AvH8-14
8th Alexander von Humboldt International Conference
Cusco, Peru, 12 – 16 November 2012

Global change and massive soil erosion endangering world heritage ancient desert agriculture in the Middle East

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Ancient agricultural fields dominate large parts of the desert landscape in the Middle East and cover vast areas in these arid regions. The ancient agriculture installations comprise of stone terrace walls built within the wadis, channels for collecting the runoff from the mountain slopes and diverting flood water from the wadis. In the Negev Highland of southern Israel, the total area exhibiting these installations comprises ca. 30,000 acres. They were built mainly during the Roman-Byzantine period (3-7th centuries) along with ancient desert towns. This unique and well preserved cultural landscape was included in the UNESCO world heritage list. However, during the last decades, a continuous process of massive soil degradation is observed in the deserts of the Middle East. In many sites the soil erosion endangers the ancient agricultural installations located within the wadis that are subjected to powerful desert floods. As the global climate change is imposed on the arid regions, and the magnitude and frequency of floods is escalating, this process is expected to become a major threat to these important sites.
Twenty-two years of field observations and more than 80 luminescence ages of soil samples taken in the Negev desert of southern Israel, enable us to analyze the forces behind the soil degradation process in order to advise on the proper strategies for long term conservation of these sites.
It was found that the Middle East is experiencing a long term, non-linear process of land degradation. This process is evolving mainly through continuous erosion of loess sediments, brought to the region as dust from the near-by deserts and deposited during the Late Pleistocene last glacial phase ($\sim$ 70-20 ka). After initial deposition, these sediments were transformed into fertile soil that supported high natural biomass. A gradual soil erosion process began at the termination of the glacial phase (17-14 ka) and intensified during the Holocene. The non-linear soil erosion generated a complex environmental response, leading towards increased natural desertification, long before human intervention became significant in this desert environment.
During the mid-Holocene, the co-existence of soil and runoff created unique geomorphic conditions, which enabled the establishment of desert runoff harvesting agricultural in the arid regions of the Middle East. It exploited the interaction between the local geology, the geomorphology of the drainage basins, the loess soil and the desert climate. The occasional desert floods were used as the major water resource for irrigation. The vast construction of stone dams by the ancient farmers led to the trapping of floodwaters behind the agriculture installations and to redeposition of fine alluvial sediments, originating mainly from the Late Pleistocene loess sections, at a rate up to 0.8 cm/y. The accumulation of the sediments contributed to soil conservation on a regional scale and opposed the general trend of natural desertification that continues to act in the arid natural environment. However, the gradual raise of the agricultural terraces increased their physical risk and they became vulnerable to collapse. This process became critical after the fields were gradually abandoned and a "domino effect" was generated, shifting the geomorphic process towards dramatic increase in soil erosion.
Therefore we conclude that throughout the Holocene, the human impact was and is super-imposed on the natural long-term trend of geomorphic changes, leading towards natural desertification of the arid zone. The rise and fall of the desert agriculture is not related to any mid-late Holocene climate or environmental change. Soil conservation methods such as terrace conservation and rehabilitation can still be applied in the Middle East deserts. Similar processes are operating in other arid and semi-arid regions worldwide, such as in southern Peru and northern Chile.