

PROJECT I.D.
1.1. Acronym: : MECAFOR08
1.2. Project title: Evaluation and Optimisation of mechanised forestry tasks in the Basque Country
1.3. Financial backers: Basque Government Department of Agriculture, Fisheries and Food
1.4. Participating bodies: Basque Country Forestry Confederation
NEIKER DETAILS
1.5. Lead researcher: Ander González Arias (agonzalez@neiker.net)
Research team: Nahia Gartzia Bengoetxea, Marta Camps Arbostain, Pablo Gamiz Ferreira, Ibai Seguroola Gurrutxaga
1.6. Start date: 15/01/2008
1.7. End date: 31/12/2008

### Summary:

The protection of soil and water quality is one of the basic aims of sustainable forestry management. Due to its topography and the extension of productive woodland, this is of great importance on the Atlantic slopes of the Basque Country.

The woods have high vegetation coverage and a high capacity to intercept precipitation, a natural mulch of fallen leaves and a highly developed, well-structured soil, rich in organic material. This favours infiltration and reduces surface run-off and the impact of raindrops. This means it plays a role in regulating the hydrological cycle, as well as mitigating erosion and the transport of sediments to the rivers. So, the phenomena of erosion and the transport of sediments to the rivers during torrential rainfall should be regarded as natural processes that are difficult to minimise.

Cultivated woodland does not satisfy this ideal situation with regard to some or all of these factors:

1. Tree coverage disappears after felling, leaving the soil unprotected during part of the rotation used by each forestry model.
2. Removal of the felled timber compacts the soil, removes mulch and alters the horizontal surface of the soil.
3. Mechanised terrain preparation task generate more stress for the soil, can eliminate the bushy and grassy vegetation to leave the mineral soil exposed to the impact of raindrops, cause soil movements and compaction.
4. Building tracks and routes on slopes involve relatively important earth movements and generate channelled flows of water that occasionally have a high potential for erosion.
5. The plantations are frequently fertilised when they are established. In certain cases, agrochemicals are applied to control infestations or diseases and, in certain cases, the competing vegetation.

These activities typical of plantations generate a number of impacts that can be summarised as follows: 1) loss of soil by direct removal and by increasing the erosion rate, which in turn leads to loss of organic material and nutritional elements; 2) compaction of the soil due to machinery traffic, reducing porosity and the infiltration rate, which increases erosion, worsens the hydric regime of the soil and reduces productivity; 3) generation of sediments by erosion of the soil as a whole and very significantly on the track and road network, which can reach the waterways and cause turbidity, increasing the silting rate in reservoirs and providing nutrients that can lead to eutrophication; 4) when trees are felled near watercourses, this can also increase the temperature of the water, with the resulting reduction in dissolved oxygen, and 5) if agrochemicals and fertilisers are used incorrectly, they can reach watercourses, with the resulting risk of pollution.

**Results:**

We studied the effect that certain forestry tasks have on certain woodland plantation soils in the Basque Country. We chose 9 plots on which 3 different treatments were used to prepare the site for the plantation: 3 of them were prepared by hand, this being the method commonly used on steep slopes, removing the cut material with the help of hand tools, piling up, clearing vegetation and preparing the holes without using machinery. Another 3 plots were prepared according to normal forestry management protocols in the area, using the front blade of a bulldozer to remove the cut material from the planting site, with a harrow to prepare the furrow for planting. The remaining 3 plots used a backhoe to remove the cut material and make the holes. In all cases, logging was carried out using skidders and planting was done by hand.

On the plots prepared by hand, the soil of 20 to 30% of the area to be planted was affected, especially by earth movement (accumulation of mineral soil) and removal of the mulch that protected the soil from the impact of raindrops. The plots prepared with backhoes had about 45% of the surface affected. Here we should highlight, as well as the effects mentioned above, the presence of machinery tracks over 5% of the surface. The plots prepared with bulldozers showed that the area affected was 85%. 35% of the surface to be planted was scalped (elimination of the horizontal surface of the mineral soil and the mulch), with 25% accounted for by displaced soil, and almost 15% was covered with machinery tracks.

Compared with the unchanged areas, the scalped areas showed an increase in apparent density of some 22%, meaning a increase in the resistance offered by the soil to root penetration of 109% and a decrease in the amount of water available to 42% of the field capacity (-10KPa).

Using backhoes may be an environmentally and economically viable alternative to the bulldozer for forestry plantation site preparation tasks in the Basque Country. In addition, the dragger tractor has an impact on forest soil that should be examined by specific studies. More research needs to be done to identify the impact of these tasks on productivity, soil fertility, the protection of watercourses, the capacity of plantations to act as carbon sinks and on biological diversity.

**Impact:**

The type of machinery that has least impact on the soil will be identified, as well as that ensuring greatest productivity in the medium term.

The methodology perfected by NEIKER in previous research projects is reliable and robust, as shown in this project, and is extremely important as it allows us to evaluate soil status after forestry replanting in a statistically objective manner. This makes it of interest to the public and private owners of mountain areas who wish to know the appropriateness of the forestry techniques used on their properties as regards the use made of them and management of the same. Thanks in part to the results of this study, the use of bulldozers on Basque mountains is being questioned.

The results of the study will allow us to choose the right parameters to act as indicators of Sustainable Forest Management and thus have an effective tool for evaluating forest management on the one hand, and identify the critical points to be monitored on the other.