Evolution characteristics of the restoration desert ecosystem and its influence on water cycling in the Tengger Desert, Northern China

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The rainfed sand-binding vegetation for stabilizing the migrating desert dunes in the Shapotou area at the southeastern edge of the Tengger Desert, initiated in 1956, using shrubs consisting predominantly of *Caragana korshinskii*, *Hedysarum scoparium and Artemisia ordosica*, has established a desert shrub ecosystem with a dwarf-shrub and biological soil crust cover on the stabilized sand dunes. Some of the effects of recovery from desertification and ecological restoration on soil properties are manifested by the increase of distribution of fine soil particle size, organic matter and nutrients. The physical surface structure of the stabilized sand dunes, and inorganic soil crusts formed by atmospheric dust has gradually formed biological soil crusts. There is a significant positive correlation between fractal dimension of soil particle size distribution and the clay content of the shallow soil profile in the desert shrub ecosystem, the longer the dune being stabilized, the greater the soil clay content in the shallow soil profiles, and the greater the fractal dimension of soil particle size distribution. This reflects the fact that during the re-vegetation processes, the soil structure is better developed especially in the upper profile. Hence, the migrating sand dune becomes more stabilized.

During the growing seasons, the average shrub community interception loss is 6.9% and 11.7% of the simultaneous overall precipitation, for *A. ordosica* and *C. korshinskii*, respectively. Taking into account the observed rainfall conditions and vegetation cover characteristics, it was concluded that the interception loss was 2.7% of the total annual precipitation verified in the period for the *A. ordosica* community with an average cover of 30%, canopy projection area of 0.8 m^2 and canopy storage capacity of 0.75 mm. It was 3.8% for the *C. korshinskii* community with an average cover of 46%, canopy projection area of 3.8 m^2 and canopy storage capacity of 0.71 mm.

The redistribution of infiltrated moisture through percolation, root extraction, evapotranspiration pathways indicates that the infiltration varied greatly from 7.5 to more than 45 cm depending upon rainfall quantity and soil surface conditions. In the shrub community area without biological soil crust cover, infiltration increased due to preferential flow associated with root tunnels. The biological soil crust cover had a significant negative influence on the infiltration for small rainfall event, it restricted the infiltration depth to less than 20 cm, and increased soil moisture content just beneath the soil profile of 10 cm, while it was not as strong or clear for larger rainfall events. For small rainfall events, the wetting front depth for the three kinds of surface cover was as follows: shrub community without biological soil crust $>$ bare area $>$ shrub community with biological soil crust. In contrast, for large rainfall events, infiltration was similar in shrub communities with and without biological soil crust cover, but significantly higher than measured in the bare area. Soil water extraction by roots associated with evapotranspiration restricted the wetting front penetration after one to three hours of rainfall.

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