STSM Report

Connecting measurement, experiments and concepts on Olive orchards

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1 Introduction

Within soil erosion research, it is still in debate, how much material is eroded by the different processes involved, inter-rill and rill processes, and how far it is transported due to the different environmental conditions. The analysis to these aspects is crucial to adopt the adequate management measures for the conservation of soils, to keep the production of high quality agricultural products and to prevent large off-site damages, like siltation of dams and channels.

Thus, it is necessary to understand and quantify the interaction of the different processes, and their individual capacity to generate and translocate sediments. As the measurement of the different processes of soil erosion and the functional connectivity is still difficult, a set of experimental methods can be applied for assesment (e.g. Wirtz et al., 2012).

Olive orchards are one of the dominating agricultural landscape units in southern Spain. It is common for all management types, that the orchards are kept free of ground vegetation to reduce water competition. Frequently, olives are cultivated on steep slopes due to their robustness where other crops are not as productive (Taguas et al., 2013, 2011), thus, they are predestined to apply and test methods for assessment of water and sediment connectivity.

2 Work carried out during STSM

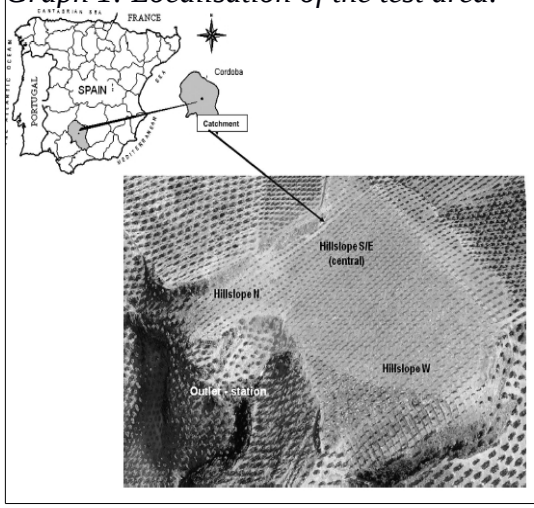
During the stay at the test site Puente Genil monitored by the host, Dr. E. Taguas, the focus was set on the collection of data and samples. In addition, the limits and the suitability of all methods were discussed by all persons involved. The experience was extended by organised visits at other types of olive orchard farms.

The complete field work was carried out with substantial support of Francisco Montero, technical director of the municipal enterprise for environmental issues.

2.1 Test site

The common research was performed at the catchment described in detail by Taguas et al. (2013, 2011), located about 50 km south of the city of Córdoba, close to the city of Puente Genil (Graph 1). It is completely covered by an extensively managed olive orchard of relatively low productivity. It shows clear evidence of intense soil erosion.

Graph 1: Localisation of the test area.

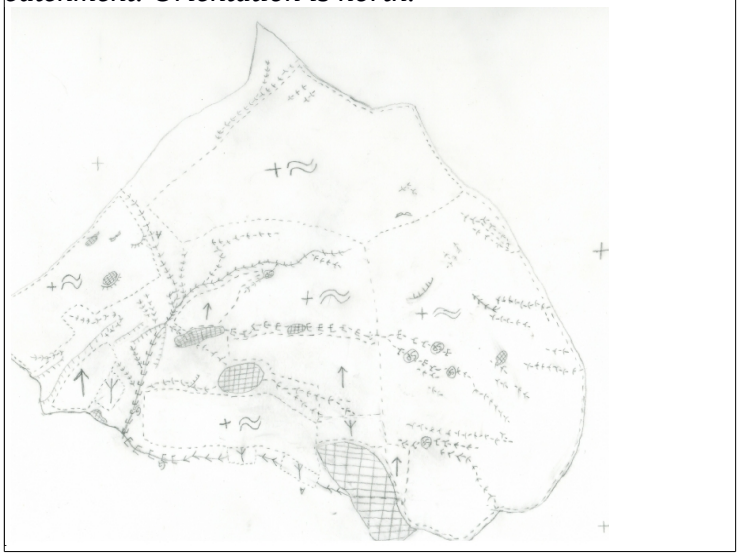


2.2 Methods & preliminary results

Mapping: During the first 4 days, a detail mapping of the catchment was conducted (Graph 2), registering mainly elements such as: the catchments boundaries, rills and (ephemeral) gullies, areas where soil has disappeared, areas with predominant inter-rill erosion, steps and terraces, etc.

First evaluation in the field has shown that the catchment is smaller than estimated by DEM-analysis, as one of the principal ephemeral gullies redirects the overland-flow out of the flume.

Graph 2: Completed geomorphological field map of the catchment. Orientation is north.



In any case, ephemeral gullies mainly appear at the slightly steeper slope, where only shallo soils are predominant or the soil is even completely eroded and outcrops of the baserock are visible. Within the area with deep soils, concentrated features of flow were only mapped where irrigation infratructures were installed.

Infiltration measurements: We performed around 20 infiltration measurements with a modified single ring infiltrometer (Hills, 1971; Tricker, 1978). The measurements were distributed throughout

the catchment, but taking into account different positions related to soil management: traffic lanes, spaces between trees and below canopy. A first evaluation of the data shows, as expected, evident differences between the position. But more unexpected was the very clear differentiation between the areas where only shallow soils and deep soils are predominant: the first ones show considerably higher infiltration rates.

Hydraulic permeability: The hydraulic conductivity of the subsoil was measured with a Guelph-permeameter (Salverda and Dane, 1993). Choosing similar places as for infiltration measurements, 10 measurements were performed. Evaluation is still going on.

Rainfall simulations: Small scale rainfall simulations (Iserloh et al., 2013, 2012; Seeger, 2007) were applied to measure runoff and interrill sediment generation at different sites of the catchment. Analogous to the previous measurements, different positions related to soil management and topographical position were choosen for the approx. 30 experiments carried out during the stage. The preliminary results show in case of the runoff generation a similar behaviour as observed with the infiltration measurements. The analysis of sediment generation is still in process.

Rill experiments: The investigation of the function of rills as crucial, but ephemeral, elements in sediment connectivity was carried out by 2 sets of experiments (Wirtz et al., 2012, 2009) on a large, complex rill system. Several samples were collected and are analysed in laboratory to determine the sediment transport. The analysis of flow is still in process.

Upcoming work: Post processing of the data will be done at Trier University and shared with the host, Dr. E. Taguas. This includes the raw data, as well as the incorporation of the results of mapping and experiments into the common connectivity models (e.g. as proposed by Borselli et al., 2008; Cavalli et al., 2013; Renard and Allard, 2013).

The first comprehensive results will be presented (if possible) at the meeting in Palermo end of february.

3 Contribution of the work to the action aims

The joint action of the host and visiting scientist will promote in a combined manner the work of the following groups:

- WG1 will be extended to combine model concepts for structural and functional connectivity with comparative data gained in the field. In addition, we will be able to evaluate the possibility of introducing “classical” methods, such as geomorphological mapping, into the concepts of sediment connectivity in soil erosion.
- WG2 will profit from this STSM, as we measured the sediment production and transport capacity of different elements of sediment connectivity in a system dominated by non-point sources for sediments. This will allow to define the suitability of different experimental and field methods to define (and weight) their contribution to sediment connectivity in a system.
- We will provide a fully accessible data-set to WG3 for modelling of sediment connectivity. This will enhance, combined with the efforts done in WG1, the suitability of connectivity concepts in soil erosion systems. This additional knowledge is crucial to test the validity of the concepts and models across temporal and spatial scales.

In addition, the STSM has contributed successfully to an exchange in knowledge about measurement methods, land and soil management systems across disciplines as agricultural and forest engineers and physical geographers.

4 References

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