

## Nota Tecnica - Technical Note

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### High-level training on the topic of landslides and slope stability in Rwanda

#### *Alta formazione in tema di frane e stabilità dei versanti in Rwanda*

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#### Riassunto

Una delle questioni più spinose in Rwanda è da sempre quella legata al rischio idrogeologico. A rendere ancora più complicato lo scenario, è la mancanza della conoscenza integrata legata alle diverse discipline che ruotano intorno ai fenomeni franosi. In questo contesto, il progetto Erasmus+ EnRHed ha organizzato una Scuola Estiva dal titolo “Frane e Analisi della Stabilità dei Versanti in Rwanda” rivolta a professionisti così come a tecnici del settore. La scuola estiva si è tenuta dall'11 al 16 Luglio 2022 a Musanze, in Rwanda.

#### Abstract

*One of the trickiest issues in Rwanda has always been linked to hydrogeological risk. To make the scenario even more complicated, it is the lack of integrated knowledge of different disciplines that are related to landslide phenomena. In this context, the Erasmus+ EnRHed project has organized a Summer School entitled “Landslides and Slope Stability Analysis in Rwanda” addressed to Civil Engineers and Geologists, as well as Technicians and Teachers. The summer school took place from 11 to 16 July 2022 in Musanze, Rwanda.*

**Keywords:** *summer school, landslides, slope stability, Rwanda.*

**Parole chiave:** *scuola estiva, frane, stabilità dei versanti, Rwanda.*

#### Introduction

From the 11th to the 17th of July a delegation of professors from the University of Parma lectured at the Summer School on “Landslides and Slope Stability Analysis in Rwanda”, organized by the Rwanda Polytechnic - College of Musanze (IPRC-Musanze) in cooperation with the Rwanda Water Resources Board (RWB) and Rwanda Transport Development Agency.

The Summer School is part of the activities planned within the Erasmus+ EnRHed Project (“Enhancement of Rwandan Higher Education in strategic fields for sustainable growth”) co-funded by the European Commission and coordinated by the University of Parma. More than 40 participants, including technicians, civil engineers, teaching staff and practitioners involved in land management and protection at local public authorities attended the event (Fig. 1). The Summer School had international relevance and proved to be a profitable opportunity to strengthen the collaborative relationships between the University of Parma and Rwandan organizing institutions.

The event was strongly supported by the Principal of IPRC-Musanze, Emile Abayisenga, together with the other Rwandan partners of the EnRHed project, namely University of Rwanda, Institute of Applied Sciences INES-Ruhengeri and University of Technology and Arts of Byumba (UTAB). It was the first time that such a kind of Summer School on the topic of slope stability analysis in Rwanda took place. The Summer School has been made possible also thanks to the contribution of many other sponsors, like ICL - International Consortium on Landslides, AIGeo - Italian Association of Physical Geography and Geomorphology, Rocscience, IAH Italian Chapter - International Association of Hydrogeologists and the University of Parma.

#### The Rwandan context

Rwanda, which has an extension of 26,338 km<sup>2</sup> and a population of more than 12,000,000 inhabitants, has been recently affected by very intense rainfalls that caused a large number of both shallow and deep landslides with significant damage to structures, infrastructures, agricultural soil and life losses. Since 2000, heavy rainfalls and landslides caused 108 deaths and ten thousand displaced and landless people, mostly in North and Western provinces. The volume of debris from landslides was 110 million m<sup>3</sup> and this was deposited

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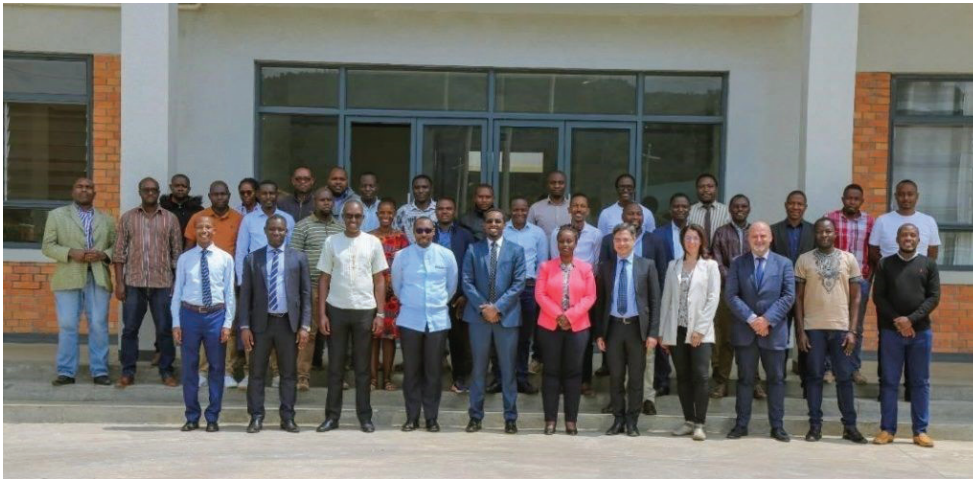


Fig. 1 - Partecipanti alla scuola estiva dal titolo “Frane e Analisi di Stabilità dei Versanti in Rwanda”.

*Fig. 1 - All the participants at the Summer School on “Landslides and Slope Stability Analysis in Rwanda”.*

into rivers and streams and affected the main roads. The most frequent types are rainfall-induced shallow landslides, which occur on very steep slopes. To reduce the occurrences of landslides, terraces have started being constructed by the government and local people. Afforestation is also being promoted everywhere to fight against landslide disasters and also some constructions of retaining walls has been performed mainly against road cut slopes. But until now, in Rwanda there is a lack of knowledge concerning hydrogeological hazard and to guarantee the protection of life, goods, natural environment and human activities. Moreover, the need for basic engineering, geological, geomorphological and hydrogeological knowledge of methods to analyze slope stability is growing and should be developed in Rwandan Higher Education Institutions.

### About the EnRHed project

The EnRHed Project has been awarded for EU co-funding within the framework of the Erasmus+ programme “Capacity Building in the Field of Higher Education”, which supports the modernization, accessibility, and internationalization of higher education in Partner Countries, in this case Rwanda.

The EnRHed Project aims at organizations to help improve curricula, governance, and the strengthening of relations between higher education systems.

The main innovative character of EnRHed Project to achieve its objectives is that all joint activities are carried out simultaneously at different levels of teaching and training in two key fields of interest (namely, Food and Science Technology and Environmental Protection, Safety and Management). Based on the advantage of working in these two specific domains, this Project can be considered a pilot experimental methodology, since it would be applied in the future in further fields of interests. The partners involved into the Project were seven: three coming from Europe and four from Rwanda. To have more info visit the web site <https://enrhed-erasmusplus.com/project/>.

The Summer School on “Landslides and Slope Stability Analysis in Rwanda” was organized in the framework of the “Environmental Protection, Safety and Management”

domain, since landslides are considered a very urgent problem to be addressed in Rwanda.

### The Summer School

Taking into account the project framework and the Rwandan context, the EnRHed team based at IPRC-Musanze proposed to organize an international Summer School entitled “Landslides and slope stability analysis in Rwanda”. The main objectives of the Summer School were: i) improving the awareness of Civil Engineers, Geologists, Technicians and Teachers about the hydrogeological hazard in the Rwandan area; ii) increasing the base knowledge of the main geomorphological, hydrogeological and geotechnical processes connected with landslide; iii) bringing up the capability of tackling and solving slope stability problems using Rocscience Software; and iv) introducing knowledge about problems connected with deforestation and solutions through replanting of soil slopes for stabilization purposes. Three professors from the Department of Chemistry, Life Sciences and Environmental Sustainability of the University of Parma (Fig. 2) were part of the teaching team: Roberto Valentino, who dealt with the issue of slope stability from a geotechnical point of view, Alessandro Chelli, who highlighted the geomorphological aspects at various reference scales, and Emma Petrella, who focused on the hydrogeological aspects mainly related with the infiltration and flow processes in a low permeability media affected by landslides. Moreover, the Summer School also fulfilled different tasks of the EnRHed project, such as the transfer of knowledge on various approaches for the study of hydrogeological risk in the Rwandan territory, the transmission of skills suitable for the management of problems related to the stability of the slopes and sharing knowledge on topics such as data acquisition, geological, hydrogeological and geotechnical experiments useful for modeling slope instability phenomena.

After an opening ceremony, the Summer School started with a cycle of theoretical lessons during which basic concepts of geotechnical, geomorphological and hydrogeological aspects were taught. Therefore, different case studies at different scales, located both in Italy and in Rwanda, were

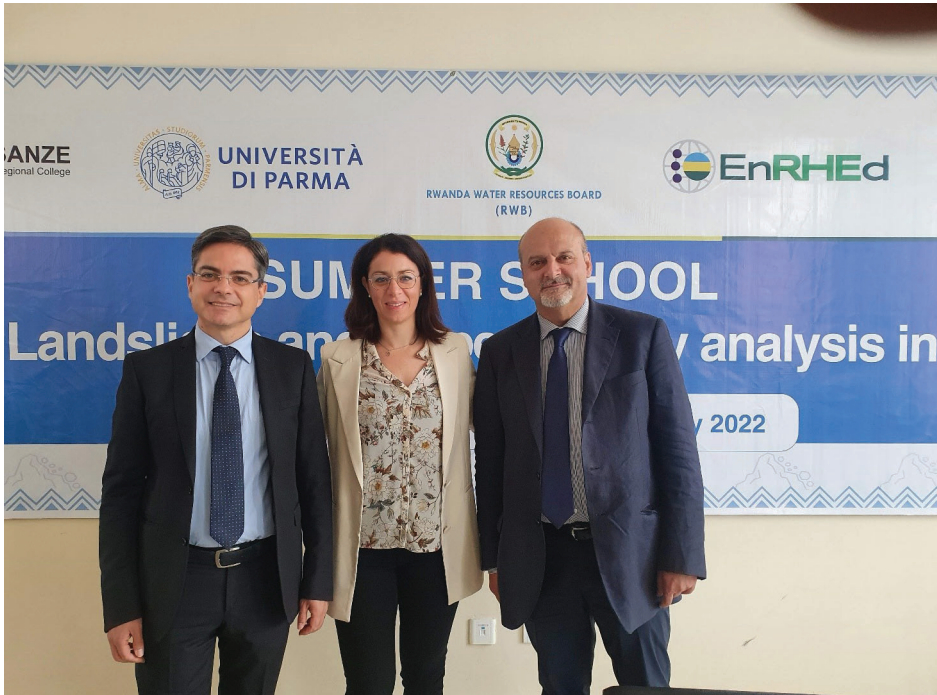


Fig. 2 - Professori dell'Università di Parma che hanno tenuto le lezioni della Scuola Estiva a Musanze in Rwanda. Da sinistra a destra: Prof. Roberto Valentino, Prof.ssa Emma Petrella, Prof. Alessandro Chelli.

*Fig. 2 - The professors from the University of Parma who held the lectures at the Summer School in Musanze, Rwanda. From left to right: Prof. Roberto Valentino, Prof. Emma Petrella, Prof. Alessandro Chelli.*

presented and analyzed in terms of monitoring network, description of involved processes, field investigation and theoretical slope models. Finally, practical exercises (Fig. 3) were performed, by using appropriate numerical codes specifically designed for slope stability analysis. The Summer School has been a success beyond the expectations and all the people involved worked with enthusiasm and professionalism. The participants particularly appreciated the practice of the software, which helped them in the better understanding of

the basic concepts and in the possible resolution of problems related to slope stability. During the concluding ceremony, all the participants asked to plan a second edition, in order to improve the knowledge and the skill acquired during this event.

And we hope to have the opportunity to organize again similar activities in such a welcoming and enthusiastic country!



Fig. 3 - Alcuni partecipanti durante l'esercitazione pratica.

*Fig. 3 - Some participants during a practical exercise.*