Combatting sand and dust storms: The performance and value of sustainable land management in arid to subtropical areas

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Abstract

Around one fifth of the earth's landmass, covered by deserts, unremittingly feeds erosive winds and the atmosphere with sediments. Whilst the hyper arid areas may irrecoverably continue providing major sources for Sand and Dust Storms (SDS), the arid to subtropical climatic zones, surrounding the global deserts, serve as the utmost important shelter belts. Those dry to subtropical regions host an immense agro-ecosystem diversity, largely cultivated by smallholder and subsistence farmers. Besides their critical role in food production, the smallholders' contribution to supporting and regulating ecosystem services is key, inevitably linked with halting desertification.

Our study tackles the performance assessment of selected Sustainable Land Management (SLM) strategies in arid to subtropical zones – specifically their role in combatting SDS through providing vegetation cover and/or resilient soil structure. In our preliminary attempt, four SLM approaches were i) spatially mapped towards their scaling-potential, and ii) investigated for their effectiveness in reducing SDS emissions within the Dust Belt area ranging from Morocco to China. Google Earth Engine was used to map different levels of suitability and impact of selected SLM: (1) micro-water harvesting based plantation of shrubs, (2) air seeding of tree a species (saxaul), (3) broadcasting of perennial legumes (sulla) and (4) conservation (reduced tillage) agriculture. Combining the SLM suitability with a global SDS source area risk map allowed the estimation of SDS reduction performance withdrawing information from case studies and expert knowledge. A stepwise efficiency assessment of integrated SLM scaling was conducted using Linear Programming (LP). The developed LP model strives towards minimising the SDS risk through successive out-scaling of SLMs, constrained by the extent of suitable areas and total costs.

Our approach links SLM performance to costs, resulting in a transparent decision support mechanism tailored for application at the country, regional or global level. Thus, to identify suitability and evaluate the integrated effectiveness of multiple SLMs on combatting SDS that threaten ecosystems and our life on land.

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