Date of Submission	22 December 2022

IPL Project Proposal Form 2022

1. Project Title: **SLOPE STABILITY IN VINEYARDS WITH DIFFERENT MANAGEMENT PRACTICES (Acronym: WINESLIDES)**

2. Main Project Fields

(1) Technology Development

A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

3. Name of Project leader

Filippo Catani

Affiliation: UNESCO Chair on Prevention and Sustainable Management of Geo-Hydrological Hazards - University of Florence (UNIFI) (ITA) – Full Member ICL. Secondary affiliation: Full Professor of Engineering Geology, Department of Geosciences, University of Padova - Contact: Via Gradenigo, 6, Padova (Italy), Tel 0039 0498279193, Email: filippo.catani@unipd.it, (secondary: filippo.catani@unifi.it)

Core members of the Project

- Domenico Calcaterra: Full Professor, Earth Sciences Department (UNINA), University Federico II, Naples (ITA)
- Fulvio Celico: Full Professor, Dept. of Chemistry, Life Sciences and Environmental Sustainability, University of Parma (ITA)
- Claudia Meisina: Full professor, Department of Earth and Environmental Sciences (ITA) - University of Pavia (UNIPV)
- Paola Revellino: Associate Professor, Dipartimento di Scienze e Tecnologie (UNISANNIO), University of Sannio, Benevento (ITA)
- Veronica Tofani: UNESCO Chair on Prevention and Sustainable Management of Geo-Hydrological Hazards - University of Florence (UNIFI) (ITA) – Full Member ICL. Secondary affiliation: Associate Professor, Earth Sciences Department (UNIFI), University of Florence (ITA)

4. *Objectives*: (5 lines maximum; what you expect to accomplish?)

1) Analyze the effects of agronomic management practices on shallow landslide triggering in vineyards;
2) Connect geohydrological information with soil biodiversity in order to understand the influence of soil fauna on shallow landslides;
3) Identify agronomic management practices, sustainable in terms of economic profitability and impact on the environment, which allow to prevent shallow landslides;
4) Development of guidelines of agronomic management practices which can help local communities to

develop effective policies and strategies for reducing the risk of shallow landslides in vineyards.

5. *Background Justification*: (10 lines maximum)

Vineyards cover currently 7.5 Mha corresponding to about 0.5% of the entire agricultural areas in the world (OIV, 2017) and are frequently damaged by rainfall-induced shallow landslides. Different agricultural practices adopted to manage the inter rows, like maintenance of bare soil, continued use of heavy machinery for tillage or permanent grass cover, influence soil physics and hydrology, i.e. soil density, water content, hydraulic conductivity (Bordoni et al., 2019). Management, as well, has an important impact on the distribution of grapevine roots in the soil. The density of roots together with their mechanical behavior related to shear and/or tensile forces, increases soil stability (Bischetti et al., 2009; Cohen and Schwarz, 2017) and is often used as an effective tool to decrease the occurrence of shallow landslides, which are widespread in areas characterized by traditional viticulture. For this reason, a quantification of root reinforcement of grapevines in vineyards with different management practices is fundamental to understand the practices that might promote the stability of sloping vineyards and the ones that cause slope instability.

6. *Study Area*: (2 lines maximum; where will the project be conducted/applied?)

   Vineyards with different management practices in Italy (Oltrepò Pavese in Northern Italy, Chianti in Central Italy and Campania in Southern Italy).

7. *Project Duration*: 3 years

8. *Resources necessary for the Project and their mobilization*

   Partners are among the most important Italian institutions dealing with landslides and will provide expertise in engineering geology (UNIPD, UNIPV, UNINA and UNISANNIO), geotechnics, hydrogeology, and soil zoology (University of Parma), field measurements and susceptibility mapping (UNIPD, UNIFI). All partners belong to the Italian ICL network and ensure a multidisciplinary approach to such item. UNIPV and University of Benevento have funds to finance studies becoming from national and European projects (LIFE). The ICL financial support will eventually support disseminations and public engagement activities such as a specific website, periodic dissemination initiatives and non-technical publications. By the way, guidelines for the selection of the best agronomic practices in steep slope vineyards, which allow to obtain a reduction of the shallow landslide hazard should be an important goal to reach at the end of the project and will be foreseen as an ICL open document to be published in the ICL Journal Landslides.

9. Project Description: (30 lines maximum)

   Task 1 – Engineering geological model of the study areas. Inventory of the shallow slope stabilities.

   Task 2 – Geotechnical, pedological soil characterization of the test sites. Disturbed and undisturbed soil samples will be collected in the identified horizons of the soil profile for laboratory analysis: A. geotechnical analysis for the determination of physical properties, volumetric characteristics,

mechanical properties; B. soil analysis (calcium carbonate, organic matter, pH); C. hydrological analysis (retention curves, permeability);

The geotechnical analyzes will be performed by PhD students at the Laboratory of Applied Geology and Geotechnics of UNIPV and UNINA. Field measurements, where needed, will be performed by UNIFI and UNIPD by using portable tensiometers, BSTs and constant head permeameters at key locations, according to the methods highlighted in Bicocchi et al. (2019).

The Soil Saturated hydraulic conductivity (Ks) will be measured in field through different devices as a constant head permeameter at different depths.

In the excavated pits the grapevine root length and root size distribution will be determined at different distances from the rootstock.

Task 3 - Data analysis. The data measured in the task 2 will be integrated in order to evaluate the influence of the management techniques on:

A. the geotechnical (texture, volumetric characteristics and their vertical variations) and pedological parameters (calcium carbonate, organic matter, main ions, pH, etc. ..).

B. the hydrological parameters (hydraulic conductivity, infiltration).

C. the biological parameters (soil fauna biodiversity).

D. the density and reinforcement operated by the root system in the soil.

Task 4 - Shallow landslide assessment. The role of the different management practices in vineyards on the shallow landslides will be assessed through a physically based model that couples a hydrological model with a mechanical one. The input data will consist of the mechanical parameters (task2), the hydrological parameters (task 2), the root reinforcement values obtained for different management practices, quantified in task 2. The shallow landslide hazard will be assessed with different precipitation scenarios, in relation to climatic changes and to the variations of management techniques in vineyards over time.

Task 5 – Guidelines development. Guidelines will be drawn up aimed at the application, on a territorial scale, of those agronomic practices that are able to reduce shallow landslide hazard in steep vineyards.

10. Work Plan/Expected Results: (20 lines maximum; work phases and milestones) M = month

Task 1 (M1-M3): Engineering geological model of the study areas

Task 2 (M2-M12): Geotechnical, pedological and biological soil characterization

Task 3 (M12-M28): Data analysis

Task 4 (M28-M32): Shallow landslide hazard assessment

Task 5 (M30-36): Guidelines development

Milestones

M12: Characterization of the pilot areas from the geological, geotechnical, pedological and biological point of view. Use of soil fauna as indicator of soil degradation processes, linked to the hydraulic features.

M24: Role of the different vineyard inter rows management techniques on soil hydrological parameters.

M36: Guidelines.

The project results will impact in the following Sustainable Development Goals (SDGs) of Agenda 2030: Goal 2 , Goal 13.1 , Goal 13.2 , Goal 15.3. The project will also contribute to actions 2 and 5 of the Priority Actions of KLC2020.

11. Deliverables/Time Frame: (10 lines maximum; what and when will you produce?)

M14: Use of soil fauna as indicator of soil degradation processes, linked to the hydraulic features

M28: Role of the different vineyard inter rows management techniques on soil hydrological parameters and root reinforcement

M36: Best agronomic practices in steep slope vineyards, which, by welding the hydrological, biological and pedological aspects with the agronomic ones, allow to decrease the shallow landslide hazard.

12. Project Beneficiaries: (5 lines maximum; who directly benefits from the work?)

Landslide professionals, researchers, policy makers developing policies and strategies for reducing the risk of shallow landslides in vineyards, farmers and people living in areas with vineyards and similar cultivations, insurance companies, land use planners.

13. References (Optional): (6 lines maximum; i.e. relevant publications)

Bicocchi, G., Tofani, V., D'Ambrosio, M., Tacconi-Stefanelli, C., Vannocci, P., Casagli, N., Lavorini, G., Trevisani, M. & Catani, F. 2019, "Geotechnical and hydrological characterization of hillslope deposits for regional landslide prediction modeling", Bulletin of Engineering Geology and the Environment, vol. 78, no. 7, pp. 4875-4891.

Bischetti, G.B., Chiaradia, E.A., Epis, T.,Morlotti, E., 2009. Root cohesion of forest species in the Italian Alps. Plant Soil 324, 71–89.

Bordoni, M., Vercesi, A., Maerker, M., Ganimede, C., Reguzzi, M. C., Capelli, E., Wei X.; Cohen, D., Schwarz, M., 2017. Tree-root control of shallow landslides. Earth Surf. Dynam.
5, 451–477.

Mazzoni E.; Simoni S.; Gagnarli E. & Meisina, C. (2019). Effects of vineyard soil management on the characteristics of soils and roots in the lower Oltrepò Apennines (Lombardy, Italy). Science of The Total Environment, 693, 25 November 2019, ISSN: 00489697, 10.1016/j.scitotenv.2019.07.196.

Organisation Internationale de la Vigne et du Vin (OIV), 2017. State of the Vitiviniculture World Market-April 2017. http://www.oiv.int/en/technical-standards- and documents/statistical-analysis/state-of-vitiviniculture⟩, Accessed date: 2 October 2018.

Parisi, V., Menta, C., Gardi, C., Jacomini, C., Mozzanica, E., 2005. Microarthropod community as a tool to assess soil quality and biodiversity: a new approach in Italy. Agric.Ecosyst. Environ. 105, 323–333.

Prosdocimi,M., Cerdà, A., Tarolli, P., 2016. Soilwater erosion on Mediterranean vineyards: a review. Catena 141,

1–21.

Remelli, S., Petrella, E., Chelli, A., Conti, F.D., Lozano Fondon, C., Celico, F., Francese, R., Menta, C. 2019. Hydrodynamic and soil biodiversity characterization in an active landslide. Water, doi: 10.3390/w11091882.

Note: Please fill and submit this form by 15 December 2021 to ICL Network <icl-network@iclhq.org> and ICL secretariat <secretariat@iclhq.org>