論 文 の 要 旨

題　目　Application of Remote Sensing Technique for Assessment of Natural Disasters in Afghanistan
（アフガニスタンにおける自然災害把握のためのリモートセンシング技術の応用に関する研究）

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Afghanistan is a country that is exposed to numerous geomorphological hazards such as earthquakes, landslides, floods, droughts, avalanches, and man-made disasters. Natural disasters such as landslides and floods are among the most common hazards in various parts of the country, causing extensive damage to buildings and killing hundreds of people each year. Safety and economic problems, instability, ongoing war, and poverty have put Afghanistan among the countries that have paid less attention to research. Therefore, it is challenging to find a published map or find reports after a disaster to show you the details of a natural disaster along with its exact geographical location. Assessing the degree of catastrophes is vital for post-disaster efforts and for structural engineers planning and constructing appropriate structures to prevent future disasters. Based on this, people would choose to reside in secure places instead of vulnerable ones. Because most structures in Afghanistan are created by people without any engineering, designs, assessments, or ideas owing to a lack of total government oversight and regular urban planning. Considering the concerns described, the relevance of the issue, and the scarcity of research in the specified areas in Afghanistan, an attempt was made in this study to perform a study on floods and landslides. It was planned to conduct current study to investigate without traveling to the impacted region for on-site data collection due to acute security issues. As a result, this research focuses on assessing two natural disasters (the Abe-Barek landslide and the Charikar flood) utilizing remote sensing analyses.

Chapter 1 discussed how natural catastrophes, notably floods and landslides, are common in many places of Afghanistan. In the background and literature review part, it has been demonstrated that, despite being classified as a natural disaster-prone country, Afghanistan has less research and knowledge on natural disasters. It has also been discussed that how catastrophe assessments are crucial for post-disaster operations and for policymakers seeking to prevent future disasters. This chapter also discussed the purpose and research problem.

Chapter 2 discussed the specifics of natural disaster risk in Afghanistan, such as earthquakes, floods, landslides, avalanches, and droughts. The availability of risk information is critical for effective catastrophe and climate risk management. The risk profile summarizes and visualizes the national multi-hazard evaluations. Such data and information will be critical for politicians, decision-makers, development planners, and infrastructure investors to create a more resilient future for Afghans. As a result, this chapter addressed the susceptibility map, lack of coping skills, lack of adaptive capacities, vulnerability map, population exposure to natural disasters, and world risk index as a result of exposure and vulnerability. Furthermore, it was also presented that which natural disasters have the greatest impact in terms of agricultural losses, property losses, and human losses.

Chapter 3 presented on the assessment of the Abe-Barek landslide using remote sensing analysis. The Abe-Barek landslide occurred on May 2, 2014 in northern parts of Afghanistan. Pre-and post-event Digital Elevation Models (DEMs) created from stereo pairs of high-resolution satellite images was used to evaluate the extent and the volume

of displaced material. For obtaining such objectives a nonlinear technique was proposed to accurately align the multi-temporal DEMs to decrease the undesired artifacts from identified landslide affected areas and finally increase the accuracy of the estimation. The landslide volume was estimated as 1.05 × 106 m3 from the corrected DEM of difference (DoD) by the nonlinear method and the relationship between the area and volume compared to those of the previous studies were discussed. Furthermore, in order to map the damaged region and determine the number of impacted people, the remote sensing-based damage assessment was also conducted.

Chapter 4 proposed a method for identifying and assessment of the Charikar flood. Since the Charikar flash flood occurred on August 26, 2020, there have been no high-resolution stereo pair satellite data available to use the same approach utilized for the landslide identification. A pixel-based spectral index approach which is suitable for assessing flash floods using lower resolution data were utilized. Relative Difference Normalized Difference Vegetation Index (NDVI) was used in Google Earth Engine with freely accessible medium resolution images (Sentinel-2). Also, pre- and post-event NDVIs and NDVI-time series were applied to track changes in the study region, and it is found that the NDVI dropped considerably after the incident and remained low for two years. The fact that the NDVI levels have not changed after two years is clear indication that there is no recovery process, neither given by the government nor by the people themselves. A DEM-based flow simulation was also conducted to examine the simulation's usefulness in detecting unsafe locations for future flood disasters. The accuracy was also assessed using the official survey reports and other on-site data, such as satellite images. Based on the available data, we concluded that both methodologies were suitable for monitoring, analyzing, and mapping almost all types of disasters in the future.

Chapter 5 concluded the overall result of this study as well as the study's strengths, shortcomings, recommendations and future directions.