REPORT
Short-Term Scientific Mission (STSM)
Contributing to the scientific objectives of ES1306 (Connecteur –Connecting European Connectivity Research) COST Action.

Artemi Cerdà (Spain) visiting Vincenzo Bagarello (Italy)

The scale effect on soil erosion. A plot approach to understand connectivity on slopes under cultivation at variable plot sizes and under Mediterranean climatic conditions

Artemi Cerdà[1] and Vincenzo Bagarello[2]

[1]Soil erosion and Degradation Research Group, Department of Geography. Universitat de Valencia, Blasco Ibañez, 28, 46010 Valencia, Spain. Artemio.cerda@uv.es

[2]Department of Agricultural and Forest Sciences, University of Palermo, Viale delle Scienze, 90128 Palermo, Italy

Vincenzo.bagarello@unipa.it

▪ Description of the work carried out during the RSTSM;

Dr Cerdà visited Professor Bagarello during 45 days to exchange results, methods, and strategies to research on the effect of scale on soil erosion and compare the results obtained by them during the last 15 years in Sparacia and El Teularet research stations.

It is well known that soil erosion changes along time and seasons and attention was paid to this issue in the past (González Hidalgo et al., 2010; 2012). However, although the scientific community knows that soil erosion is also a time spatial scale-scale dependent process (Parsons et al., 1990; Cerdà et al., 2009; González Hidalgo et al., 2013; Sadeghi et al., 2015) very little is done on this topic. This is due to the fact that at different scales, different soil erosion mechanisms (splash, sheetflow, rill development) are active and their rates change with the scale of measurement (Wainwright et al., 2002; López-Vicente et al., 2015). This is making the research on soil erosion complex and difficult, and it is necessary to develop a conceptual framework but also measurements that will inform about the soil erosion behaviour.

Connectivity is the key concept to understand how changes in the scale results in different rates of soil and water losses (Parsons et al., 1996; Parsons et al., 2015; Poeppl et al., 2016). Most of the research developed around the connectivity concept was applied in watershed or basin scales (Galdino et al., 2016; Martínez-Casasnovas et al., 2016; López Vicente et al., 2016; Marchamalo et al., 2015; Masselink et al., 2016), but very little is known about the connectivity issue at slope scale (Cerdà and Jurgensen, 2011).

El Teularet (Eastern Iberian Peninsula) and Sparacia (Sicily) soil erosion experimental stations are being active for 15 years and data collected on different plots sizes shed light into the effect of scale on runoff

generation and soil losses at different scales and give information to understand how the transport of materials is determined by the connectivity between pedon to slope scale (Cerdà et al., 2014; Bagarello et al., 2015a; 2015b). The comparison of the results of the two research stations shed light into the rates of soil erosion and mechanisms involved that act under different scales.

Our proposal was to share the information collected during the last 15 years in the Sparacia and El Teularet soil erosion experimental stations under the same management and research how the concept of connectivity can help us to have a better understanding of the soil erosion process, and the effect of scale. All the data have be treated to show the runoff and sediment eroded at different plot sizes to understand how the sediment is transported at event and year scale. The rainfall characteristics were also analysed to understand the soil erosion processes at different scales.

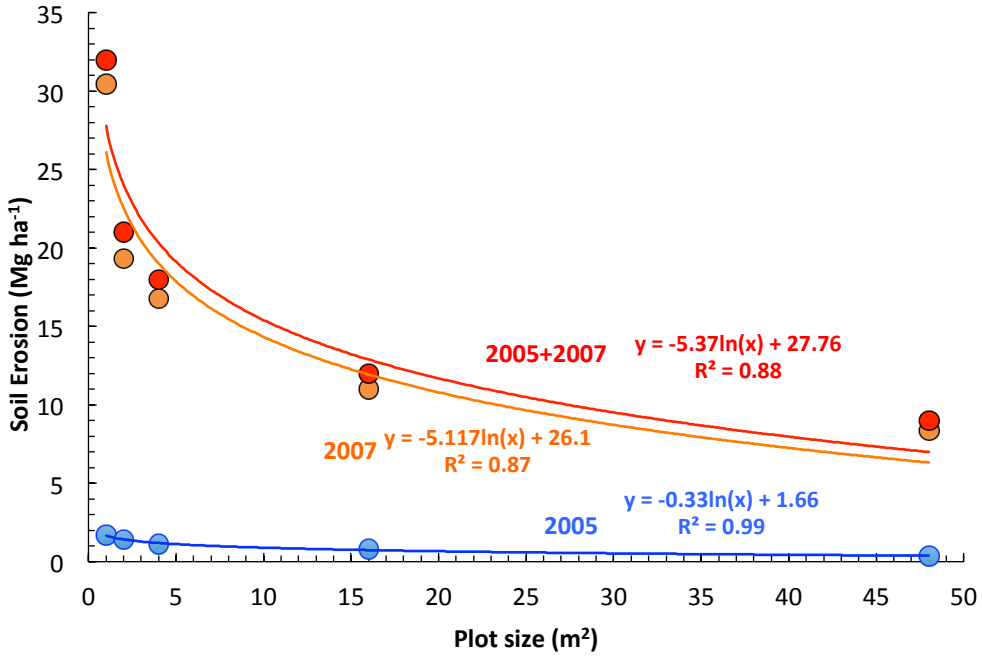
The plan developed between the University of Valencia and the University of Palermo was: i) to understand how the scale determines the runoff initiation and develop useful information that will allow to design strategies to reduce the soil and water losses; and ii) to write relevant publications to show how the size of the contributing area is relevant to explain the soil water erosion processes.

The research developed shown a clear decrease in runoff rates and sediment delivery when measured in small plots, while the large plots show lower soil and water deliveries (per m^2). Along the research developed we found that the infiltration is a key issue on this is why we researched the role of land management on infiltration rates, and as a consequence on the connectivity. We found that management highly control the infiltration behaviour and then will result in a dis-connexion of the flows along the slope. This is why we developed measurements to understand how the infiltration process determines that some areas will act as sinks of the runoff generated and reduce the connecticity.

- **Description of the main results obtained;**

The research carried upon the analysis of the data collected during the last decade show that in both, El Teularet and Sparacia research sites, the runoff rates and the soil erosion rates decline when the length and/or the surface of the plots increase. Figure 1 shown this effect that is contrasted between the wet and the dry years such as 2005 and 2007.

Figure 1. Correlation between plot size and soil erosion of the two experimental years (2005 and 2007) and the whole studied period (2005 and 2007).



The control the size of the plots exerts on soil erosion was found at each rainfall event. The influence of the rainfall volume was relevant to understand the soil erosion rates changes along the time and how the connectivity is enhanced by the increase in rainfall volume (See figure 2)

Figure 2. Correlation between rainfall and soil erosion for the five sizes of plots during the studied period Figure 4a. Rainfall and runoff distribution during 2005 and 2007 for the 1 m^2 plot

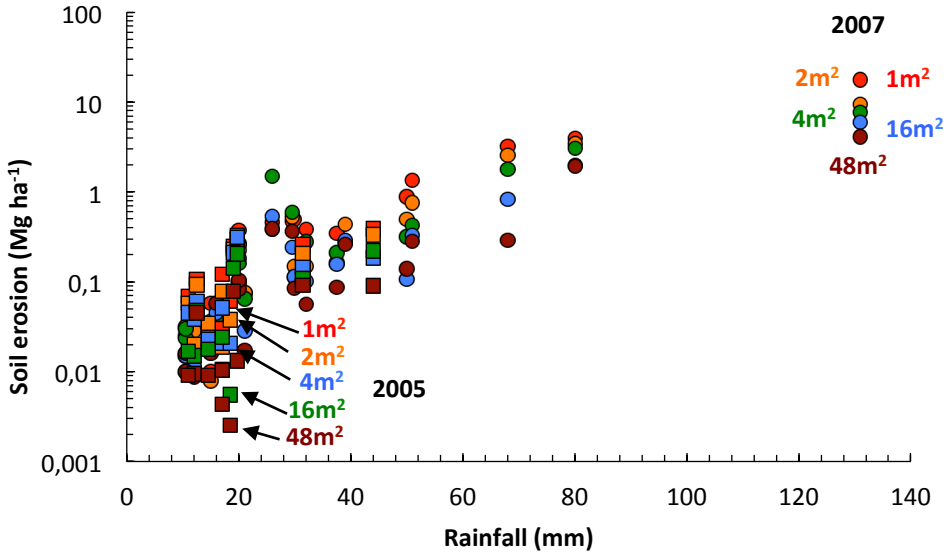
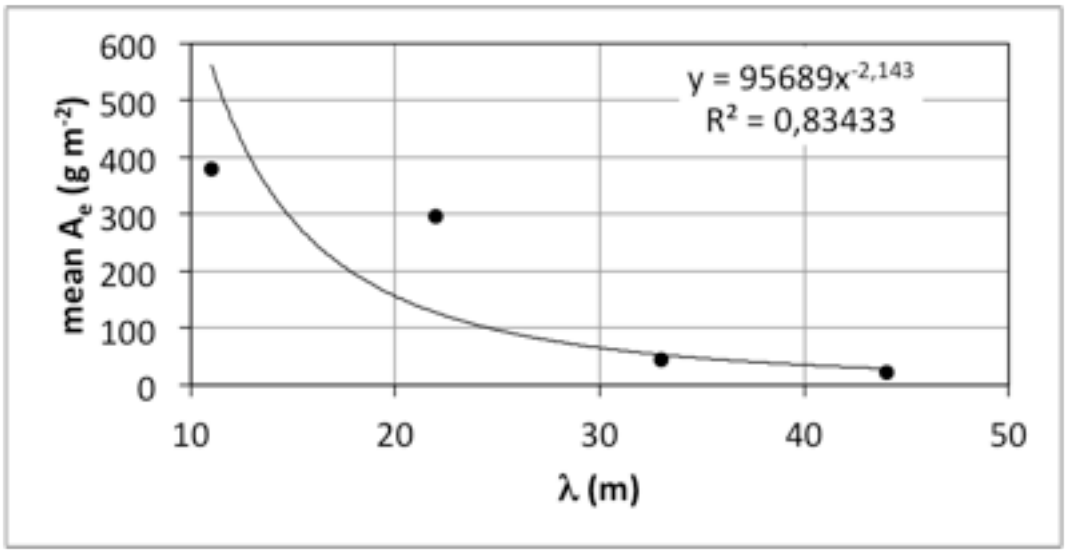
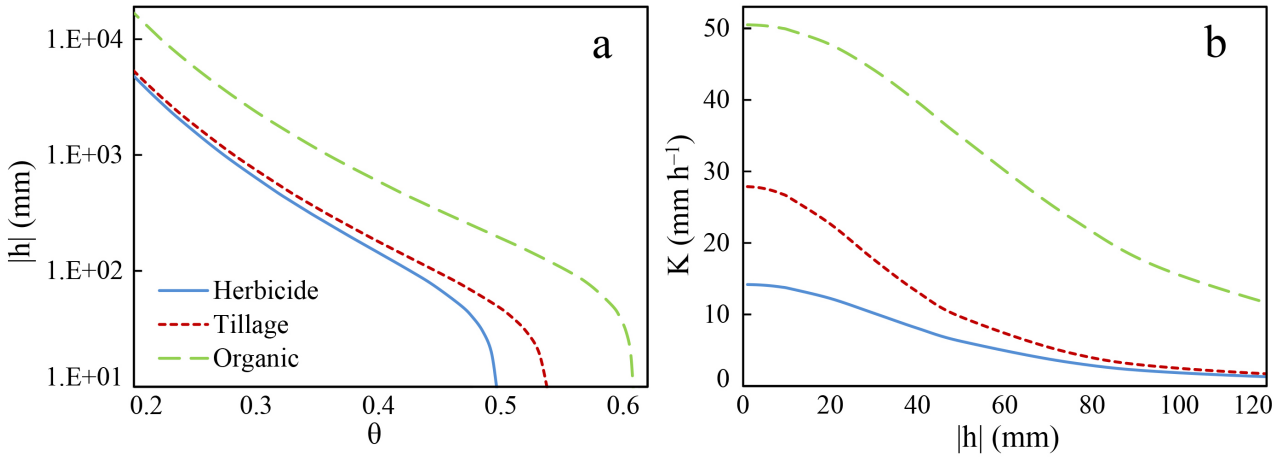


Figure 3. The effect of scale on soil erosion in Sparacia plots



The research at different scales found that Sparacia plots also are affected by the reduction in soil erosion rates when the Length of the plot increase (Figure 3). The transmission losses of runoff is due to the infiltration of the runoff and this is why we developed measurements to understand how land management can control the soil losses such as figure 4 show that organic farming can dis-connect the flow of water and sediments.

Figure 4. **(a)** Water retention curves and **(b)** hydraulic conductivities functions for the three land managements.



- **Future collaboration with the host institution (if applicable);**

The results achieved in this STMs developed the need to research the effect of transmission losses of runoff. Moreover we need to pay attention to the fact that are the high magnitude – low intensity rainfall events the ones that control the soil erosion process. This is why we propose a research based on rainfall simulation experiments in the field under different plot sizes to determine the effect of the scale on high intensity rainfall events (return period of 50 years) under different management.

- **Foreseen publications/articles resulting from the RSTSM (if applicable);**

After the 45 days of collaborative research in Palermo University we have two manuscripts under discussion to be submitted to Soil and Tillage Research and to Land Degradation and Development (special issue on connectivity).

- **Confirmation by the host institution of the successful execution of the RSTSM;**

See attached certificate by Vincezo Bagarello

- **Other comments (if any).**

The close collaboration of the two teams involved in this STMs will keep for some years as the field work developed for a decade will supply relevant information to better understand the sediment and water flow along the agriculture plots.

See attached the two papers we are working with.

Literature

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