A global initiative to combat desertification

A publication from the DESIRE project - funded by the European Union's 6th Framework Program 'Global Change and Ecosystems'

2011 - 5

Newsletter 6

More about the work of PhD students in the DESIRE Project

DESIRE students demonstrate new research results and ideas

Ph.D students share their research experiences at a DESIRE conference held at ITC

A plenary meeting for all DESIRE researchers: Cape Verde in 2007

Postgraduate students are responsible for testing hypotheses that further our understanding, and help us to suggest new measures to combat desertification. In May 2010 there was a special conference held at ITC-University of Twente in the Netherlands, where students could demonstrate their work and receive some training on research techniques. This Newsletter (6) follows Newsletter 5 and provides some more examples of the research questions that are being answered by postgraduates, about: erosion and rainfall in Cape Verde; tracing soil particle movement; semi-automatic gully detection using high resolution images: modeling wind erosion; improving rainwater-use efficiency through innovative land management technologies in Ribeira Seca, Cape Verde; erosion and sediment on the loess plateau, China.

Each page is from a DESIRE PhD student:

Juan F. Sanchez-Moreno (ITC); Mila I. Luleva (ITC); B.V. Shruthi (ITC); Feras Youssef (WUR, ICARDA, U. Ankara; Isaurinda Baptista (INIDA, WUR); Gao Peng (ISWC, CAS, MWR)

Edited by Nichola Geeson, February 2011

For more information and contact details see:

• The DESIRE Harmonised Information System: www.desire-his.eu and DESIRE website: www.desire-project.eu

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Website: www.desire-project.eu
Contact DESIRE coordinator: Coen.Ritsema@wur.nl
Contact DESIRE Communications: ngproject3@googlemail.com
Contact EU Scientific Officer: Marie.Yeroyanni@ec.europa.eu

ALTERRA WAGENINGEN UR

A global initiative to combat desertification

SIXTH FRAMEWORK PROGRAMME

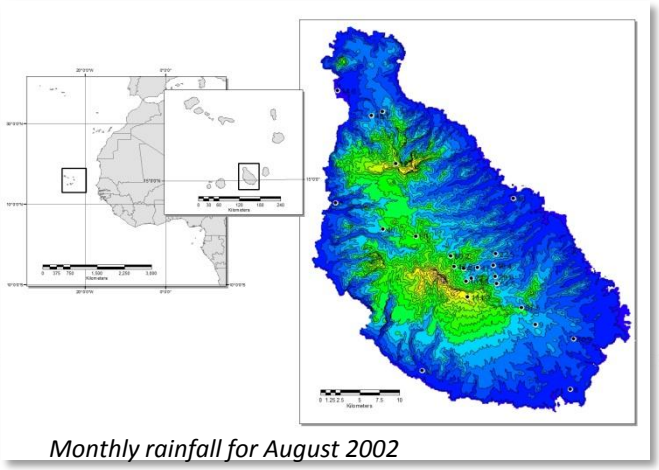
Erosion and rainfall in Santiago, Cape Verde

by Juan F. Sanchez-Moreno

Faculty of Geo-information Science and Earth Observation U.Twente

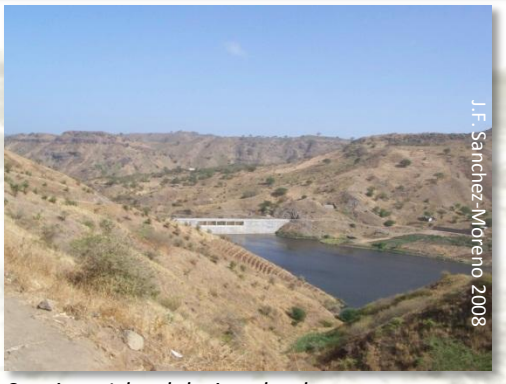
Rainfall and relief

Cape Verde, off the west coast of Africa, is subject to strong and irregular rainfalls that produce flash floods and erosion. Santiago island, the biggest of the archipelago, has a steep relief that influences the rainfall occurrence. The landscape of the island changes from desert to blooming after the rain. Research in the relationship between different topographic parameters and their effect on rainfall variability in the island showed that the most intense events are less affected by elevation.

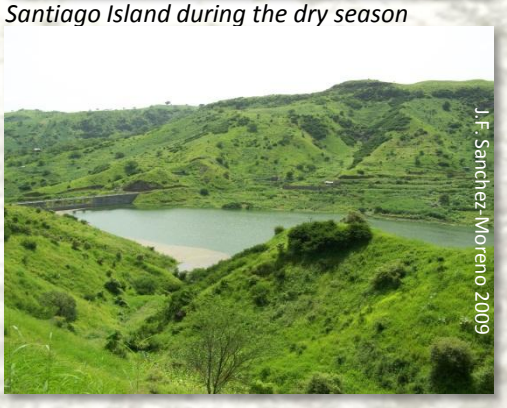


Monthly rainfall for August 2002

Rainfall in Ribeira Seca catchment, Santiago Island



Santiago Island during the dry season



Santiago Island during the rainy season

Optical disdrometer for measurement of raindrops

Describing erosivity

Erosivity, - the ability of rainfall to detach soil particles, is usually described in terms of the kinetic energy of rain (KED) and its relationship with rainfall intensity (I). Diverse relationships between kinetic energy and intensity KED-I are possible but are site dependent. In the Instituto Nacional de Investigação e Desenvolvimento Agrário INIDA, an optical disdrometer has been installed to measure drop sizes distribution and to create a KED-I relationship to describe erosivity in Cape Verde.

For further information email sanchez@itc.nl

Tracing soil particle movement by Mila I. Luleva

ITC, University of Twente, The Netherlands.

Using potassium to trace soil particles

Soil condition and fertility are strongly influenced by displacement of soil particles due to land degradation. The Cesium 137 (^{137}Cs) isotope technique is most commonly used for soil particle tracing. However when large areas are considered, the expensive soil sampling and analysis present a limitation. Infrared spectral measurements would provide a solution, however the small concentrations of the isotope do not influence the spectral signal sufficiently. Potassium (K) has similar electrical, chemical and physical properties to Cs. It is applied to agricultural fields annually in the form of fertilizers.

ASD Spectrometer measurements, South Limburg

Guadalentín basin, Murcia, Spain

The main aim of the current study is to test whether this element (K) can be used as a possible replacement for the radioactive isotope in terms of soil particle tracing.

Slope measurements, South Limburg

Experiments and measurements

Data collection took place in Murcia Spain and Limburg, the Netherlands. Various field-based flow experiments were set up and infrared spectral measurements were collected. These were followed by soil texture analysis and chemical tests as well as various spectral sensitivity analyses, carried out under laboratory conditions. Soil erosion and sediment deposition were related to the amount of applied fertilizer. Spectral absorption feature parameters were also

Flow experiment, South Limburg

A new tool to determine soil erosion

The method is considered suitable for soils with sandy and sandy silt texture, which are associated with soil erosion. The results indicate that the technique could present a fast and cost-effective method for tracing particle movement caused by soil erosion. It as a new approach to soil particle tracing using an environmentally friendly element that can be detected with infrared spectroscopy.

For further information email: lule14713@itc.nl

Semi-automatic gully detection using high resolution images

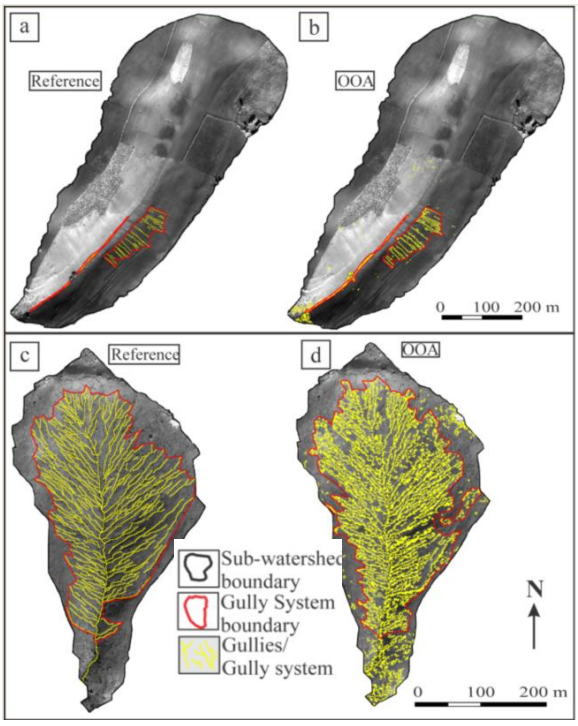
by B. V. Shruthi

A new method to map gullies

Gullies are one of the main drivers for soil loss and there is an imperative need for detailed monitoring and better prediction of the gully locations. This study focuses on rill/ephemeral gully and permanent gully erosion (gully features are much narrower - width less than 10m). This study attempts to: Develop a generic method for semi-automatic gully detection using object based image analysis (OOA).

Gully erosion feature extraction using the OOA method follows the steps as in the diagram below: a) removing segments as background class (area perpendicular to flow direction, flat to gentle slope, vegetation, settlements), b) contrast filter on PAN data for the subset (red rectangle) c) identifying potential gully candidates, d) Sigma-Lee edge filter on the PAN image, e) gully/ gully system identified from potential candidates and f) gully/ gully system separated from false positives.

Diversity in gully forms in the Sehoul, Morocco



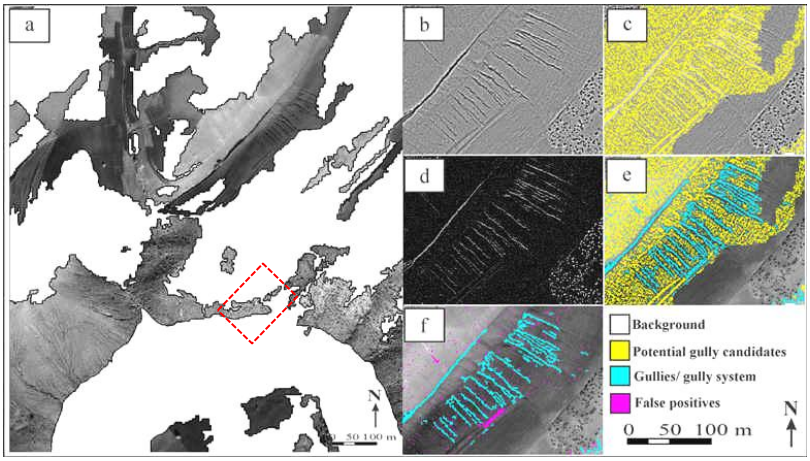
Results from OOA method

In the test image an area of about 81,000 m^2 is affected by gully system, that is approximately 8% of the total area. The total area affected by gullying in a validation area was estimated at approximately 150,000 m^2, that is about 18% of the total area of about 0.84 km^2. Nevertheless, when assessing the accuracy of detected gully systems it must be remembered that even a relatively low erosion level (8% and 18%), renders the land around the gullies useless for any other land use activity, effectively turning them into badlands.

Highlights of OOA:

Finer gully-related edges within the complex gully systems were better identified semi-automatically than was possible by manual digitization. OOA could be used to map gullies semi-automatically. The method :

- ❑is robust and knowledge driven.
- ❑is generic, with successful transferability.
- ❑shows an advancement from the existing methods to detect gully erosion.



Steps to extract gully features

For further information email shruthi@itc.nl

Modeling wind erosion
by Feras Youssef

Predicting erosion by wind

There is currently no validated wind erosion model that predicts the windblown mass transport on a regional scale. Therefore the prediction of wind erosion at a regional scale is an essential tool for land policy makers for future land use planning, in order to minimise the wind erosion hazard. Vegetation has the potential to decrease soil loss by wind erosion through protection of the soil surface, through reduction of the wind speed and through trapping of moving or saltating particles.

Dust devil in the study area of Khanasser Valley

Testing a new sediment catcher (BEST)

Developing and validating models

Developing regional models based on validated field scale models leads to a more reliable output for the derivative models. Here we have developed a regional scale wind erosion model through the establishment of relations between the intensity of windblown mass transport and vegetation cover and distribution in a patchy landscape in Syria. In this research the RWEQ wind erosion model was calibrated and validated to be used later as a base for developing the regional scale wind erosion model. The effects on the surrounding area of the measurement plots were determined. Finally, relations between vegetation cover and distribution, and the total mass transport were derived.

Establishing the climate station

Visiting farmers in the region, asking them to guard research equipment

The study site

The Khanasser valley is 70km south-east of Aleppo, Syria. The annual rainfall is 150 to 250 mm. During the summer the wind comes from south /west and the daily average wind speed can exceed 10 ms^{-1}.

For further information email feras.youssef@wur.nl

Improving rainwater-use efficiency through innovative land management technologies in Ribeira Seca, Cape Verde

By Isaurinda Baptista

Coping with low, irregular rainfall

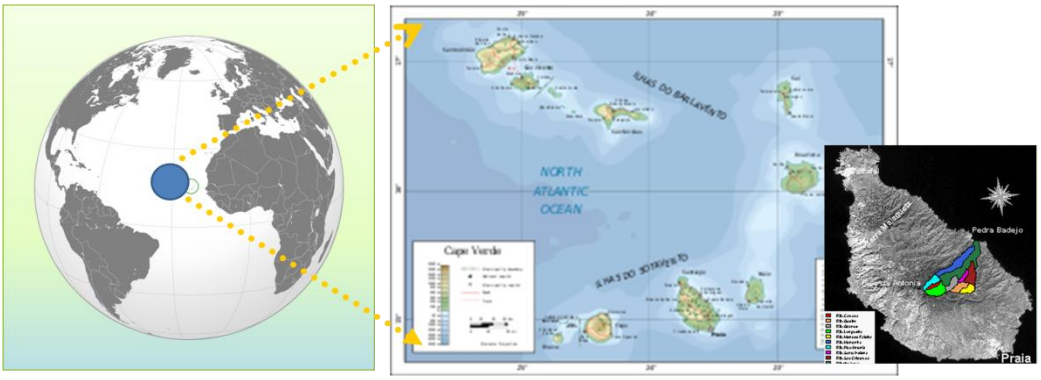
Food production in dryland environments, such as Cape Verde, is severely hindered by low and irregular rainfall, recurrent drought, high intensity storm events, water losses through rapid runoff and high soil evaporation rates, resulting in poor rainwater-use efficiency. Despite past investments in soil and water conservation techniques in Cape Verde, rainfed crop yields remain low. The low input farming system, dominated by continuous maize and beans intercropping, faces severe climate conditions, inadequate crop and land management practices, and increasing land degradation.

Aims of the research

This project aims to investigate land management technologies for Cape Verdean dryland conditions to increase rainwater-use efficiency and crop yield, combining traditional and scientific knowledge in a field-based participatory approach. Plot scale experiments will be installed to test the effects of integrated techniques on crop yield, soil nutrients and water balance. Field trials will be designed and executed in close collaboration with farmers and the results evaluated using biophysical and economical indicators.

Developing the FAO Aqua Crop model

The FAO AquaCrop model will be used to simulate maize and beans crop water productivity under the different management options as a decision support tool for food security. Main focus will be on affordable techniques which result in significant positive effects on crop yields caused by improved water and nutrients uptake rates, increasing soil water holding capacities, increasing nutrient content and/or minimizing soil evaporation rates. This work will directly contribute to achieving the Millennium Development Goals of reducing poverty, protecting the natural environment, and enhancing livelihood conditions in fragile dryland environments.



Geographic location of Ribeira Seca research site

Scientific/societal relevance

✓Integrated tecniques to increase Rain Water-use efficiency and crop yield
✓ Sustainable land management options
✓ Food security
✓ Millenium Development Goals

Specific objectives

✓Establish biophysical and socio-economical baseline data
✓ Investigate alternative land management techniques with potential to increase RWUE and crop yield and select promising options with local stakeholders
✓ Test the selected options in field in collaboration with farmers and evaluate their efficacy using indicators
✓ Simulate maize and beans yield response under different management practices with AquaCrop modelS

Terraces of rainfed maize and beans

For further details email Isaurinda.Baptista@inida.gov.cv

Erosion and sediment on the Loess Plateau, China

by Gao Peng

Institute of Soil and Water Conservation, CAS and MWR

Soil erosion in the Yan river basin

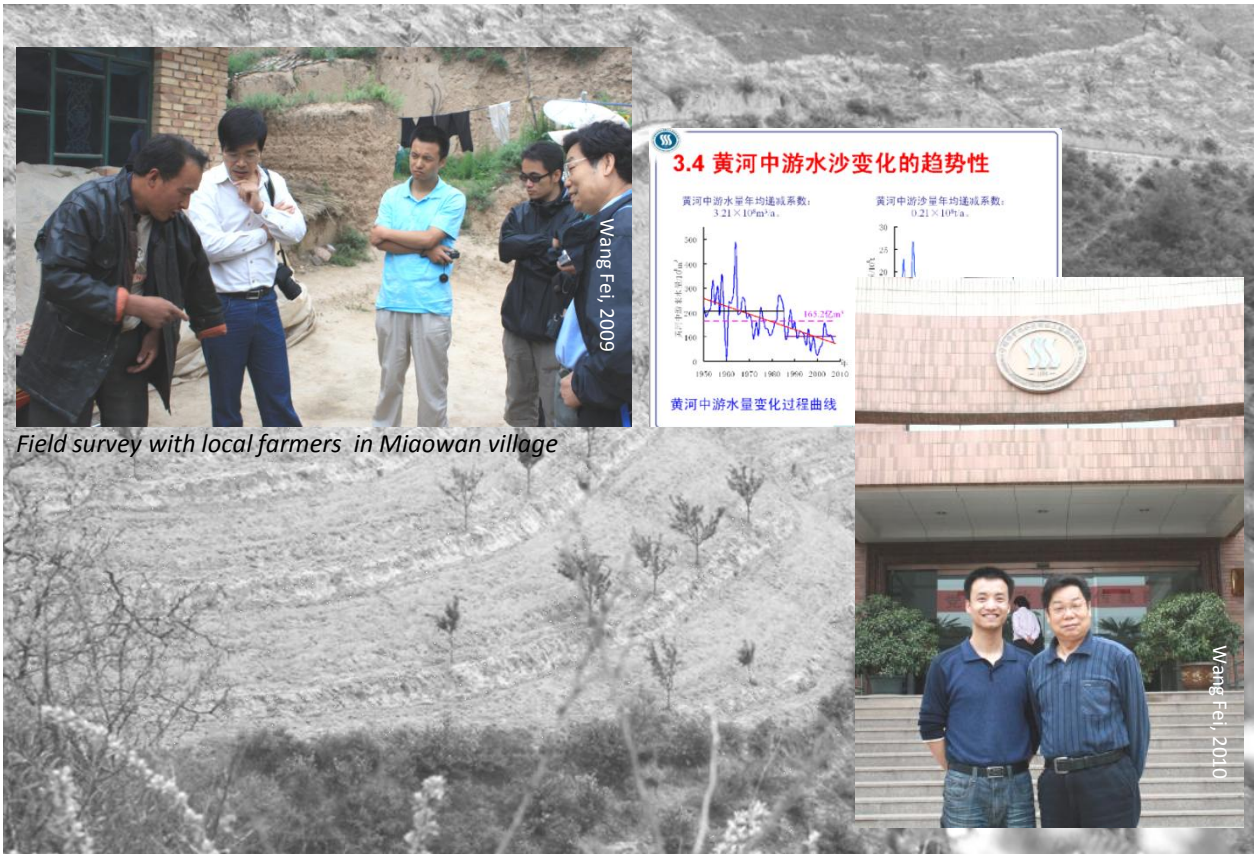
The Loess plateau is cut by the Yellow River and its tributaries, and the characteristics of erosion of soil by water, and the re-deposition of eroded sediment are important factors for the local community. The conservation of water and sediment has been promoted, and measures to do that have been implemented. It was found that these measures do decrease runoff and soil loss locally, which is beneficial, but it was also found that there has been a decrease of discharge in the Yellow River itself. Knowledge of soil erosion processes is an important basis for evaluation of ecological planning and ecosystem restoration across the Loess Plateau.

Climate change and human activities

Climate change (reduced precipitation) and human activities, (such as agriculture), are the two most important factors to be considered for reducing soil erosion and its on-site and off-site impacts. The contributions of soil and water conservation (SWC) measures were welcomed when extreme water shortages and even dry river beds began to be experienced in the downstream parts of the Yellow River. An additional problem is that this lack of water results in deposition of the sediment that was carried by the water, resulting in a rise of the river bed compared to the surrounding lands. Local results show that strongly decreasing trends in annual stream flow are 30% due to reduced precipitation and 70% due to human activities. In the same way, reduction in the rate of sediment discharge was 20% due to reduced precipitation and 80% due to human activities.

Mitigating flood risk

It was also found that 9.2% of the reduction in discharge, and 42.2% of the reduction in sediment yield, was caused by the application of SWC. The remainder of the reduction caused by human activities is mainly due to abstraction of river water for irrigation and industry. In the middle reaches of the Yellow River catchment new SWC measures that could further reduce soil erosion, and therefore also reduce sediment yield, would be helpful. This would mitigate the sedimentation problem greatly, and would therefore reduce flooding risk.



Field survey with local farmers in Miaowan village

Gao Peng and Prof. Li Rui after defence of Doctoral Thesis (May 2010)

For further information email wafe@ms.iswc.ac.cn