"Soil Erosion and Geomorphic Features of Land Degradation"

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Ancient Maya Impacts on Soils and Soil Erosion

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Summary

Many studies across the Maya Lowlands have found evidence for sedimentation and soil erosion during the ancient Maya period from 1000 B.C. to the Maya Collapse of the Ninth Century A.D. Herein we synthesize a decade of our own research on the timing of soil erosion and the major paleosols across the Maya Lowlands in Guatemala, Belize, and Mexico and synthesize findings from other major studies. The methods used at these sites include stratigraphic analysis of over 100 trenches in upland and depression sites, cores of lake and wetland sediments, and a suite of sediment analyses ranging across radiocarbon dating, texture analyses, magnetic susceptibility, carbon isotopes, elemental analyses, and ceramic identification. The main foci of these tests are to date when sedimentation and soil erosion occurred, identify stable surfaces, and correlate them with what we know about past land use. These findings indicate three general epochs of accelerated soil erosion and two major paleosols. In the Northern Peten, Guatemala and adjacent southern Yucatan and Belize, soil erosion came in two waves: the Preclassic period (1200 B.C. to A.D. 250), and again in the Late Classic. The major paleosol ('Ekluum') in these sites is a well-developed Mollisol that started forming in the Early Holocene and was buried in either the Preclassic or Classic (A.D. 250-830). In some sites the Ekluum paleosol lies beneath sediments with a fainter paleosol, which are in turn buried by Classic and later sediments. This picture shows higher than expected soil erosion linked to the region's first pioneer farmers in the Preclassic and less than expected soil

erosion in the Late Classic when population and land use were highest. However, at some regions like Cancuen, Guatemala most soil erosion occurred during the Maya Late Classic (A.D. 550-830). Erosion here was high but short-lived: depressions record 1-3 m of aggradation in two centuries. The third epoch of accelerated soil loss and aggradation arose with the rapid land use changes brought by new pioneers of the last several decades.

Keywords

Soil Erosion, Paleosols, Maya Lowlands, Ancient Maya Impacts

Badlands in Southern Basilicata.
Examples of Land Degradation and Remodelling

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Summary

In Basilicata (Southern Italy) Plio – Pleistocene sediments are widespread; they are sands and clays little or no consolidated. Due to both intrinsic properties and to intense deforestation which was carried out during various historical period, there sediments are affected by rapid erosion on morphologically susceptible slopes.

Consequently badland landforms are created, which are known in Italy as calanchi and biancane, Agriculture mechanization, after the II World War, has brought to reclaim some of the areas through the remodelling, which creates longer slopes at lower angles. The seasonal cultivation of durum wheat and cereals, together with the frequent abandonment of some of these areas, has deeply increased the erosion effectiveness of natural processes over these lands, thus causing marginality conditions. Rills, gullies, debris flows, mudflows, soil creep and occasionally small land-slides are the main features of what was once a remodelled area.

The analysis of aerial photos at different times in the last 50 years (1954, 1989, 2002) together with the field survey allow a map to be drawn, showing the progress in environmental degradation in the sample areas of the badlands in Southern Basilicata.

Keywords

Badlands, Basilicata, Southern Italy, Remodelling, Degradation

Soil Erosion and Runoff of an Acrisol Under Four Agronomic Treatments in Mexico

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Summary

The REVOLSO Project (Alternative Agriculture for a Sustainable Rehabilitation of Deteriorated Volcanic Soils in Mexico and Chile, 2002-2006. European Union INCO/DEV Project #ICA4-CT-2001-10052) aims at finding technological solutions, adapted to socio-economic local conditions, to rehabilitate unproductive and erodible deteriorated volcanic soils in a sustainable way (Internet: http://www.ird.teledetection.fr/revolso).

This work presents the main results of one year of runoff and soil erosion measurements on an Acrisol in Morelia district, Michoacán State, Mexico.

Four treatments are tested on 1000 m^2 plots: (1) C-Conventional: faba beans as a monoculture, with low agronomic inputs; (2) CI-Conventional improved: faba beans + Vicia sativa, with high inputs; (3) O-Organic: faba beans as a monoculture, applying 15 t ha^{-1} of cow manure, and (4) F-Fallow system, which had the native vegetation with free grazing animals.

Rainfall parameters, soil moisture and bulk density, infiltration, soil rugosity, plant cover, and crop developmental sequence are measured as well as soil, sediments and water parameters as pH, EC, CEC, N, P, K. Every plots are equipped with an H-flume and a water level recorder. The affluent is conducted to a rotating tank of 2000 l seated on two electronic weight cells. When it is full, 2% of the excess of water is collected in another reservoir. Water and sediments samples are analyzed.
The rainy season started late at the end of June and finished in November. The annual rainfall was about 1320 mm, 32% more than the mean value; 128 days present rainfalls but only 22 generated runoff. 15 rainfalls had more than 30 mm; 10 rainfalls had an intensity between 10 to 20 mm*h^{-1}, four had between 20 to 50 mm*h^{-1} and the strongest had 62, 83, 91 and 141 mm*h^{-1}.
Annual erosion rates ranged from 1 to 14 t*ha^{-1}. The F treatment produced the lowest erosion rate but the highest runoff rate. The O treatment got the highest erosion, followed by the CI (13 t*ha^{-1}) and the C (11 t*ha^{-1}).

Keywords

Soil Erosion, Faba Bean, Fallow, Acrisol, Mexico

Effect of Land Use Change on Soil Quality and Soil Erosion in a Tropical Deciduous Ecosystem (Chamela, Mexico)

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Summary

In the last 50 years, the tropical deciduous forest in Mexico has been severely transformed into pasture. This conversion leads water soil erosion as a main degradation process. Soil aggregates and their stability have an influence on physical properties, resistance to erosion and the soil's ability to transmit liquids, solutes, gases and heat, which have a strong influence on geomorphic and hydrologic processes. Thus, aggregate stability can provide key information about soil function capacity, which defines soil quality and soil erosion.

The objective of this study was to determine the pasture conversion effect on soil quality and the landscape response, in terms of soil erosion. The study was done in Chamela watershed located along the Pacific coast of Mexico characterized by low hills with steep slopes (18-23°) over granite on undisturbed forest soil, old pasture soil and burned pasture soil. Sampling consisted in three replicates of 0-5 cm of rhizosphere soil and non-rhizosphere bare soil. Samples were characterized by texture, bulk density, soil water content, organic carbon, water stable aggregates, root weight and volume, and extrametrical mycelium of AM fungi. Besides, we determine qualitative rain-splash and runoff erosion signs.

The pasture system shows intense qualitative field erosion (soil mounds to depths of 5-12 cm and surface crusting) signs and a decrement in aggregate stability. Pasture soils have the highest root volume but the lowest soil C, humidity and aggregate stability than forest soils. Results showed that the pasture conversion clearly affect soil quality diminishing soil buffer ability against erosion processes.

Keywords

Soil Quality, Soil Erosion, Land Use Change, Mexico

Improvement and Degradation: Floodplain Changes and Agriculture

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Summary

Floodplains are geomorphically unstable environments, but in terms of agriculture they can be highly productive. Farmers in arid lands have been attracted to floodplains since antiquity because of their fertility and because of the availability of water. In order to be productive, however, floodplains have to be modified considerably. This paper first articulates the environmental changes necessary to convert floodplains to fields. It then outlines some of unanticipated negative consequences of these changes. It ends with some sobering thoughts about the nature of these environments and their agricultural sustainability. Examples are provided principally from southern Arizona, USA.

Keywords

Floodplains, Arid Lands, Agriculture

Erodibility of Andisols.
Is the K Factor Estimation Suitable for Volcanic Ash Soils?

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Summary

Most Andisols show a strong resistance to water erosion. This low erodibility is related to their specific physical properties like high porosity and high aggregate stability. The objective of this study was to determine the soil erodibility factor K in Andisols, and to examine its relationships with aggregate stability and particle-size distribution. Results will help to establish if K estimation, which includes variables poorly correlated with properties that greatly improve the resistance to erosion, is a suitable procedure for predicting erosion risk.

Soil samples were collected from topsoil and subsurface horizons of eight Humic Udivitrands on the north sub-humid slope of the Cofre de Perote volcano (eastern Mexico) at 3100-m elevation. Organic matter (OM) content was obtained using the Walkley-Black method. Particle size fractions were determined by the pipette method. Wet-aggregate stability (WAS) was determined with the Yoder procedure. K factor was obtained using the Wischmeier et al. (1971) nomograph from known values of percent silt and very fine sand, percent sand, OM content (K_{aprox}), structure grade, and permeability grade (K_{final}).

Results of 14 horizons showed that OM content varied from low to high (2.4-13.7%). Silt and very fine sand ranged from 68-87%, and coarse sand from 2.5-15.5%. WAS changed from 45-87%. K_{aprox} values were medium to high (0.32-0.53) as were K_{final} values (0.28-0.56). Wet-aggregate stability showed a strong positive correlation with % OM ($r = 0.93$) and a negative correlation with % sand ($r = -0.88$), and % silt and very fine sand ($r = -0.78$). Organic surface horizons were more resistant to water erosion than subsurface horizons. In conclusion, K_{aprox} values are significantly correlated with aggregate stability ($r = -0.88$) and therefore provide a suitable erodibility estimation for this type of Andisol.

Keywords

Erodibility, Aggregate Stability, Andisol

Geomorphological Controls on Land Degradation in Southern China

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Summary

According to data from audits of soil erosion status, the severity of land degradation has increased markedly in recent decades across many areas of southern China. But as the classification of erosion status employs topographic variables it is not immediately apparent whether there is a geomorphological expression of land degradation or merely a 'guilt by association' where agriculture exists on, or close to, steeplands. Land capability assessment has a longer tradition, and perhaps a more pertinent value, than detailed analyses of soil erosion processes. However, it is useful to consider the extent to which geomorphology controls the spatial pattern of land degradation. The use of radionuclide tracers (principally ^{137}Cs, but now also ^{210}Pb) enables variations of net soil loss to be estimated. Drawing on field results mainly from the Dongxi Basin, Fujian Province, the paper examines how Quaternary evolution of the landscapes, on which modern agricultural practices are superimposed, leads to spatial variability of degradation risk, from both soil erosion and acidification. The dissection of basin infills (Red Beds) produces hills of limited relief but steep slopes. Several significant differences in soil chemical and physical properties between slope positions and land use types are observed.

Keywords

Land Degradation, Soil Erosion, Soil Acidification, Caesium-137, China

Use of Vegetation to Mitigate Flooding and Erosion in River Channels

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Summary

The effects of flooding disasters are often exacerbated by associated erosion, High sediment loads and sedimentation. Erosion and sedimentation are highly variable along river channels and related to availability of sediment and channel morphology. Sources of sediment and zones of erosion need to be identified and their relations to extent of sediment transport downstream and distance of propagation of effects need to be examined. This requires recognizing and understanding the sediment connectivity in the system. Models of connectivity are presented.

A major way in which erosion can be prevented is by the presence of vegetation cover. Contrasts between vegetated and unvegetated channel reaches are demonstrated. The vegetation can effectively disconnect the coarse sediment transfer by encouraging deposition and preventing sediment supply from the channel. It also tends to reduce flood transmission so attenuating flood peaks through increased roughness. Understanding of these geomorphic processes and relations is being used to investigate how and where vegetation could be encouraged to grow to mitigate flood disasters and to reduce erosion in stream channels of the Mediterranean region. The types of vegetation which grow in the channels are identified and the conditions they require are being measured. The thresholds for survival in relation to hydraulic conditions and to other environmental conditions are being investigated. These requirements for vegetation growth are then being matched with the understanding of the sediment connectivity to identify optimal locations for management through vegetation.

Response and Recovery of the Mississippi River to Land Degradation and Engineering Modifications

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Summary

The Mississippi is the largest river in North America and is frequently considered the most humanly manipulated river system on earth. Analysis of a high-resolution data set documents the morphologic adjustment of the Mississippi River to land degradation and engineering modifications from the late nineteenth century through the twentieth century. Although most of the sediment produced from accelerated soil erosion throughout the Mississippi basin was stored in tributary valleys, the slight increase in sediment yields resulted in substantial channel disturbance to the Lower Mississippi River. Thus, at the scale of a large drainage system a relatively minor increase in headwater sediment flux results in significant channel disturbance within the lower basin. Additionally, although the Mississippi is intensively regulated, the data shows that the river was able to adjust to major human modifications within only a few decades, and has reached a new period of equilibrium manifest by a stable pool - riffle morphology. The results of this study are significant because it defines the maximum extent of channel degradation possible while under human influence, the time-scale for returning to an equilibrium condition, and the range of variability that can be expected under the present regulated regime. After significant perturbations have been introduced into a drainage system, rivers may not return to the same form as the "natural" channel, but they recover and exhibit stability much faster than previously realized.

Keywords

Lower Mississippi River, River Response, Channel Incision and Aggradation

Mapping European and Global Soil Erosion Risk: The PESERA-RDI model

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Summary

The Pan-European Soil Erosion Risk Assessment model (PESERA) offers a methodology to assess regional, continental and global soil erosion risk. The physical basis of the model offers the potential to enhance future land degradation predictions, distinguishing between the effects of land-use and climatic changes. As the components are explicit within the model the sensitivity of changing environments can be explored.

The PESERA-RDI model expands from the concepts of both MEDALUS and MODEM and offers an explicit theoretical response based on a simple and conservative erosion model, making use of land-use, topographic, soil and climatic data. The model estimates ground cover, surface crusting, runoff and sediment transport, to give an estimate of water and sediment delivered to stream channels. The estimates are consistent with finer scale erosion models for flow strips, evaluated at the slope base; and are integrated across the frequency distribution of storm magnitudes. The model is based on a partition of daily Precipitation into Hortonian and Saturation Overland flow, Subsurface flow and Evapo-transpiration. Hortonian overland flow, which is mainly responsible for soil erosion, is generated with respect to local soil and sub-surface moisture characteristics. Allowance is also made for snow accumulation and melting. The emphasis of the PESERA-RDI model is the prediction of hillslope erosion, and the delivery of erosion products to the base of each hillslope. Channel delivery processes and channel routing are explicitly not considered.

Preliminary model results are available, and forecasts are now being calibrated against runoff plot and small catchment data.

Although currently being applied at a 1 km resolution for Europe the model may be applied at other scales: at 50-250m to areas of particular concern and, at coarser resolution (5-10 km) data, globally, although with some inevitable degradation of quality.

Keywords

Risk, Soil Erosion, Land Degradation, PESERA

Discontinuities in Policyclic Paleosols and Landscape Stability of the Nevado De Toluca Volcano

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Summary

Frequently, some catastrophic events of erosion-deposition can destroy any preexisting soil and/ or otherwise given a fresh land surface (soil discontinuity). However in other cases, deposition of new soil materials at the surface of an existing soil occurs so slowly that a new soil is not created, but instead an existing soil slowly grows upward (policyclic soil). Both phenomenon are good represented in the buried paleosols located in Nevado de Toluca landscape. Field stratigraphyc research showed that the presence of these discontinuities and policyclic soils in this area is indicative of geomorphic events and of different stability cycles occurred during Late Pleistocene-Holocene epochs.

The aim of this study is to identify the different periods of landscape stability and paleosol typegenesis occurred in these geologic epochs according to selected laboratory analysis from seven pedostratigrafic units (PT1-PT7). Our results revealed that six soil properties like organic carbon, texture, ferrous cristalinity grade, clay type, micromorphology and magnetic susceptibility were a good tool for to identify either discontinuities as policyclic soils. According to these results we recognized the presence of 13 discontinuities or cycles: PT1 consider two pedogenetic cycles, PT2 has five cycles, PT3-PT4 have two cycles and PT5-PT7 one cycle.

Each discontinuity corresponds to an event that interrupted the landscape stability and some times, the pedogenesis process. The more evident discontinuity is showed between PT4 and PT5 and the great landscape stability periods probably were between PT5-PT7. In such soils the presence of argillic horizons suggest long stable periods, because these horizons require several thousand years to be formed.

In addition micromorphological studies in PT2, PT3 and PT7 showed the coexistence of two patterns of microaggregates as well as diverse cutans and phytolites types indicating the presence of soil policyclic phenomenon.

Keywords

Discontinuity, Policyclic Soil

Effect of Basin Morphology on Sediment Production in the Middle Yellow River Basin, China

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Summary

More than 50 river basins with gauging stations were chosen for an analysis on relationships between sediment yield and basin morphological characteristics in the Middle Yellow River. They have drainage areas ranging from 500 to 2500 km^2 and can be categorized into 6 types of basins with different physiagraphical backgrounds. A set of data on river basin morphology were obtained by using morphometric method, including drainage density, percentage of inter-gully area with slope steepness less than 15°, relief ratio, basin roughness, basin circularity etc.. Different relationships between sediment yield and basin morphological characteristics were obtained for different types of river basins by plotting and multi-variate analyses. It was shown that the best correlation exits between sediment yield and drainage density, but the relations between sediment yield and the other morphological characteristics were not as good as expected due to heavy disturbance of surface material, vegetation coverage, morphological development from various river basins. If the basin types are taken as parameters different correlations were observed between sediment yield and drainage density for different types of river basins, showing a control of other basin characteristics, such as surface material, vegetation, landform development etc. It indicates that basin morphology is an important factor affecting sediment yield of river basin but can exert substantial influence on sediment yield of river basin only when the basin characteristics are more homogeneous. Therefore a classification of river basin types is necessary before a correlation between sediment yield and basin morphological characteristics begins.

Keywords

Basin Morphology, Sediment Production, The Middle Yellow River, China

Changes of the Sedimentation Rate Caused by Land-Use Development in Kushiro Mire, Hokkaido, Northern Japan

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Summary

Rapid sedimentation in the Kushiro Mire, Hokkaido, northern Japan, has been caused by extensive land-use development and stream channelization in the 1960s to the 1970s, being a great concern for the last decade. The purpose of this study is to clarify the history of sediment deposition occurring for several decades before the land-use development until today at the marginal of the Kushiro Mire where the Kuchoro River drains.

We adopted the dendrochronological technique studying an even-aged uniform forest and adventitious roots to assess short-term (for 20 years) deposition rates and the frequency of heavy rainfall events. For the medium and long-term (for 40 and 100 years) deposition rates, radiochronological analyses using ^{137}Cs and ^{210}Pb were also conducted. Several massive deposition rates caused by heavy rainfall events in the last 20 years are recognized from the adventitious roots analysis. The maximum sedimentation rate between 1963 and 2000 estimated by ^{137}Cs is 6.2 cm/year, and most of the deposited sediment seems to be originated from the bare streamside slopes. Using the improved ^{210}Pb method, three deposition rates in the last 60 years are estimated as 2.0 cm/year from 1981 to 2000, 8.9 cm/year from 1975 to 1981, and 0.14 cm/year from 1939 to 1975. The analysis of environmental radionuclides indicates that the highest sedimentation rates occurred in the years from 1965 to 1980 when the Kuchoro River had been extensively channelized. This suggests that the agricultural activities produced a large amount of sediment transported into the wetland through the drainage system. Before the channelization, floods had been inundated and sediment deposited at the midstream floodplains, but the rate of deposition at the wetland has increased since 1980s, likely because of the decrease in floodplain areas and increase in bank erosion through degradation processes of riverbed.

Keywords

Sedimentation Rates, ^{137}Cs, ^{210}Pb, Adventitious Roots, Wetland

Morphological Mapping as Tool for Urban Planning in Southeastern Brazil

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Summary

The research was performed in a gully erosion prone, highly dissected area, which is an urban expansion vector in a midsize city in southeastern Brazil. The morphological mapping aimed to identify changes in the typical hillslope profiles that could represent unstable sites for normal hillslope evolution in a tropical environment. For best results, it was stablished a specific legend that could be both intuitive and clear and fit to the type of features observed. The legend focused mainly in the definition of concave and convex features. The overlaying of the morphological map over a gradient map revealed that concave forms associated with critical slope gradients, in this case over 7º, poor vegetation cover, concentrated surface and subsurface flow and the outcrop of wheathered metamorphic rocks, represented threshold situations that were related to the onset of gully erosion. Changes of slope profiles in the apparently gentle topographic conditions seem to be one of the factors controlling gully erosion. Morphological mapping may then represent a useful tool in the definition of guidelines for safe urban growth.

Keywords

Morphological Mapping, Legend, Gully Erosion, Urban Growth

Quaternary Volcanic Ashes Indicators for Land Degradation in the Northern Andes, Colombia

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Summary

In the Colombia Central Cordillera northern highlands, situated at altitudes above 2000m, volcanic ashes erupted from volcanoes located 150km erupted from volcanoes located 150km southward cover the landscape. Their lower stratigraphic limit is a stone-line which was emplaced between 0.35 and 0.44. My ago, as determined from fission tracks counted in associated volcanic zircons. In the study area, which covers about 900km^2, maximum thickness reaches 2m. Mineralogical analyses of the fine sand fraction show evidence of several volcanic events, now relatively mixed by bioturbation and weathering. Lack of buried soils is probably the consequence of successive thin supplies which did not detain soil processes. In undisturbed areas, andosol thickness varies with slope and distance from the volcanic centers. Last ash supply predates Spanish conquest of the territory and possibly also preColumbian occupancy. Alluvial mining stared at the beginning of seventeenth century, by exploitation of flood plains and terraces and was simultaneous with forest destruction. Soil failed to develop in the terraces since that time. Traditional agriculture in slopes still contributes to soil losses and cattle raising causes soil deterioration through the development of cattle tracks and soil compaction. Furthermore we suspect that forest cutting started an important loss of organic and A horizons. Volcanic ash soils have been recognized as a non renewable resources and are now protected by environmental regulations, due to their importance for rain infiltration and water retention.

Assessing and Correlating Inter-Basin, Pre-Hispanic and Colonial Period, Human-Induced Environmental Impact and its Affects on Subsistence in the Oaxaca and Puebla Regions of Southern Mexico: Challenges to Developing a Macro-regional Environmental History

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Summary

Since Cook's path breaking investigations on the subjects of degradation and soil erosion in Mexico during the 1940' and 50's, a number of researchers have produced case studies that constitute the basis for reconstructing an environmental history for Southern Mexico. The following paper examines and discusses recent findings and their implications for the Nochixtlan and Coixtlahuaca Basins and the Tehuacan Valley. It explores how variations in environmental controls and drainage histories have influenced human adaptive change. The paper makes special reference to changes in hydrology, water management, soil erosion and terracing in Southern Mexico since the Archaic through the Late Colonial Periods and other evidence of environmental change directed by human agency.

Gullies and Landscape Degradation at Uberlândia City (Br)

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Summary

During the last four decades erosion processes accelerated rapidly in the Uberlândia County as a function of savanna clearing and introduction of new land uses. Gully development is a natural process in the Central Brazilian Plateau but after "the new agricultural practices in former savanna areas, thresholds of the soil erosion were easily match and speed of gully development has a huge growth. The peri-urban gullies are filled with garbage and waste. In one of these gullies over 60.000 tires were deposited. In January 2003 someone provoked fire in this deposit and a disaster affected the area. Oil and chemicals products are contaminating the water, which is flowing inside the gully. Both the groundwater quality and the water quality of the Douradinho brook have been affected. The objective of the research is measure and analyzes the dynamics of the erosive process, as well as the antropics transformations in the environment and your results. They are made measurements in 3 different points in the gully by 12 days, starting in February of 2002, in the end of the rainy season. The gully's wall retreat and depth are done with stake plotted in the two sides of the erosion. The monitoring allows the creation of a database, in which information were systematized and interpreted making possible the elaboration of graphs that show the evolution of the erosive process. Besides, the data made possible to develop a wall gully retreat equation associated to the local characteristics of Cerrado.

Keywords

Gullies, Erosion at Urban Areas, Land Degradation, Water Degradation

Runoff and Gully Erosion in a Small Mediterranean Catchment

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Summary

Gully erosion and surface hydrology were investigated between 1990 and 1997 in a small catchment under Mediterranean climate. The experimental basin represents the widely distributed rangelands with disperse tree cover and peneplain morphology in South-west Spain, where gullies are mainly found in the valley bottoms, dissecting shallow alluvial fills. Previous studies have shown that accelerated channel erosion in this area is related with high amounts of overland flow generated on hillslopes with shallow soil cover and low infiltration capacity.

Sediment loss was determined by means of repeated measurements of topographic cross sections and discharge was monitored continuosly at the catchment outlet using an H-flume. Rainfall was measured with a tipping-bucket device and with a time resolution, as well as discharge, of 5 minutes. Mean sediment loss for the 7-year period amounted to 39.05 m^3 a^{-1} or 1.5 t ha^{-1} a^{-1}. However, gullying was highly variable during the study period with values ranging between +4.92 and –219.20 m^3. Although the data indicate a close relation between discharge and gullying, no simple relationship exists. This is due to the complex hydrological response of the catchment. During dry antecedent moisture conditions Hortonian type overland flow dominates, whereas during humid conditions saturation excess overland flow is more important. Temporal rainfall distribution is a crucial factor, and this in two ways. Low frequency, high magnitude events (high intensity rainstorms) generate rapid runoff response with peak discharges, of importance especially during dry soil conditions, whereas the continuity of rainfall with amounts in access of 250 mm produces soil saturation, including the sediment fill of the valley bottom, which greatly enhances runoff production. Highest sediment losses were observed under the latter condition. These findings are compared with results from an analysis of long-term rainfall data (94 years) from a meteorological station nearby.

Keywords

Gully Erosion, Runoff, Rainfall, Wooded Rangelands, Mediterranean

Exposure Effect on Soil Erosion Processes on Central-East Africa Cultivated Hill Slopes: The Tare Crest example, Rwanda

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Summary

In the Central part of Rwanda, the Tare Crest stretches over 6km with a NNW/SSE orientation that is perpendicular to the main winds. This rectilinear divide displays two rather regular steep slopes that are completely cultivated. A short time before the beginning of the wet season, the tilling of the soil let these hillsides without any protection against the rains. High peaks of intensity characterize the first stormy rains of the rainy season. These showers always accompanied by strong gusts of wind lead quickly to erosion processes that differ from one another, depending on which slope they occur. On the windward slope runoff appears very rapidly after the beginning of the rain. Numerous rill erosion scratches appear on the whole slope, unaffected by the man made erosion reducing system. Theses parallel rills sometime converge with the help of a local concavity of the slope leading to the formation of deep gullies. On the leeward side of the slope linear marks of erosion are absent but after a more or less long time, depending of the amount of the rain felt, shallow landslides often occur. There are no significant differences between the soils of the two opposite slopes, which are issued from the same Burundian metamorphic bedrock and the cultivating system is roughly the same on the whole hill.

The velocity of the wind controls the mass of the drops and both velocity and drop mass control the trajectory of the raindrops. On windward slope, the oblique rain falls quite perpendicular to the soil surface. The important kinetic energy liberated by the raindrops impact on the ground leads quickly to the formation of a thin waterproof surface crust. This can explain, on this slope facing the wind, the runoff appearance a very short time after the beginning of the rain. On leeward slope, sheltered from the winds, the rain falls more vertically. The raindrops, arriving with an acute angle on the soil, maintain the soil surface porosity open during the rain by removing the soil particles. They favor by that the predominance of water infiltration and the appearance of mass movements on this slope.

Keywords

Soil Erosion Processes, Cultivated Steep Slopes, Rain, Wind Effect, Rwanda, Africa

Rehabilitiation of severely eroded and indurated Volcanic Ash Soils in Mexico and Chile (REVOLSO)

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