

Hydrodynamic functioning of different eolian microdunes in sahelian area of Burkina Faso

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The study was performed in the Sahelian part of Burkina Faso. The country is subject to difficult climatic conditions, a strong demographic growth and a continuous decrease in soil fertility. The resulting degradation affects the processes which govern ecological systems and leads, on the long run, to a modification of the ecosystems. This is particularly the case of the eolian formations, the only ecological units susceptible of being useful in the area, since they present good infiltration capacity and support the main part of the vegetation. Field measurements (rainfall, runoff, saturated hydraulic conductivity, bulk density, hydraulic conductivity function, soil water content and pressure head) have been done to assess the impacts of the environmental degradation on the hydrodynamic behavior of these formations. Within this context, an experimental device made of seven measurement sites has been installed in three contrasting zones. The results show significant differences in the hydrodynamic behavior of the soils, according to their surface properties. On one hand, the sites located on an erosion crust as well as on a drying crust in transition towards an erosion crust, are characterized by a low infiltration capacity which favors runoff. The quantity of infiltrated water is very low when compared to total precipitation. Water is stored near the soil surface (in the first 30 cm) favoring evaporation in the days following rainfall events. Thus, little water is available for plants. The resulting water stress causes a weak density, or even complete absence of plants which have difficulties to colonize such surfaces. Surface runoff is favored with runoff coefficients ranging from 50 to 80 %. On the other hand, the sites situated on drying crusts are characterized by good hydraulic conductivity and infiltration capacity. The storage of water in the root zone is more important. Water flows deeper into the soil and, occasionally, drains at the reference depth of 50 cm. The runoff coefficients were found to be lower than in the other sites (30 to 40 %). This differentiated behavior is one of the main factors affecting the formation of different landscapes in the area through the existence of a relationship between soil surface properties, the type of landscape and the ratio runoff/infiltration. The sites located on an erosion crust and those in transition towards an erosion crust behave like impluviums, while those situated on drying crusts are more favorable to infiltration. Observation of the evolution of the hydraulic properties of the soil surface shows a progressive alteration that frequently leads to strongly degraded mediums unfavorable to plants. Control and rehabilitation methods considered in the study, namely "restoration" and "mise en défens" have only partial and time-limited effects; they do

not make it possible to stop durably degradation or to favor rehabilitation. Among the other measures assessed on the INERA plots, only the restitution to the soil of the beforehand mown plants causes an improvement of the soil surface properties; the restitution causes the formation of an important macroporal system favoring water infiltration and circulation in the soil. The effects of those different measures occur mainly in the first years after their introduction and concern especially vegetation regeneration, soil protection against degradation factors, improvement of hydrodynamic soil properties, reduction of runoff and erosion. They make it possible to slow down soil degradation, but not to stop it definitively. Within this context, proposals of further studies focussed on other measures to control and rehabilitate degraded areas have been suggested, taking into account the specificity of the sahelian zone, the endogenous knowledge of the agro-pastors, as well as socio-economic and ecological conditions.

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