From natural land to irrigated crops: impact of land use change and crop diversification on interrill erosion

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Soil erosion is one of the most important processes of **soil degradation.** Especially vulnerable to soil erosion are many **agricultural systems of SE Spain** which are being **transformed** from a **rainfed to irrigated** agriculture. We hypothesized that **crop diversification** can be an excellent measure to **reduce soil erosion** and to **generate multiple benefits** for ecosistems.

We assessed, during **14** months, **interrill soil erosion rates** and **processes** along an intensification gradient including three land uses **(natural shrubland, rainfed crops and irrigated crops)**, in **a semiarid area of SE Spain (Murcia Region).** Moreover, in rainfed and irrigated areas, **different crop diversifications** were applied to **evaluate their effects on interrill or sheet erosion**.

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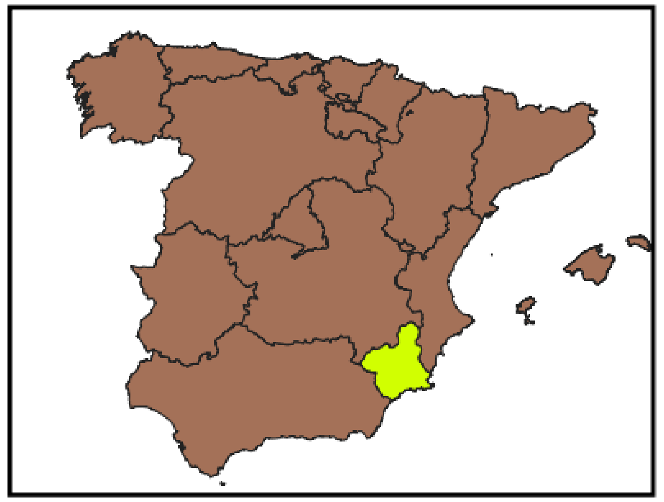
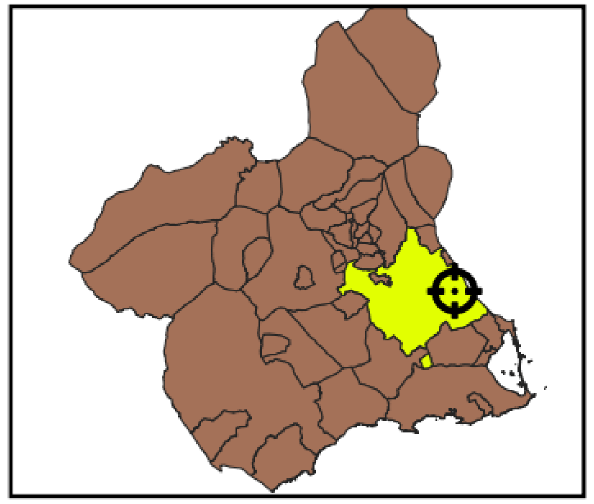
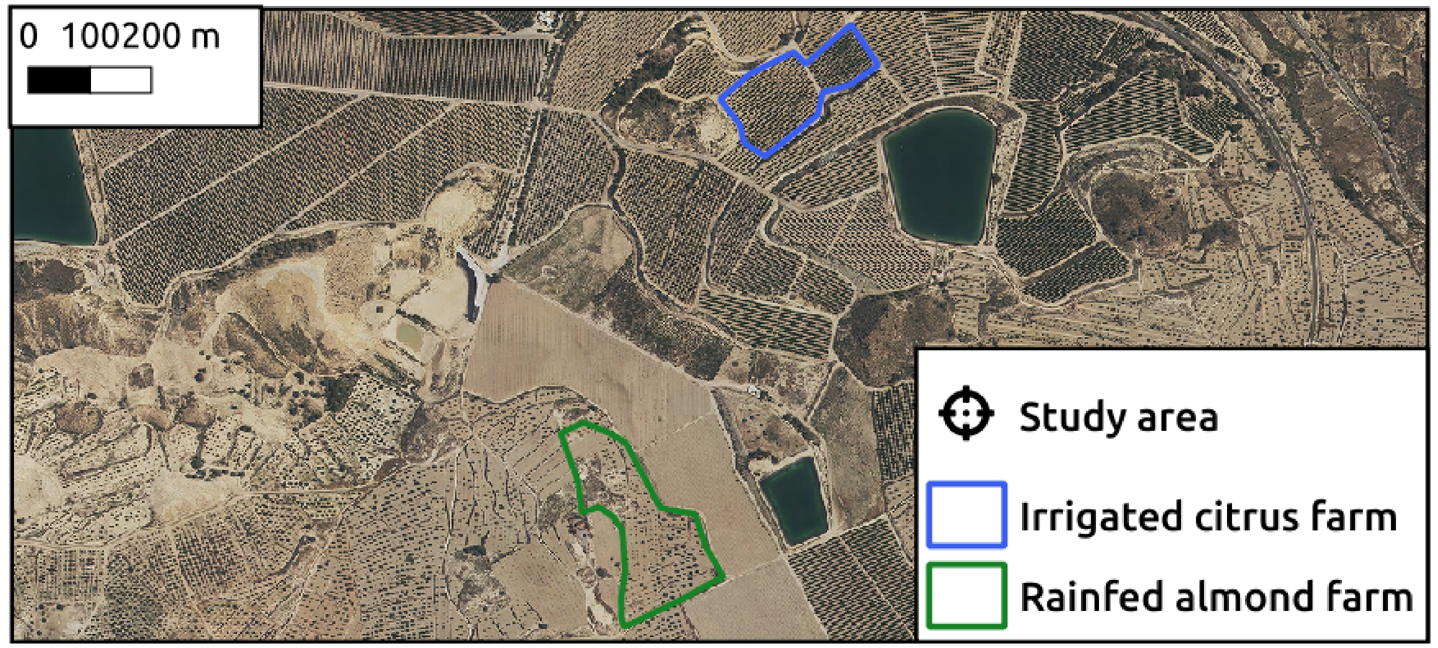
Spain



Murcia Region





Study area

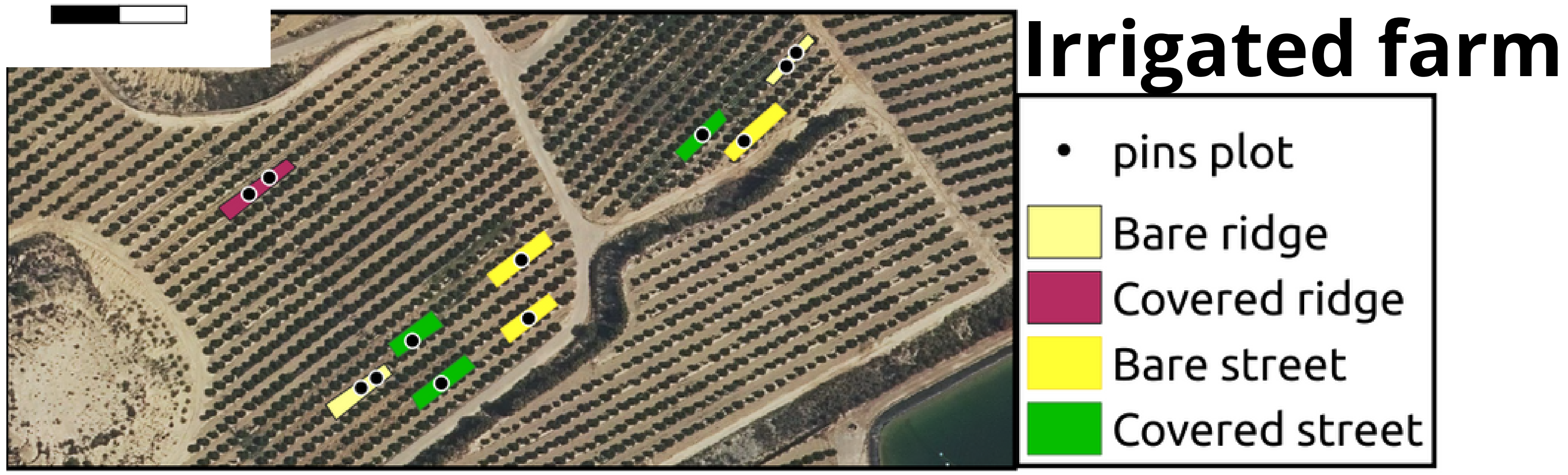
Study area is located in **two farms** near to each other and with the **same characteristics** (lithology, soils, climate, same past land use). One of them is a **rainfed almond crop** (*Prunus dulcis* Mill.) in terraces. The **natural shrubland** in rainfed farm was also included for this study. The other one is a **irrigated citrus crop** (*Citrus reticulata* Blanco) with street-ridge morphology (see pictures below).

Experimental design

The experimental design (see experimental set up in the picture to the right) included **two diversification schemes.** In the **rainfed almond area**: intercropping with **caper** (*Capparis spinosa)* and with **thyme** *(Thymus hyemalis*). While in the **citrus irrigated area** a rotation with **barley** (*Hordeum vulgare*) and **vetch** (*Vicia sativa*) (from February to July) or **faba bean** (*Vicia faba*) (from October to January) were intercropped in the **streets**. Some **ridges** were kept **bare** and another covered with **natural vegetation**.

To **measure erosion, pins plots** of 1 m2**, with 9 erosion pins each, were set up.** In the **rainfed farm 23 pins plots (207 pins)** and in the **irrigated area 12 pins plots (108 pins)** were set up (see the picture above right). Pins were measured after **each erosion event** and/or **each month**, identifying **detachment** (positive values) and **sedimentation** (negative values), **by comparing posterior** and **initial height** of each pin.

Pin plot **(click on image to see better**)



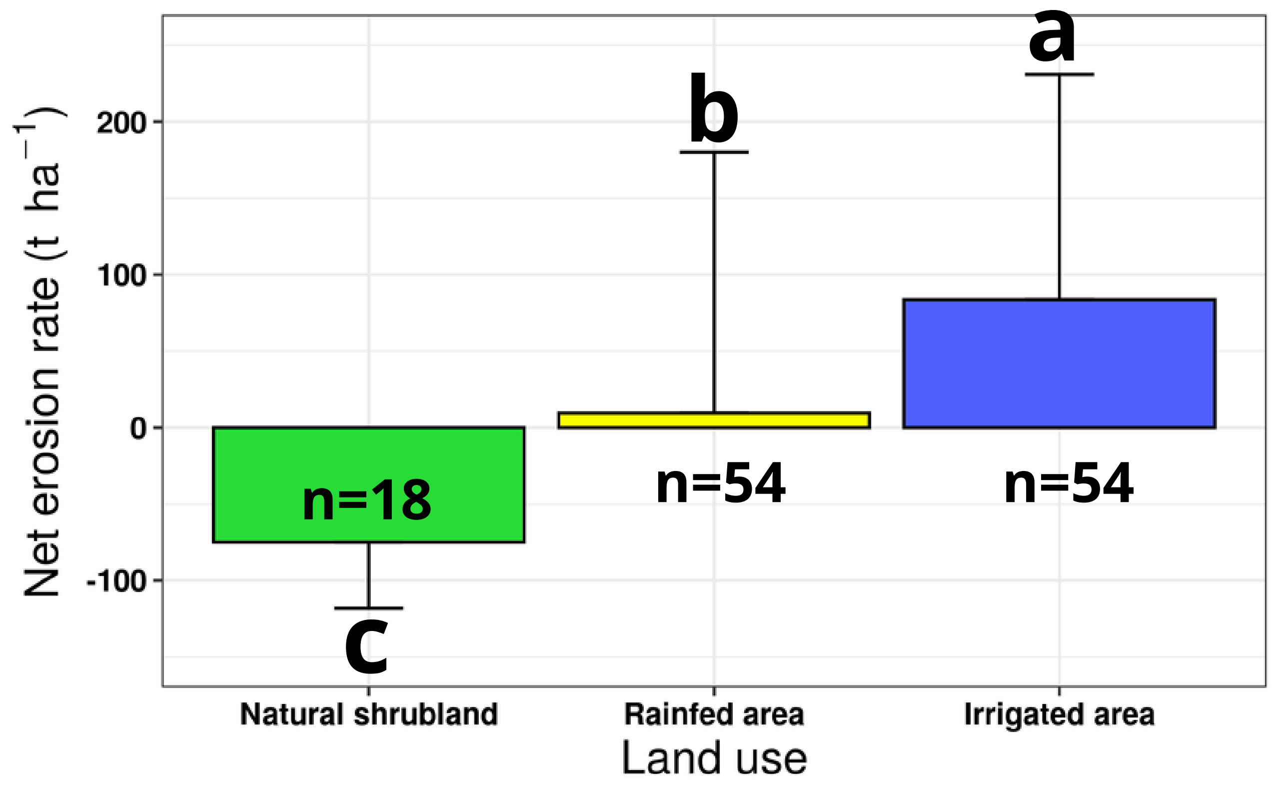
Rainfed farm

Irrigated farm

LAND USE, RAINFED INTERCROPPING AND NET EROSION RATE

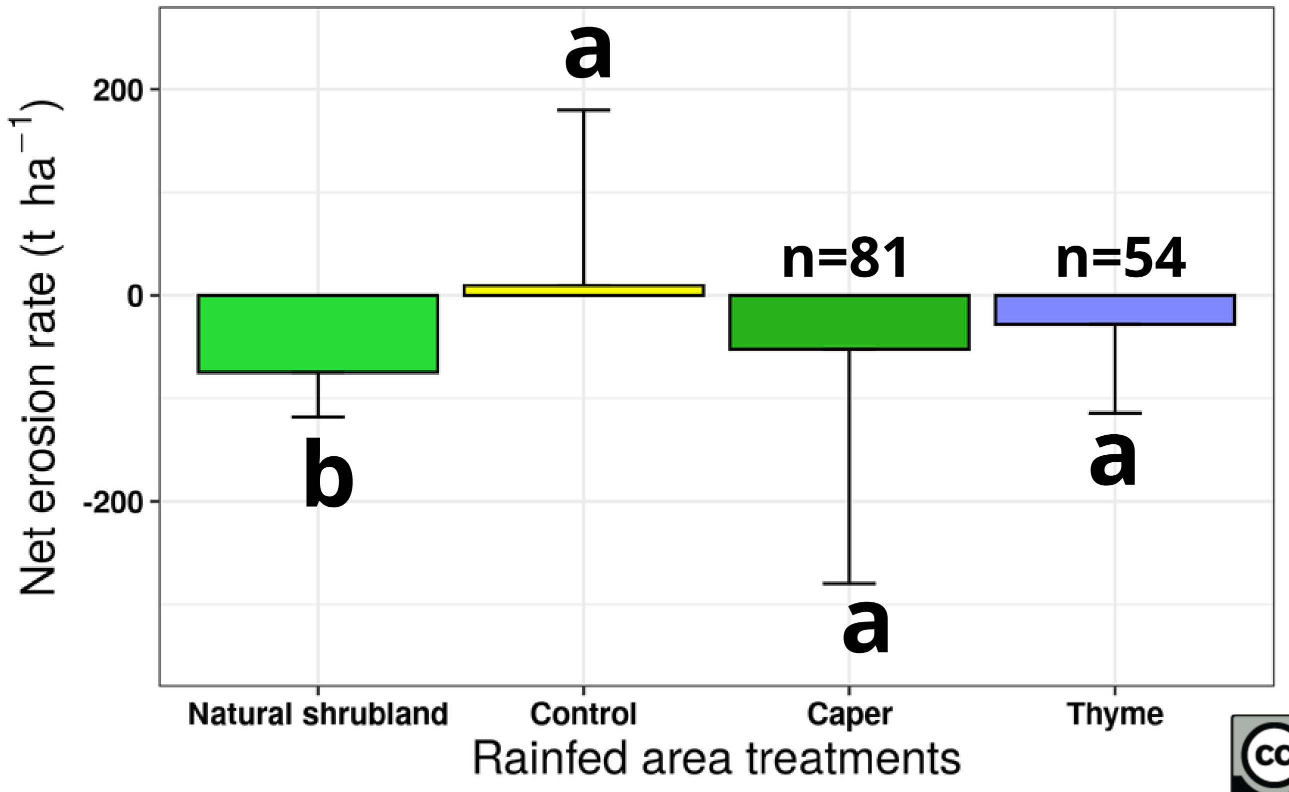
The **shrubland area** acts as a **sediment sink**, due to this we found **negative net erosion rates** (-74,97 ± 43,08 t ha-1). Those were **statistically different from** the net erosion rates in the **rainfed almond** (9,59 ± 170,34 t ha-1) where **erosion processes** were **dominant** (see right graph).

Land use conversion from rainfed to irrigated area **increased significantly net erosion rates (83,6 ± 147,4 t ha-1)** (see right graph).

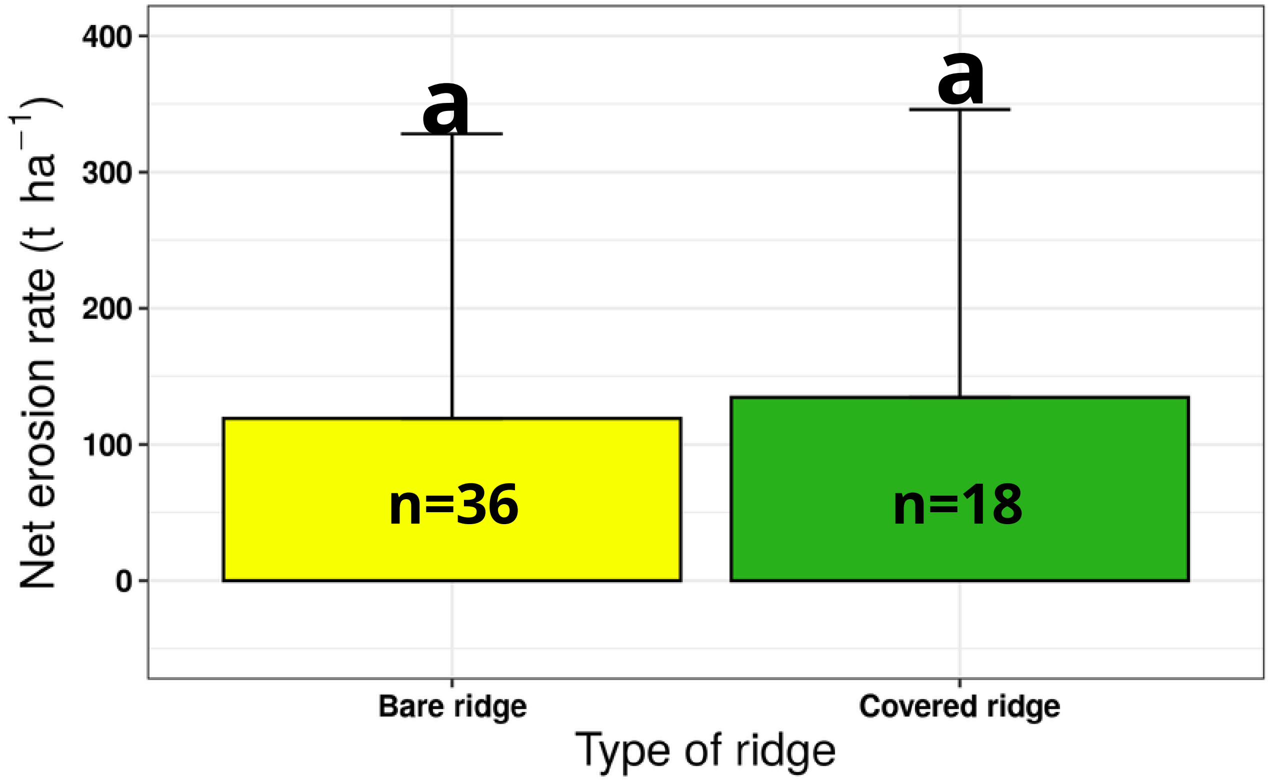


Natural shrubland showed **lower net erosion rate** than the other treatments (**Control, Caper (-52,56 ± 227,09 t ha-1) and Thyme (-28,29 ± 85,94 t ha-1) (see right graph).**

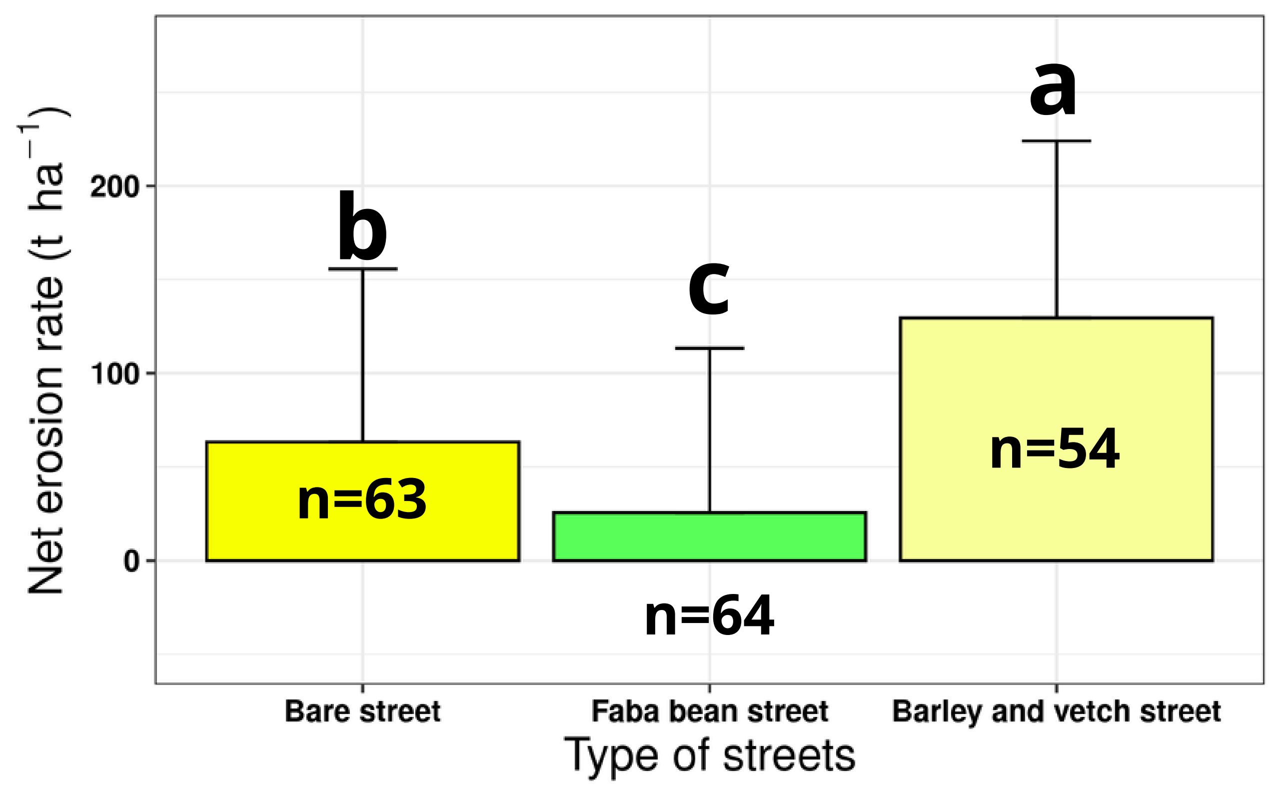
Control, Caper and **Thyme** intercropping, **were not** statistically **different,** but both intercroppings **showed similar negative mean net erosion rates values, which means sedimentation,** in contrast with **Control** (with a mean **positive** value) **(see right graph).**



IRRIGATED INTERCROPPING AND NET EROSION RATE



So far, in the **irrigated area** with a street-ridge morphology **no statistical differences** between net erosion rates of **bare** and **covered ridges** were observed (**119,04 ± 209,05 t ha-1 vs 134,47 ± 211,47 t ha-1, respectively**) (see left graph).



On the street areas, **bare streets** showed **higher** net erosion rates **(63,32 ± 92,35 t ha-1)** than streets with **faba bean (25,61 ± 87,77 t ha-1), but lower erosion rates** than streets with **barley** and **vetch (129,58 ± 94,43t ha-1)** (see left graph).

There was a **clear difference** between net erosion rate of **faba bean streets** and **barley and vetch** streets. In fact, mean net erosion rate **in the latter** was almost **six times higher. More rotation cycles of faba bean and barley and vetch** are needed to have a **better data representation.**

CONCLUSIONS

1. **Natural shrubland** and **traditional terraced rainfed** crop systems are **effective** systems for **soil conservation.**

2. The **conversion** from **rainfed to irrigated crops** meant a **significant increase of erosion rates** due to the fact that **the latter** does **not facilitate retention** of detached soils.

3. **Intercropping of Caper and Thyme** between rainfed almonds **induced sedimentation processes** while in **control areas (no intercropping) erosion processes** were **dominant.**

4. At the irrigated area, maintenance of **vegetation cover on ridges** has **no yet effect** over **net erosion rate.**

5. At the irrigated area, **streets** with **faba bean** showed **lower net erosion rate**, while **the higher one** was observed at the **barley** and **vetch streets**.

6. A **longer experimentation period** is needed to **determine better** the **effect of crop diversifications** on **soil erosion**

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