The success of headwater rehabilitation towards gully erosion control

Amaury Frankl (1,2), Jean Poesen (3), and Jan Nyssen (1)

(1) DEPARTMENT OF GEOGRAPHY, Ghent University, Krijgslaan 281 (S8), B-9000 Ghent, Belgium
(amaury.frankl@ugent.be), (2) RESEARCH FUND FLANDERS (FWO), Egmonstraat 5, B-1000 Brussels, Belgium, (3)
DIVISION OF GEOGRAPHY, KU Leuven, Celestijnenlaan 220E, B-3001 Heverlee, Belgium

Abstract
The ill-management of headwaters has frequently shown to have adverse effects on both humans and the
environment. Historical examples often refer to altered hydrological conditions and stream incision resulting
from deforestation. Agricultural expansion and intensification – often accompanied with land reforms in the 20th
century – also showed to severely impact the fluvial environment, with stream incision and gully erosion hazards
increasingly affecting many headwater areas around the world. To counter this, many regions have adopted
improved management schemes aiming at restoring the physical, biological and hydrological integrity of the
soil- and landscape. In terms of hydrogeomorpology, the objective was to minimize dynamics to a lower level so
that runoff, sediment and pollutant transfers do not cause danger to human life, environmental/natural resources
deterioration or economic stress. Therefore, much attention was given to the rehabilitation and re-naturalization of
headwater streams and gullies, which are the conduits of these transfers. This is done in both indirect and direct
ways, i.e. reducing the delivery of runoff and sediment to the gullies and interventions in the incised channels.
Although much has been published on gully erosion development and control, few studies assess the success of
gully rehabilitation on the mid- to long term or confront results against the gully life-cycle. The latter refers to
the rate law in fluvial geomorphology, whereby gully morphological changes (increases in length, area, volume)
are initially rapid, followed by a much slower development towards a new equilibrium state. Here, we present
a review of headwater rehabilitation measures and their success towards gully erosion control. By confronting
this to the life-cycle of a gully, we also want to shed light on our understanding of when and where gully erosion
control needs to be applied; making land management more efficient and effective.

Keywords: land rehabilitation, check dam, cut-and fill cycle, soil and water conservation, erosion