System (GPS), help at all stages by providing accurate location and navigation data, helping to manage land and infrastructure, providing information for rescue teams and therefore allowing them to coordinate their search work (Ross, 2018). Finally, satellite communications (SATCOM) allows you to transfer data (voice, images / maps, video) when conventional communications infrastructures are disconnected due to a disaster event.

The Space Disaster Management Technology Team (STDM) aims to bridge this gap and raise awareness of how space technology contributes throughout the disaster management cycle. Despite the importance of space technology in disaster management and the participation of several national and international organizations in promoting the use of space for disaster management, this is still a relatively unknown area. Members of academia, industry, governments, and the general public can benefit from filling this gap and deepening knowledge of how space is used to prepare, respond, and recover from natural disasters (Space Generation Advisory Council, n.d.).

According to UN Secretary General António Guterres, Asian and Pacific countries are most vulnerable to natural disasters. Satellite imagery can be used to illuminate seismological conditions in earthquake prone areas. A geographic information system (GIS) is a good tool

for pre-disaster planning when specialists create life support maps and infrastructure. Remote sensing technology can update information on the most suitable locations for telecommunications, electric networks, bridges, power plants, etc. On the other hand, planners can quickly identify high-risk areas and plan ahead in emergency situations.

According to Futurism magazine, numerous threats are not tracked because they did not erupt after a while or because they are located in underdeveloped areas. In addition, some signals are too thin to be caught on the ground, but they can become more noticeable using satellite technology. The radar technique, called Synthetic Aperture Interferometric Radar (InSAR), uses comparative images to provide detailed visualizations of the average motion of the Earth's surface.

Francesco Pisano of the United Nations Institute for Training and Research (UNITAR) recalls how satellite maps and GIS technology were widely recognized after the Indian Ocean tsunami in 2004. This tsunami was the first of its kind to be recorded in space as a front wave still spreading across the sea. To assess the extent of the emergency, about 650 satellite images were received. These data were then used by the coordinators to respond to emergencies, including for logistics, distribution, personnel safety, transportation, and the creation of refugee camps and telecommunication networks.

Large-scale events, such as tsunamis, often require various types of images, including high-resolution maps. These images may be useful for relief workers who compare information to locate villages and other settlements that are no longer visible on earth. Comparing information before and after a natural disaster obtained from space maps could be an important way to increase the effectiveness of humanitarian assistance.

Studies on the visual interpretation of satellite imagery in crisis management conducted in 2014 showed that the key advantage of using aerial photographs in crisis

management is their good readability and lower requirements for abstract thinking, which can be reduced as a result of stress. However, it is advisable to supplement the aerial photographs with a clear description and other thematic additions.

Polar Orbiting satellites provide higher resolution images, even lower time frequencies, which are used for detailed monitoring, damage assessment and long-term control. It is known that geostationary satellites provide continuous and synoptic observations over large areas of the weather, including cyclone monitoring. Recently, very small aperture terminals (VSAT) and very small aperture terminals (USAT) are also being used with growing capabilities.

Mapping flood-affected areas is an important application for satellite remote sensing in flood management. To assess the degree of damage from crop loss, destruction of infrastructure, etc. Modern satellite imagery is used. Meteorological satellites are useful for monitoring and predicting cyclones.

Satellite data, aerial photographs and GIS methods are used to classify terrain and prepare maps showing the formation of landslide prone areas. Satellite imagery can be used to determine neotectonic structures and to elucidate seismotectonic conditions in areas prone to earthquakes.

The National Aeronautics and Space Administration has its own natural disaster program, which facilitates the use of Earth observations to accelerate disaster management. NASA's Disaster Science Program also brings together disaster response agencies and other Earth observation space organizations around the world. The program is based on a large amount of environmental data collected by NASA satellites over many years.

The European Space Agency is also contributing to this infrastructure. The agency has dozens of emergency response projects. For example, a unified space data collection and delivery system for the Charter on natural disasters, a real-time on-site human resources management service; I-GARMENT, EMERGSAT emergency communications satellite communications system; etc.

The European Commission has a science and knowledge center - the Joint Research Center (JRC). The focus is on the automatic analysis of satellite data to provide information and analytical services for disaster risk reduction and conflict prevention. The main project of JRC is the Global Settlement Level, which defines all the settlements in the world. JRC also supports the Copernicus Emergency Management Services (EMS), which deals with both natural and man-made disasters inside and outside the EU.

The European Union Project Copernicus is a program designed to develop information products based on satellite and non-space data. Copernicus EMS consists of a requested mapping component that provides emergency response cards and recovery cards for prevention and planning. There is also an early warning and monitoring component that includes systems for droughts, floods and forest fires. The largest EMS projects are the European and Global Flood Awareness System, the European Forest Fire Information System and the Drought Observatory.

Private companies are also creating disaster management solutions. Among the many services, the Earth Observation System (EOS) offers emergency response programs for emergency response teams. EOS technologies have already been applied in some cases, for example, using a thermal infrared channel to detect fires, creating an algorithm based on aerial photographs to create an accurate model of damaged electrical lines and monitoring

zones affected by seasonal floods, hurricanes and tropical cyclones, according to studies of optical and synthesized aperture.

8.1 UN SPIDER

In its resolution 61/110, the General Assembly decided to establish the United Nations Platform for the Use of Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) as one of the programs within the United Nations to provide universal access to all countries and all relevant international and regional organizations to all types of space information and services related to emergency prevention and response in support of a full cycle of emergency response activities.

In total, 79 organizations from the following 32 countries were represented at the Conference: Austria, Algeria, Armenia, Bangladesh, Belgium, Brazil, Bhutan, Venezuela (Bolivarian Republic of), Vietnam, India, Indonesia, Iraq, Iran (Islamic Republic of), Cambodia, Canada , China, Lao People's Democratic Republic, Mozambique, Mongolia, Myanmar, Nepal, Oman, Pakistan, Peru, Saudi Arabia, Singapore, United States of America, Sudan, Thailand, Turkey, Switzerland and Ethiopia.

In accordance with the Sendai Framework, the following main actions are required at the national and local levels:

a) encourage the collection, analysis, systematization and use of relevant data and practical information;

b) recommend baselines for use and refinement and periodically assess disaster risks;

c) accumulate, periodically update and disseminate, as appropriate, disaster risk information in a particular area, including hazardous area maps and information obtained through geographic information systems;

d) systematically assess and record loss from disasters and disseminate and publicize information about them and analyze the economic, social, health, educational, environmental and cultural consequences;

(e) Facilitate real-time access to reliable data and use data obtained from space and in the field, including data from geographic information systems.

The objectives of the meeting were to explain the role of technology in disaster management; match data requirements with potential data sources; List the main partners of the space agency and the platforms available to support disaster management; identify free resources for creating cartographic products; Identify stakeholders involved in disaster management and describe how cartographic products are customized to meet needs; and create a map product for this disaster risk reduction and / or response scenario.

At the conclusion of this workshop, participants were able to list and describe the main stages of the disaster management life cycle; Describe the main goals and objectives of disaster management in the context of the Sendai Framework for Disaster Risk Reduction; Create a representative diagram of the disaster management organization structure optimized for their country; identify available resources to assist in the development of disaster management plans and policies; Explain the role of space technology for every major phase of disaster management. identify programs of the United Nations and relevant regional partners that facilitate the collection and exchange of space-related information for disaster management; match the appropriate type of remote sensing data; and / or a product for a

disaster type and a list of critical basic data sets necessary for the successful use of space technology for disaster management. Participants also learned how to become an authorized user of the International Charter “Space and Major Disasters”.

UN-SPIDER uses space-based information to respond to emergencies and disaster management. UN-SPIDER provides developing countries with specialized technologies that can be vital at all stages of the disaster management cycle, including prevention, preparedness, early warning, response and recovery.

UN-SPIDER conducted a training program on disaster management in arid regions using space and geospatial technologies from February 18 to 20, 2020 in Istanbul, Turkey. This event was the first attempt to expand the efforts of UN-SPIDER to cover countries located in a wide strip of arid regions in Asia and North Africa and raise awareness of the need to use space technology to deal with natural disasters in the face of climate change and population growth. The program was co-organized with Delta State University, the UN-SPIDER regional support unit. The President of Turkey for Emergencies and Emergencies (AFAD) has provided local support as a hosting agency.

Participants also visited the AFAD Istanbul Headquarters for Disaster Management and Emergency Management and received a demonstration at the AFAD Crisis Management Center (for Turkey Disaster Response Plan Service Team), the Istanbul AFAD Call and Communication Center, and the Istanbul Mobile Focal Points AFAD vehicles. The training also contributed to raising awareness of the services offered by UN-SPIDER, and participants from several countries showed great interest in working with UN-SPIDER. The UN-SPIDER program will continue to work with this region to develop more effective partnerships to

promote the use of space-based information in disaster management and emergency response (UNOOSA, 2020).

9. Research Goals

The objectives of the research are disclosed here, but it should be noted that some objectives will most likely be adjusted in the course of research, as the work also wants to focus on the specific interests of national stakeholders.

• Identify existing national capacities to access and use space-based information

• Analysis of the current institutional framework in the field of natural disaster prevention and preparedness for using such information

• Clarification of possible restrictions and gaps in knowledge regarding space-based fieldwork

The topic "Socio-ecological challenges and resilience steps with the focus on using space technologies for seismically active regions of Turkey", as well as my practical experience with UNOOSA and my stay in Turkey are the driving power of my interest that resulted in conducting a research paper. This project is a purely qualitative study which provides both deeper knowledge and interpretation.

Research questions:

• How can different stakeholders in Turkey prepare for natural disasters by acquiring knowledge about space technologies?

• What are the difficulties/challenges of the different stakeholders in accessing the necessary space-based information?

The following hypotheses were made based on the research questions:

• Hypothesis 1: Space-based information is actively used in disaster management in Turkey

• Hypothesis 2: There are difficulties in accessing knowledge about space-based information such as lack of knowledge and steps during resilience measures

It is also possible here that new considerations regarding the hypotheses could arise during the research.

10. Research methodological approach

The goal of qualitative research is “to reconstruct processes by which social reality is created in its meaningful structuring” (Lamnek, Krell 2005, p. 45). A key feature here is the interpretative approach by which "social reality [...] is constructed through interpretation and assignment of meaning and is not seen as objectively predetermined" (Lamnek, Krell 2005, p. 44). With this in mind, various perspectives can be taken into account in research and "the subjectivity of the examined and investigators becomes part of the research process" (Flick, 2006, p. 19). At the beginning of the synopsis, a detailed literature search was carried out on the subject of preparing the various stakeholders for the use of space technologies as a resilience to natural disasters. The research question How can different stakeholders in Turkey prepare for natural disasters by acquiring knowledge about space technologies? To be able to answer satisfactorily, interviews with experts are carried out in the form of a face-to-face survey. In particular, it examines the difficulties faced by stakeholders in Turkey and to what extent they are aware of the resilience measures that they can apply in the event

of natural disasters. In the following, the methods used are presented which are suitable in relation to the topic and the research interest. The transcription system used is then explained. In addition, the analysis method used to evaluate the qualitative data is explained. It should also be noted that the research is circular in nature, since the results of the study are strongly linked to the subject of the study and could therefore lead to new issues (Mayring, 2010, p. 232).

11. Qualitative interviews

Due to the exploratory nature of this work, guide-based expert interviews in the form of a face-to-face survey appear to be an appropriate course of action. For this guideline questions are chosen in an open form in order to get to the subjective truth of the interviewee. The guidelines created for this purpose are designed on the basis of the literature research previously carried out and on the basis of the research questions elaborated. This method is intended to bring the survey to new perspectives and to expand the entire interview. In this case, the interview guidelines will consist of open questions, since openness avoids the expected answers; thus this corresponds to the purpose of the research interest (Helfferich, 2014, p. 559).

"The actual value of what has been found, described, discovered, and recognized can actually not be determined by the discipline itself, but must be determined by non-scientific actors" (Faschingeder, 2012, p. 49). Based on this, certain criteria are adjusted in the course of this work when selecting the respondents. In order to gain a multi-page insight into the problem of climate change and its consequences on Turkey, people from different directions are selected. When selecting the interview partners, particular attention is paid to who has the relevant information and who is willing to share this knowledge as part of this research. The

interview partners should have implicit knowledge and are interviewed based on the assigned status. Depending on the group of experts, their knowledge is based on specialist knowledge, competence, personal concern and experience (Helfferich, 2014, pp. 559). It is a deliberate challenge to conduct the discussions neutrally and objectively. For this reason, care is explicitly taken to avoid personal opinions of the interviewer. In order to get the most honest and informative answers possible, the interview partners are interviewed individually and their information treated anonymously. The interviews are transcribed and then evaluated using a qualitative content analysis according to Philipp Mayring.

11. 1 The content structure

The aim is to use a category system to filter the structure out of the data material. It should be noted that the focus of the analysis is on the categories. For this, the important basic principles of a qualitative content analysis according to Philipp Mayring are described: First, the interview texts are defined as analysis units and content-relevant statements are assigned to certain categories. "All text components that are addressed by the categories are then systematically extracted from the material" (Mayring, 2015, p. 97). When assigning the categories, the feedback loops are of great importance, since it is a circular process. Subsequently, the relevant statements are paraphrased: "rewritten in a concise, descriptive form that is limited only to the content" (p. 71). In the next step, data extracted in paraphrases are reduced and generalized. As part of the reduction, similar paraphrases are removed.

11.2 Research partners

As part of the master's thesis, with the aim of ensuring the most transparent information possible about the research partners: In order to deal with the problem of the

double burden of working students, the potential research partners are presented in the table below. “Transdisciplinary research is essentially defined by working in teams that not only span scientific fields, but also the integration of practitioners is also looking for a collaborative research process” (Novy et al., 2008, p. 14). In order to be as transdisciplinary as possible in the study, I was able to use the personal network to attract co-researchers from various disciplines who will research, determine and be involved in all phases of the research process, because: “Non-scientific actors can help to broaden the perspective“ (Faschingeder, 2012, p. 49). Because of the data protection and confidentiality reasons already mentioned, interlocutors are only shown anonymously. Research will focus on meetings with key stakeholders in Turkey who are responsible for disaster management and / or geoinformatics at national level, as well as UNOOSA experts. At this point, a preliminary table with the potential research partners is presented, as new experts can also be found here in the course of research.

11. 3 Documentation

A methodologically sound evaluation of the expert interviews requires documentation (in this case audio recordings) and transcription of the interviews. In turn, the interviewees' consent is required for inclusion. Therefore, special attention is paid to this aspect during the documentation process (Novy et al., 2008, p. 24). After obtaining the research partner's consent, the interview is recorded with a voice recording function on the smartphone.

11. 4 Transcription

The transcription is an important and influencing transformation process of an audio or video recording in writing, which enables us: "to permanently transform the fleeting and fluid form of conversations and discourses into graphic representations" (Dittmar, 2004, p. 9).

There are various transcription systems that are related to the meaning of individual symbols and their application rules. Each system is written in its own way, with a focus on different areas of the transcription. The coding system determines how a transcription system is written. Depending on the system, one can transcribe both verbal and non-verbal elements as well as prosodic phenomena. The purpose of a transcription system is to prepare the data as the basis for later analyzes (p. 49). It is important for a transcription to record the audio and video recordings so that "they can be used both for evaluation procedures and made accessible to the reader for scientific evaluation" (Dresing and Pehl, 2010, p. 723).

However, a transcription cannot represent a complete picture of the recorded situation. It should be noted that information can be lost during the transformation process, despite the accuracy with which it is carried out (p. 726). In the context of this work, the transcription system used is based on the rules of Kuckartz, since this promotes a quick-to-learn and easier transcription control system and focuses on the content (p. 729). This system with a focus on the content seems to be the most suitable for the research interest of the master thesis. It always takes a lot of time to process the recordings, but “at the same time, transcription stimulates memory and reflection of what has been experienced” (Novy et al., 2008, p. 24).

11. 5 Qualitative Interviews

The qualitative interview is a method of collecting qualitative data that, depending on the research question and interest in knowledge, is intended to be used to describe a social phenomenon, to embed it in context or to gain new perspectives on a topic - the focus is on

understanding connections. It is characteristic of qualitative research methods that they are open to the complexity of the object of investigation and that the method follows the object of investigation.

Due to the exploratory nature of this research, we decided to use guideline-based expert interviews in the form of an oral survey. A characteristic of this type of interview is that the topics and questions are pre-structured by means of a guide and the data collected can be compared. Since this type of interview is about expressing the interviewee's point of view, the guidelines are kept flexible. Therefore the questions were chosen in an open form in order to get to the subjective truth of the interviewees. The questions created for this purpose were designed on the basis of the previous literature research and on the basis of the research question elaborated. The aim is to obtain valuable information or knowledge to answer the research questions.

In order to get a more varied insight into the problem different experts from the space sector were interviewed. When selecting the interview partners, particular attention was paid to who has the relevant information or who is affected by the study topic, and who is willing to share this knowledge within the framework of my research. In order to determine informative answers, the interview partners were questioned individually. It was assumed that this would make the research partners feel more comfortable and secure. Before the interview, the person to be interviewed was informed about the purpose and type of use of the interview, that their opinions and experiences are at the center of my research interest. Also, their identity is preserved anonymously. The interviews were later transcribed and then evaluated using a qualitative content analysis according to Mayring analysis. Mayring analysis is a helpful tool to cluster all the matching interview responses into different groups (Mayring, 2015, p. 220).

After obtaining the consent of the research partners, the interview was recorded with a voice recording function on the smartphone.

The transcription is an important and influencing process of transforming an audio or video recording into a written form, which enables us to “permanently transform the fleeting and fluid form of conversations and discourses into graphic representations” (Dittmar, 2004, p. 9). The purpose of a transcription system is to prepare the data as a basis for later analyzes.

11. 6 Qualitative content analysis according to Mayring

The aim of content analysis is to evaluate material obtained from any type of communication. It is not only concerned with the analysis of the content of communication, but also with formal aspects of communication. Its application enables communication, language, texts, but also symbols, music, images and the like to be analyzed (Mayring, 2010, p. 95). According to Mayring, the peculiarities of content analysis as a social science method (p. 12f) can be described as follows:

- The subject of the content analysis is the fixed (logged, recorded) communication.
- The content analysis is characterized by a systematic approach: The analysis is carried out according to clear rules (rule-based) and is theory-based.
- With the help of the content analysis, conclusions on certain aspects of communication should be made possible.

The qualitative content analysis focuses on the content and especially on the latent structures of meaning of texts, which are analyzed with defined criteria and defined work steps, which also makes the qualitative content analysis stronger than other interpretation methods (Mayring, 2015, p. 61).

Mayring differentiates between three basic forms of interpretation, namely the summary, the explication and the structuring, with which an analysis of the material can be carried out. Mayring describes the process of structuring, which the central content analysis technique is based on the following work steps:

- The basic structuring dimensions are derived from the question
- These structuring dimensions are split up into individual characteristics. The characteristics and the dimensions together form the category system.
- It must now be determined when a material component is assigned to a category.

This is done in three steps:

1. Definition of the categories: It is precisely defined which text components fall under a category.

2. Anchor examples: Concrete text passages are cited from the material that fall under a category and serve as examples for the category.

3. Coding rules: Rules are drawn up which enable a clear assignment if problems of delimitation arise between categories.

When structuring the content, the focus of the analysis is on filtering out and summarizing certain topics, content and aspects of the material. In the assignment of the categories, the feedback loops are of great importance because it is a circular process. Subsequently, the relevant statements were paraphrased in order to receive and demonstrate 'clear' and informative yet concise answers. In the next step, data extracted in paraphrases were reduced and generalized.

At the same time I would like to emphasize that the quotations suggested in this table serve as confirmation of statements in the form of generalizations and paraphrasing. Paraphrasing — especially in the case of oral interviews' transcription — is an important tool to facilitate further categorization. Hence, this does not mean changing the topic and context of paraphrased material. Once the responses have been successfully paraphrased to meet the criteria for generalised categories they will be shown in a separate section.
Citations are chosen by the authors based on the importance of their content. In addition, I ask the readers to make sure that the generalizations have been sorted by the authors directly according to their category.

11. 7 Research partners data

As part of the project, with the aim of ensuring the most transparent information possible about the research partners I have presented the research partners in a Table 1.
Before introducing the main methodological approach results I will share a get-to-know table of the participating interviewees so that the reader knows their professional activities and experiences that might have affected their responses on a more personal level as a part of the upcoming context analysis. Furthermore, some of the interviewees did not have any prior knowledge of the UN-SPIDER space program, still they have been interviewed for being professionals in their field of work and research since an outside perspective on some valuable topics is always positively estimated and appreciated.

For data protection and confidentiality reasons, the conversation partners are only shown anonymously.

Interviewee	Place of origin/residence	Profession	Language
1	Hungary/New York, United States	Senior Technical Advisor, Lead of GRID3 Project Secretariat at United Nations Population Fund (UNFPA)	EN
2	India/Vienna, Austria	Senior Programme Officer at the United Nations Office for Outer Space Affairs (UNOOSA)	EN
3	Turkey/Turkey	AFAD	EN
4	Italy/Italy	Senior Research Fellow at European Space Policy Institute (ESPI)	EN
5	Turkey/California, United States	Senior Technical Advisor - Risk Reduction Education for Disasters (Risk RED)	EN

Table 1

12. Categorization

As has been already stated the ultimate goal of Myring analysis is to use a category system to filter out the structure of the information shared in the interviews. It should be mentioned that the focus of the analysis are categories. Subsequently, the respective statements were paraphrased. Further, data material extracted in paraphrases was reduced and generalized. As part of the reduction, similar paraphrases were eliminated.

For better navigation and higher readability of my research the succession of categories presented below correspond to the same sequence of research questions. That means Category 1 and all the falling subcategories are grouped according to the first research question with a target point of Turkish stakeholders' preparedness for natural disasters.

Category 2 and its subcategories are grouped together in accordance with the topic of the second research question: What are the difficulties/challenges of the different stakeholders in accessing the necessary space-based information?

Finally, Category 3 with its relevant subcategories would fully correlate with the last research question's topic: required measures for a proper use of technology systems.

	Categories		
Subcategories	C1 : Strategy	C2: Challenges	C3: Measures
S1	Sharing disaster management plans [and maps]	Legislative and political limitations	Information sharing
S2	Knowledge incorporation	Information sharing	Changing working habits
S3	Sharing expertise	Knowledge implementation	Cooperation with external actors
S4	Resilience strategy	Lack of service providers	Customized know-how

S5	Quick responsiveness		
S6	Service-oriented approach		

Table 2: Categories

13. Results

From the table above we can see that interview partners have provided different perspectives towards research questions during the interview. In the introduction part of this paper, it has been noted that the main focus regarding successful implementation of resilience-programs is oriented towards stakeholders and their ability to implement methods and utilize technology during various phases of disaster management programs.

For the management of natural disasters a large amount of multi-temporal spatial data is required. However, regardless of technological improvements the challenges stakeholders face are mostly resulting from the nature of the remote sensing data which coincides with all challenges' subcategories presented above. For example, in Turkey, the biggest challenge lies within legislative and political limitations that slow down disaster responsiveness and information-sharing. Channels for acquisition of satellite data and its incontinuity is one of the key issues why stakeholders and the general public are struggling during disaster prevention activities.

In this sense, interviewees have all collectively agreed that issues related to resilience programs and action plans can be solved through constant and wise information sharing in order to raise awareness both for stakeholders and the general public. Another significant suggestion that has been put forward is directed towards close cooperation with external actors such as companies and countries that had previously dealt with earthquake theory action plans. Thus, Turkish stakeholders can gain more knowledge from those actors who are highly have already established well-established emergency plans and dedicated legislation for e.g. anti-seismic consolidation of buildings, and had successfully implemented and coordinated their action plans.

Overall, the strategies interviewees suggested to Turkish stakeholders are mostly focusing on expertise sharing and service-oriented approach. In the following section, these subcategories would be thoroughly discussed and backed up with a more detailed overview.

14. Discussion

While important similarities can be identified within resilience and action taking plans, a wise cooperation and expertise sharing is extremely important for countries who are more exposed to seismic-oriented events. They can learn from each other and apply strategies that were successful for some countries. Among the countries that have been actively using space data for Earthquake monitoring and response, particularly important would prove the experience of the United States, but so does the experiences of China, Japan, and several European countries, including Italy, Greece, Spain.

In addition, there are plenty of international cooperation initiatives dedicated to disaster management relief who focus on resilience steps and earthquake prevention missions such as The Disaster Monitoring Mitigation Network within APSCO or The Sentinel Asia programme within APRSAF mentioned by one of the interviewees.

However, not only governmental organizations or the government as a whole unit should take actions when it comes to earthquake action plans and resilience programs. Since they undertake dedicated efforts, NGOs are invaluable actors in disaster resilience programs, also in terms of a faster response than governments. Hence, they often lack the resources and tools at disposal of governments (including access to sensitive information). Conversely, governments often lack dedicated programs, have slower response, and do not have immediate visibility on the actual requirements in the field. The issue according to one of the interviewee's opinions is not who is more qualified, but how to integrate the competences of these two actors in a holistic and more structured manner. Therefore, NGOs and the government should be in a constant and fair interplay with each other which is why open data policy is of highly importance. In this sense, creation of common platforms through which different stakeholders can access relevant space- and ground-based data is playing an important role. Of course, the delivery of space data or space-based services does not per se suffice to prepare for natural disaster. There is also a need to know what to do once data is provided. Therefore, one of the interviewees suggested that it would have been important to

create dedicated programmes to use these data to enhance preparedness for disasters and support risk assessment and mitigation strategies.

Earthquake prevention programs are typically understood as public services and products to be provided by public authorities. Hence, there is some room for involvement of private actors in some related activities, for instance, in the development of specific applications providing more value-adding information as compared to those already provided by governments.

Also, both actors should enhance coordination and create synergies among the different stakeholders involved in disaster management by having protocols defining responsibilities and actions of the various stakeholders before, during and after disasters.

15. Limitations

The present paper has been based on a face-to-face interview with different experts who have been asked multiple questions regarding resilience mechanisms and earthquake action plan in Turkey. As has been stated before the interview partners names and occupation including other personal details are not present and therefore represented in the course of this paper anonymously.

All the interviewees have provided their detailed responses regarding the research question that has been mentioned before. On the basis of their replies has been created a table following the Mayring model for qualitative research categorizations. Subcategories were included in the table since the interviewees have shared different opinions and introduced multiple topic-related points that did not fall under any category, however were extremely helpful within the course of research.

The key results of this study have been discussed in the previous section, however some limitations can apply to the research as a whole. Firstly, the suggestions and advice from an interviewees' side have been entirely based on their previous experience in the space sector. Each of the interviewees work in the space-related industries and business sectors, be that NGOs or non-profit enterprises. During the collection data of this research no related academic papers or studies have been found to share the common tendencies and strategies for stakeholders to maintain a post-earthquake resilience program. The main studies have been collected from the UN Spider program and qualitative interviews that have added a huge impact to this master paper.

Another limitation that has been found was the outbreak of COVID-19 global pandemic due to which other interviewees have rejected the interviews. Since these unforeseen circumstances the current qualitative research would have covered other interviewees' answers and personal advice that were supposed to have been added to the general conclusion of this paper.

The final limitation comes from the fact that the general public's opinions and views have not been considered, however I suppose if an interview for the general audience had been a part of this master paper it would have taken a much greater time to finish this master paper. However, the general public's answers and advice to the topic of how different stakeholders in Turkey can maintain and develop their current resilience program would have been helpful since resilience is a process that directly affects stakeholders and people who suffer from earthquake aftermaths.

Still, the qualitative research interview results and Mayring categorization demonstrate that interviewees experts share common opinions on the main research question. Therefore, it can be considered that this paper provides helpful information for stakeholders in Turkey who want to improve their disaster management programs and resilience action plans.

Overall, the methods demonstrated in this paper were the ones that obtained the most robust results.

16. Conclusion

Human-environment social relationships in the context of disaster management programs have always been and still are dependent on complex interrelations of different levels: geographic, governmental, economic, and mostly social. These interrelations depend on the nature of existing and ever-changing environments that have a direct impact on society, especially on people who are living in the areas of high natural disasters frequency areas.

Since the twenty-first century technology access and knowledge sharing in a highly globalised world have given rise to advanced levels of both technological and space progress. The resilience and disaster management programs still face multiple challenges in different regions that are sensitive to natural disasters, especially earthquakes.

Turkey being one of the seismically active regions faced many different threats and damages in the past years including the most devastating earthquakes in 1988. Since that many disaster management plans and national earthquakes theory were developed in order to mitigate the risks and build an active resilience program. As has been reported by the UN Secretary General for Risk Reduction a lot of mechanisms have been created and devised in order to minimize future earthquake risks. (Singh, 2017) Due to the automation of technological applications and constant geospatial updates a lot of work has been dedicated to national resilience programs. UNESCO and other global associations such as Office for Outer Space Affairs of the Secretariat and UNISPACE III have organized regional workshops including the ones located in Turkey on the use of space technology in the field of natural disaster management under the United Nations Program on Space Applications.

It has been proven that space technologies and geo-tracking applications play an important role in minimizing the negative impact of natural disasters to prevent, prepare, assist, reconstruct, warn and monitor at various stages of disaster management. The most favorable and effective program has been launched under the name of UN Spider that has been presented to 32 countries including Turkey during the meeting by the General Assembly. The resolutions and action plans were highly recommended during the Sendai Framework that occupied both national and local levels.

The main focus of the present paper was merely focused on socio-ecological challenges and resilience steps with the focus on using space technologies for seismically active regions of Turkey. Within my research I have interviewed multiple experts on the topic regarding the main objectives within the field of earthquake related knowledge information. In addition, one of the major keys I aimed to embrace within this paper was the stakeholders' behavior and their general preparedness during the resilience period and future risks mitigation action plans. During the interviews the information has been collected thoroughly and analyzed to fit in Mayring's categorization system in order to trace down similarities and trends based on the interviewees' replies.

The implications from the interviews revealed that the biggest challenge for Turkish stakeholders lies within legislative and political limitations that slow down disaster

responsiveness and information-sharing applications and initiatives. The key objective according to one of the interviewees is how to integrate the competences of both private and governmental stakeholders in a structured manner. For maintaining a better work for disaster management programs these actors should be in a constant and fair interplay with each other which is why open data policy is of highly importance. All the interviewees have agreed to the fact that issues related to resilience programs and action plans can be solved through constant and wise information sharing for raising awareness for stakeholders and the general public. Also, it has been collectively suggested that Turkish stakeholders should draw the experiences of the countries that are sensitive to Earth crust movements meaning that they should be encouraged to gain new knowledge from countries that have successfully implemented disaster management plans in their area (China, Japan, and several European countries).

This paper has proven that a complete analysis of the earthquake risk management system demands a thorough and detailed examination of the interplay of all system elements in Turkey needed to respond to the larger environment. It is recognized that the fields of local regulations and legislative openness, market economics, social responsibility, and knowledge sharing both in geosocial and space sectors require a developed framework that gives full consideration to all the aspects necessary for a successful resilience action plan. These plans should be holistic in order to provide a balanced attention to the social, economic, environmental systems that lead to a more rapid recovery from earthquakes, and be taken into account by appropriate interplay between different social groups: the government and private service providers, nonprofit organizations, and the general public.

References

Aksel, D. (2012) Irregular Migration in Turkey. *Supporting Turkey's Efforts to Formulate and Implement an Overall Policy Framework to Manage Migration.* pp. 7-72. https://mirekoc.ku.edu.tr/wp-content/uploads/2017/01/Irregular-Migration-in-Turkey.pdf (accessed 20 August 2020).

CEOS (2015). Satellite Earth Observations: Serving Society, Science, & Industry. pp. 5-35. https://ceos.org/document_management/Publications/Data_Applications_Report/DAR_Summary-Brochure_Digital-Version_Dec2015.pdf (accessed 20 February 2021).

Dittmar, N. (2004) Transkription. Ein Leitfaden mit Aufgaben für Studenten, Forscher und Laien. 2. Auflage. Wiesbaden: VS Verlag für Sozialwissenschaften.

Dresing, T. and Pehl, T. (2010) Transkription. Handbuch Qualitative Forschung in der Psychologie. Wiesbaden: Springer. S. 723-733.

Faschingeder, G. (2012) Nachgetragene Überlegungen zu einer transdisziplinären Veranstaltung. Soziale Ungleichheit und kulturelle Vielfalt in europäischen Städten. Dokumentation des transdisziplinären Symposiums am 14./15. Oktober 2010 (= Aktion & Reflexion. Texte zur transdisziplinären Entwicklungsforschung und dialogischen Bildung; Heft 7) Wien: Paulo Freire Zentrum. pp. 47-53.

Flick, U. (2014) Quantitative Sozialforschung: Eine Einführung. Reinbek bei Hamburg: Rowohlt Taschenbuchverlag.

Gülcan, P. (2012) National Earthquake Strategy and Action Plan. https://www.preventionweb.net/files/26236_eqstrategyturkeysmall.pdf (accessed 27 December 2020).

Haubold et al. (2012) The United Nations Human Space Technology Initiative (HSTI): Activity Status in 2012. pp. 1-17. https://www.researchgate.net/publication/232272986_The_United_Nations_Human_Space_Technology_Initiative_HSTI_ActivityStatus_in_2012 (accessed 19 September 2020).

Helfferich, C. (2014) Leitfaden- und Experteninterviews. Handbuch Methoden der empirischen Sozialforschung. Wiesbaden: Springer. pp. 559-574.

Ilki A., and Celep Z. (2012) Earthquakes, Existing Buildings and Seismic Design Codes in Turkey. Arabian Journal for Science and Engineering. pp. 365-380. https://www.researchgate.net/publication/257803112_Earthquakes_Existing_Buildings_and_Seismic_Design_Codes_in_Turkey (accessed 6 April 2021).

Kumar, R. (2011) Development Communication: A Purposive Communication with Social Conscience - an Indian Perspective. *Global Media Journal – Indian Edition/ISSN*. Vol. 2/No.2. http://www.caluniv.ac.in/global-mdia-journal/Winter%20Issue%20December%20%202011%2Articles/AR-3%20Kumar.pdf (accessed 27 August 2019)

Lamnek, S. and Krell, C. (2016) Qualitative Sozialforschung. 6 Auflage. Weinheim: Beltz.

Langthaler, M. (2015): Die Konjunkturen der Bildungszusammenarbeit. Ein Liebkind der internationalen EZA. *Bildung und ungleiche Entwicklung. Globale Konvergenzen & Divergenzen in der Bildungswelt. Wien*. New Academic Press. pp. 33-58.

Lerner, D. (1966) The Passing of Traditional Society. Modernizing the Middle East. New York: The Free Press. Introduction: The Rise of Modernization Theory. http://tupress.temple.edu/uploads/book/excerpt/2142_ch1.pdf (accessed 27 August 2019).

Maringe, F. (2015) Human Capital Theory. *International Encyclopedia of the Social & Behavioral Sciences.* Second Edition. https://www.sciencedirect.com/topics/social-sciences/human-capital-theory (accessed 9 February 2021).

Mattissek A., Sakdapolrak P. (2016) Gesellschaft und Umwelt. In Freytag T., Gebhardt H., Gerhard U., Wastl-Walter D. (eds) *Humangeographie kompakt*. Springer Spektrum, Berlin, Heidelberg, pp. 13-37.

Mayring, P. (2010) Handbuch Qualitative Forschung in der Psychologie. Wiesbaden: Springer. pp. 225-237.

Mayring, P. (2015) Qualitative Inhaltsanalyse. Grundlagen und Techniken. 12 Auflage. Weinheim und Basel: Beltz.

Meita et al. (2012) Earthquake Education, Learning and Training for Risk Reduction in Romania. Case Study of a Special Platform and Facility. https://www.iitk.ac.in/nicee/wcee/article/WCEE2012_2084.pdf (accessed 10 March 2021).

National Academy of Sciences. (2011) Elements of the Roadmap. *National Earthquake Resilience Research, Implementation, and Outreach*. pp. 107-114 (accessed 15 April 2021).

Novy et al. (2008) Methodologie transdisziplinärer Entwicklungsforschung. (= Aktion & Reflexion. Texte zur transdisziplinären Entwicklungsforschung und Bildung; Heft 2) Wien: Paulo Freire Zentrum.

Wald, L. (n.d.) The Science of Earthquakes. https://www.usgs.gov/natural-hazards/earthquake-hazards/science/science-earthquakes?qt-science_center_objects=0#qt-science_center_objects (accessed 15 July 2020).

Ross, S. (2018). How GPS has revolutionized our lives. *Geospatial World.* https://www.geospatialworld.net/blogs/how-gps-has-revolutionized-technology-today/ (accessed 7 May 2020).

Seidler, C. (2018) Erdbebenrisiko in Istanbul: Die Katastrophe wird tatsächlich kommen. *SPIEGEL ONLINE*. https://www.spiegel.de/wissenschaft/natur/erdbebenrisiko-in-istanbul-die-katastrophe-wird-tatsaechlich-kommen-a-1223578.html (accessed 13 September 2020).

Singh, D. (2017) Space technologies key to risk reduction. *United Nations Office for Disaster Risk Reduction (UNDRR)*. https://www.unisdr.org/archive/56167 (accessed 7 October 2020).

Space Generation Advisory Council. (n.d.) Space Technology for Disaster Management Project Group. https://spacegeneration.org/projects/space-technology-disaster-management-project-group (accessed 1 May 2021).

UNOOSA. (n.d.) Human Space Technology Initiative Events. https://www.unoosa.org/oosa/en/ourwork/psa/hsti/events.html (accessed 3 April 2021).

UNOOSA. (n.d.) International Charter Space and Major Disasters. https://www.un-spider.org/space-application/emergency-mechanisms/international-charter-space-and-major-disasters (accessed 11 April 2021).

UNOOSA. (2020) UN-SPIDER strengthens capacity for combatting disasters in arid regions using space technologies. *Knowledge Portal.* https://www.un-spider.org/news-and-events/news/un-spider-training-disaster-arid-regions (accessed 15 April 2021).

USGS. (n.d.) What are the Effects of Earthquakes? https://www.usgs.gov/natural-hazards/earthquake-hazards/science/what-are-effects-earthquakes?qt-science_center_objects=0#qt-science_center_objects (accessed 15 July 2020).

Table: The result of qualitative interviews

Questions	**Interviewee 1**
How can different stakeholders in Turkey prepare for natural disasters by acquiring knowledge about space technologies?	They [AFAD and some public agencies] prepare their **disaster management plans** or disaster susceptibility maps etc. with the inventory information and / or analyses of RS data and **share** it through web services etc to each other.
What are the difficulties/challenges of the different stakeholders in accessing the necessary space-based information?	Difficulties in accessing the necessary space-based information is mostly resulted from **the nature of the RS [remote sensing] data**. That means if the temporal and ground resolution of data, cloud percentage, etc is not suitable we cannot use them. Otherwise we use.
H1: Space-based information is actively used in disaster management in Turkey	Yes, it is. It is summarized above.
H2: There are difficulties in accessing knowledge about space-based information such as lack of knowledge and steps during resilience measures	There are not any difficulties in accessing knowledge about space-based information but **promoting its use / changing working habits** is another challenge.

Questions	**Interviewee 2**
What measures can be taken to achieve more detailed and personalized information from using technology systems?	I think, whatever reports do is basically inward because **we don't want external** parties to come and give tool to the country. What is the best situation that we would like to see and do is **providing the know our capacity to the country**, and they develop what they like, then we can **provide expertise in all kinds of things**. You need is a **combination of tools**.

	I think there has to be **cooperation with outside agencies** for filling up the data gaps, but the tools and rest of the mechanism has to be **customized** once needed.
How can different stakeholders in Turkey prepare for natural disasters by acquiring knowledge about space technologists?	What we need more is interventions at bit higher level or I would call it an **expert meeting** kind of thing or kind of **special workshops** where in high level, decision makers are given ideas about how space is progressing, how they can **contribute**. And not only that apart, but getting all other providers of those technologies in one place so that we can act as a catalyst so that it gets **incorporated**. And it's needed in, even in a highly developed country like South Korea, I was there. But they also see that disaster amendment people are not too much involved with space providers, space technology providers to take full benefit. So I think we can afford that platform, and some kind of two, three years of **continuous programs and new programs** or something, I think we can generate that kind of culture. But the training, whatever, I think they have the training programs and all that needs to be held needs **to have systematic and medium to long term plan** of you know, incoming five years like these, these things one should do. I think that will help definitely
What are the difficulties, challenges of the different stakeholders in accessing the necessary space based information?	Within the country, it's only one big problem is the **data sharing policy and coordination mechanism** within the country So that is what is the main most important thing needed in country like Turkey, not so much about technology training, but more of **identifying who has what, and how it can be shared** and that kind of

	understanding at organizational level so that no, **no permissions are needed all the time**.
What are the underlying risk factors within building disaster resilience programs?	And this is where country needs to remember what are the priorities in Sendai framework that means always **knowing understand the underlying risks prepare for emergency response** and all that it means on daily basis whether there is a disaster or not That's why I'm talking about that needs very good **disaster management strategy**. Turkey itself any authority by 2020, as per Sendai framework, every country should have **revised up to date disaster management strategy** and in their strategy, then these things need to be included that no new risks should be generated by development
Do you think is there any potential for private stakeholders to get involved into earthquake prevention programs?	And the trend as you already said that there is trend that **more and more private companies are coming**. So government becomes more as administration and **private people become real executer payers**
Advice	If there is one organization that takes the **mandate** that we want to drive, it is much better, because that organization then would do all the things that that basically are required in the country when it comes to space. This Virgin Galactic [as a private player], you know, so we are also going in that direction, because you can't ignore those big players. And they also have, every every this private industry has potential to contribute to humanity.

Questions	**Interviewee 3**
How can different stakeholders in Turkey may prepare for natural disasters? By acquiring knowledge about space technologies, different stakeholders?	If you're not, again, looking at risks, to make sure that the system comes back online, in a relatively short period of time is important. **Proper education, public outreach, standard messaging**
What measures should be taken in order to achieve an effective result in both information gathering and its practical use?	The space technology as far as I can follow it that relates directly to **disaster risk mitigation** and **resilience** can be broken down into, you know, **communications related technologies**. Over the last five years, some of these have been out there, and being installed and deployed. And that could be also very important advancement in terms of risk mitigation, and minimizing loss by **early warning systems** of some sort, but not the early warning as we know it now, where the earthquake happens, and then you get the information ahead of the earthquake waves. And, and also, we used to set up what we call the humanitarian Information Center, which would allow the the parties that are responding to the disaster, to coordinate their efforts through **information sharing**, because information under stressful conditions, information sharing is extremely, extremely valuable to minimize waste of resources and efficient use of resources and so there might be certain sensitivities as it relates to sharing critical information with You know, others outside the country, but under stress, there could be some **protocols** established in **advance**.

What countries do you think Turkish government should consider in their national earthquake theory and action plan?	I think the critical, of course, is **mutual support**, both at the **international** and **regional** level. that type of collaboration also is very important in terms of things in **proper information management**, in addition to you know, sending people out, having agreements in place and new people out to, to those sites from, you know, friendly and, you know, neighbors as not as additional physical help, and technical help, you know, having advanced information management, **information sharing agreements**,

Questions	**Interviewee 4**
How can different stakeholders in Turkey prepare for natural disasters by acquiring knowledge about space technologists?	The government sectors, of course, need to have the resources in place to be able to **respond** to make sure that the you know, going back to normal is, as is the fastest possible and help **build resilience**, collectively, not be very selective in terms of who to go out and, you know, help out.
What measures should be taken in order to achieve an effective result in both information gathering and its practical use?	In the potentially impacted area can be warned to take the **necessary precautions**, both socially, institutionally as well as individually. Also, **information sharing** would be the biggest advantage to boost this early precaution not only for stakeholders but for the population to stay alert and ready for upcoming earthquakes, and future alerts.
What are the difficulties/challenges of the different stakeholders in accessing the necessary space-based information?	I personally think **information sharing and early warning** in case of disaster problems not only in Turkey but all the neighbourhood areas are one of the major troubles that you know, can cause difficulties regarding space-based information.

Questions	**Interviewee 5**
How can different stakeholders in Turkey prepare for natural disasters by acquiring knowledge about space technologies?	Shifting the perspective from a purely technology-push approach to a service-oriented approach; Integration user perspectives and requirements into the process; Establishing an effective platform for dialogue between the service providers and users; Raise general awareness; Common platforms and open data policy
What are the difficulties/challenges of the different stakeholders in accessing the necessary space-based information?	Channels for acquisition of satellite data and its incontinuity; A shortage of service providers for value-added business solutions
What countries do you think Turkish government should consider in their national earthquake theory and action plan?	US, China, Japan, EU-countries (Italy, Greece, Spain)

Abstract

This paper focuses on enhancing socio-ecological resilience in seismically active regions of Turkey through learning from past seismic events and utilizing space technology. It explores how Turkish stakeholders can prepare for natural disasters. Complex interrelations among geographic, governmental, economic, and social factors in disaster management, influenced by the ever-changing natural environment, are acknowledged. Technological advancements and knowledge sharing have made progress in resilience and disaster management, but earthquake-prone regions still face challenges. Turkey has implemented measures and earthquake theories to mitigate risks. Space technologies and geo-tracking applications minimize negative impacts through prevention, preparedness, reconstruction, warning, and monitoring. The United Nations Program on Space Applications, including UN Spider, promotes space technology use for natural disasters. Legislative and political limitations hinder disaster responsiveness and information-sharing among Turkish stakeholders. Effective disaster management requires integrating competencies of private and governmental stakeholders with an open data policy. Learning from experienced earthquake management countries like China, Japan, and European nations is suggested. A holistic approach, involving collaboration among government, private organizations, nonprofits, and the public, is necessary for successful resilience action plans.

Zusammenfassung

Diese Arbeit stärkt die sozio-ökologische Resilienz in seismisch aktiven Regionen der Türkei durch das Lernen aus vergangenen seismischen Ereignissen und die Nutzung von Raumtechnologie. Sie untersucht, wie türkische Akteure sich auf Naturkatastrophen vorbereiten können. Komplexe Wechselbeziehungen zwischen geografischen, staatlichen, wirtschaftlichen und sozialen Faktoren im Katastrophenmanagement, die vom sich ständig verändernden natürlichen Umfeld beeinflusst werden, werden anerkannt. Technologische Fortschritte und der Austausch von Wissen haben zwar Fortschritte bei Resilienz- und Katastrophenmanagement erzielt, aber erdbebengefährdete Regionen stehen weiterhin vor Herausforderungen. Die Türkei hat Maßnahmen und Erdbeben-Theorien umgesetzt, um Risiken zu mindern. Raumtechnologien und Geo-Tracking-Anwendungen minimieren negative Auswirkungen durch Prävention, Vorbereitung, Wiederaufbau, Warnung und Überwachung. Das Weltraumprogramm der Vereinten Nationen, einschließlich UN-SPIDER, fördert die Nutzung von Raumtechnologie für Naturkatastrophen. Gesetzgeberische und politische Beschränkungen behindern die Katastrophenreaktionsfähigkeit und den Informationsaustausch unter türkischen Akteuren. Eine effektive Katastrophenbewältigung erfordert die Integration von Kompetenzen privater und staatlicher Akteure mit einer Politik des offenen Datenzugangs. Das Lernen von erfahrenen Ländern in der Erdbebenbewältigung wie China, Japan und europäischen Nationen wird vorgeschlagen. Ein ganzheitlicher Ansatz, der die Zusammenarbeit von Regierung, privaten Organisationen, gemeinnützigen Einrichtungen und der Öffentlichkeit einschließt, ist für erfolgreiche Resilienz-Aktionspläne notwendig.