

Gael Sola (2&3), Brice Mayima (1&4), Joseph Levillain (1&2), Philippe Deleporte (2), Laurent Saint André (2)
(1) UR2PI, Congo (2) CIRAD, France (3) AgroParisTech-ENGREF, France (4) Université Marien Ngouabi, Brazzaville, Congo.

1- Context

In most cases, tropical soils are less weak than temperate soils but rain intensity is higher (Roose *et al.*, 2004).

Near Pointe Noire, soils are deep and sandy. Their high surface permeability permits a great and speedy infiltration of rain, between 144 and 360 mm/hour (Van Caillie, 1989). So erosion and run off risks should be low.

However field observations in that area show that erosion can create gullies on nude soil like skid-trails.

Furthermore, Roose's report (2007) dealing with risk evaluation of erosion and run off on eucalyptus plantations (1st year CarboAfrica Annual Report), had shown that erosion and run off risks were not negligible, almost in nude and burned areas. These risks are mainly dependent on the slope, soil occupation and land cover.

Objective:

In these poor soils, identifying causes of soil erosion and quantifying the inherent nutrients and carbon losses are necessary to:

- Establish maps of soil potential erosion at the plantation scale;
- Adapt forest management in the main risky areas;
- Determine sustainability of eucalyptus plantation.

2- Study site :

Forest area:

- 42 000 ha planted in savanna near Pointe noire, Congo.

Soil characteristics:

- sandy soils.
- poor in nutrients except for P
- high surface permeability

Climate characteristics:

- mean annual rain fall: 1200 mm
- highest rainfall intensity observed each year: 60 to 80 mm/hour.

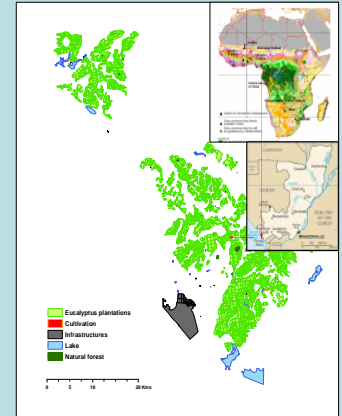


Figure 1 : situation of studies area, Pointe Noire, Congo

3- Methodology

3-1. The Rainfall simulator

Soil erosion monitoring with **permanent systems** are **costly** and **don't permit to study many cases**. This study is being done with a **simple and transportable rainfall simulator** which permits to simulate the highest rainfall intensity (60 to 80 mm/hour) monitored yearly in this region. The rainfall simulator has been adapted from the ORSTOM rainfall simulator (Casenave, 1982).

3-2. Sites studied and Protocol

In order to determine land use and slope influence to run off, we have defined:

- **8 land use types:** firebreak (CF), young eucalyptus (EJ), young eucalyptus burned (EJB), old eucalyptus (EV), old eucalyptus burned (EVB), trail (P), savanna (S), burned savanna (SB);
- **4 slope classes:** (1) 0-5 %, (2) 5-10 %, (3) 10-15 %, (4) ≥ 15 %.

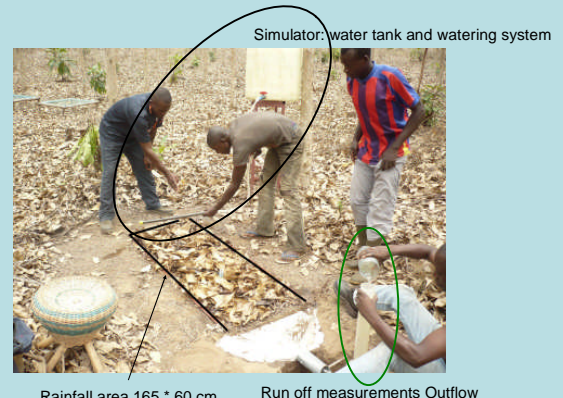
For each case (land use * slope classes), we repeated **two simulations in two different sites** or **three simulations in a single site** (some situations do not exist in this area, particularly unburned savannas and high slope sites).

3-3. In situ measurements

- Characterization of the soil surface (% of soil closure, % of soil cover);
- Rainfall intensity (initial and final intensity) during the simulation;
- Run off intensity during the simulation;



Photo 1: Surface state measurement (30 points in a 3 meters long line).



3-4. Laboratory measurements

- Soil analyses in Congo: bulk density, textural distribution.
- Soil analyses in France: C and N concentrations.
- Run off analyses in Congo: mass of soil and organic matter removed during the simulation.
- Run off analyses in France: C, N and major nutrients in run off, organic matter and soil.

4- Preliminary results

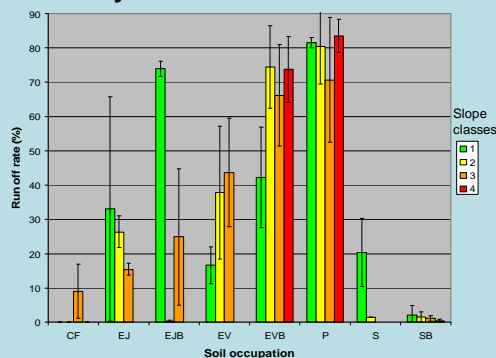


Figure 2: Run off rate as a function of soil occupation and slope (CF: firebreak, EJ: young eucalyptus, EJB: young eucalyptus burned, EV: old eucalyptus, EVB: old eucalyptus burned, P: trail, S: savanna, SB: burned savanna).
Slope classes: 0-5 % (1), 5-10 % (2), 10-15 % (3), ≥ 15 % (4).

Run off rate = run off (mm/hour) / simulated rain intensity (mm/hour) * 100

High run off for skid-trail and burned plantations, conversely to savanna and firebreaks where risks were low (Photo 2).



Photo 2: erosive figure (gully) after rainfall simulation on skid-trail.

Nude soils exhibit different patterns of run off risks. Human action (firebreaks ploughed every year keep soil infiltration to high values, whereas skid-trails have a very low infiltration rate) may play a considerable role.

Concerning eucalyptus plantations, run off can be high.

Chemical analyses of the soil and the organic matter removed during the simulations are ongoing to determine the potential losses of carbon and nutrients in these plantations.

Literature:

- CASENAVE A., 1982, Le mini simulateur de pluie, conditions d'utilisation et principes de l'interprétation des mesures, cahiers ORSTOM, série Hydrologie, XIX, 4.
 ROOSE E., DE NONI G., 2004, recherches sur l'érosion hydrique en Afrique, revue et perspectives, Science et changement planétaires / Sécheresse, XV, 1, 121-9.
 ROOSE E., 2007, Évaluation des risques de ruissellement et d'érosion sous les plantations d'Eucalyptus dans la région de Pointe Noire, CIRAD-UR2PI.
 VAN CAILLIE X., 1989, Erodabilité des terrains sableux du Zaïre et contrôle de l'érosion, Cah. ORSTOM, sér. Pédol., vol. XXV, no 1-2, 1989-90: 197-208.