ASFORESEE

A multidisciplinary model to assess **forest protection** service against **rockfall** in the **Alpine Space**

ROCKtheALPS
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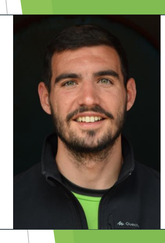

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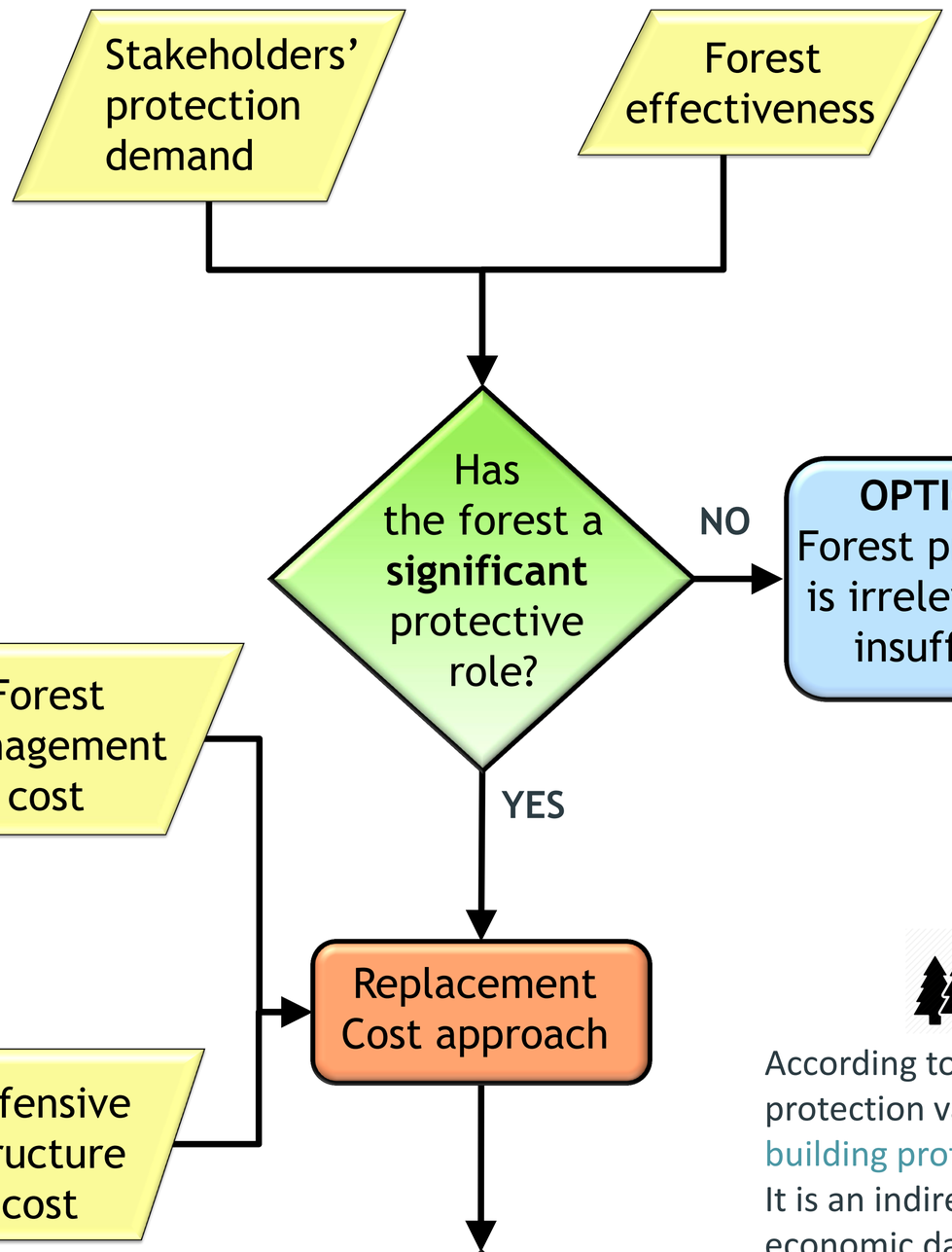
THE PROJECT: Alpine forests have always been managed to maintain their protective functions against several gravitational hazard. Nonetheless, a lack of harmonised tools and methods to evaluate and predict their effectiveness prevented their adoption as nature-based protective solution. The INTERREG Alpine Space Project "RockTheAlps" capitalizes the knowledge gained in previous EU project filling the current gaps in mapping, evaluating and modelling the protection service of forests against rockfall.

AIMS: Our contribution to the project consists on the development of ASFORESEE: the first harmonized model to evaluate the protection service provided by forests against rockfall risk at stand level. The framework of the model is presented below.

The **Stakeholders' protection demand** is the minimum degree of protection stakeholders expect to receive. It represents the demand side of the protection ES. This value is currently evaluated qualitatively *via* dedicated workshops.

Forest management costs represent the expenditures of forest management in order to maintain the protective role of the stand. We adopted a 2% interest rate in a 25 years period.

To estimate the cost of a **standard protective structure** as effective as the forest, we designed net fences according to the ETAG 027 EU guidelines, with a site-specific approach. Their sizing considers the 95° quantile of blocks distribution, integrated with safety factors.



The **Rockfall Protection Index**, developed within the Arange project, was adopted to measure the % of blocks stopped by the forest.
It considers forest (density, DBH, species), slope (length, steepness, height difference, cliff height) and block (diameter, shape, type) features.

Option A: the forest protection value is equal to the discounted forest management costs

$$P_v = \sum_{t}^{0} M_i \cdot \frac{1}{(1+r)^i}$$

P_v is the protection value ; M is the NPV of the management expenditures *i* incurred in the period from *0* to *t*, discounted at the rate *r*.

According to the **Replacement Cost approach**, the protection value of the forest is equal to the cost of building protective structure to reproduce its benefits. It is an indirect method based on technical, forest and economic data.

Option C: the forest protection value is equal to the cost of the defensive structure needed if there was no forest.

$$P_v = (F_s \cdot \mathrm{K}_{red}) - \sum_{t}^{0} M_i \cdot \frac{1}{(1+r)^i}$$

P_v is the protection value; F_s is the cost of an alternative standard protective structure; K_{red} is the reduction coefficient describing the forest effectiveness; M is the NPV of the management expenditures *i* incurred in the period from *0* to *t*, discounted at the rate *r*.

Option B: the forest protection value is equal to the cost of building a smaller protective structure

$$P_v = F_s - F_{wf} - \sum_{t}^{0} M_i \cdot \frac{1}{(1+r)^i}$$

P_v is the protection value ;F_s is the cost of an alternative standard protective structure;F_{wf} is the cost of the smaller structure built considering the forest role;M is the NPV of the management expenditures *i* incurred in the period from *0* to *t*, discounted at the rate *r*.

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