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# Effect of vegetation coverage on aeolian dust accumulation in a semiarid steppe of northern China

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ABSTRACT

Wind erosion and sand storms are common phenomena in semiarid steppes of northern China and could have important impact on soil nutrient balances. Vegetation coverage is one of the key factors influencing wind erosion and aeolian dust accumulation. We conducted a field experiment to investigate the effects of vegetation coverage on airborne dust accumulation and evaluated effects of dust input on the contribution of nutrients to vegetation-mulched fields. Five vegetation coverage treatments (15%, 35%, 55%, 75% and 95%) were constructed, with 0% coverage as a control. Vegetation coverage significantly affected dust accumulation in degenerated semiarid grasslands. The amounts of dust trapped by the increasing coverages were 1.7, 1.8, 2.0, 2.1 and 2.1 times of that by the control plot, respectively. The total accumulations reached a maximum of 2.5 g $m^{-2}$ $day^{-1}$ at 75% coverage and remained stable with further increasing vegetation coverage. The particles in the dust trapped by treatment without vegetation coverage were significantly coarser than those by treatments with vegetation. In addition, the dust trapped by treatments with vegetation contained more organic carbon, nitrogen and phosphorus content than that by the control plot. This finding indicates that areas with higher vegetation coverage can obtain more nutrients by trapping airborne dust in semiarid steppes.



## 1. Introduction

Dust transport pathways can range in scales from local (over a few hundred meters) to global (over thousands of kilometers) distance. This indicates that potential dust impacts upon ecosystems can operate over similar scales (McTainsh and Strong, 2007). On a global scale, a region or one major ecosystem type can be a large "dust collector"; the positive or negative effects of dust collection determine whether an ecosystem is a dust source or sink and can also directly reflect the loss and accumulation of soil resources. Therefore, it has been suggested that dust plays an important role in many biogeochemical processes (Prospero, 1999;Muhs et al., 2008).

In the past several decades, a large number of studies have shown that nutrient input is a function of aeolian dust and an important factor affecting soil nutrients, especially in those regions where winds often occur (Leys and McTainsh, 1999; Lv and Ma, 2003; Stoorvogel et al., 1997; Swap et al., 1996; Thomas and Dougill, 2011). Aeolian dust may often be higher in fertility than the existing soil where it is deposited. There is a net increase in soil nutrients when wind deposition is stronger than wind erosion, otherwise, a net loss of nutrients will occur (Lv and Ma, 2003; Thomas and Dougill, 2011). Stoorvogel et al. (1997) showed that 50% of the nutrients in a humid tropical rainforest along the Ghana coast were derived from the dust carried by dry and hot winds from the Sahara. Swap et al. (1996) drew more startling conclusion in that a particularly strong sandstorm was capable of blowing $4.8\times10^5$ t dust at one event from the Sahara in Africa to the Amazon Basin in South America, with an annual transport of settled dust of up to $1.3\times10^8$ t, corresponding to 190 kg·$ha^{-1}$. Through dust fall, the Amazon Basin has obtained 1–4 kg P·$ha^{-1}$·$yr^{-1}$, which is greatly distributed to the nutrient pool of the rainforest ecosystem. Leys and McTainsh (1999) also showed that the filtration effect of vegetation on the dust is a crucial process,

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