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Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydrologic feasibility of artificial forestation in the semi-arid Loess Plateau of China" *by* T. T. Jin et al.

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We would like to thank Anonymous Referee #2 for his insightful comments on our manuscript. We take the opportunity to answer his questions:

1. As the authors recognised, soil moisture is a product of different factors that include not just the rainfall amount but also type of vegetation and soil. The latter plays a key role in water budget and, as I see it, relationships between soil properties and SMC must be explored further.

Reply: Soil properties would indeed influence SMC, and a dozen of soil properties may have impacts on SMC, for example soil texture, soil porosity, soil aggregate stability, saturated hydraulic conductivity, bulk density, saturated hydraulic conductivity, heat

conductivility, and etc.. Soil texture in the Loess Plateau is quite uniform (please refer to “reply to hess referee 3”), and soil has a limited effect on SMC. On the other hand, our study was not intended to reveal the relationship between soil properties and SMC, instead we wanted to know how would SMC change after planting. Although many soil properties haven’t been measured, previous studies have given us the necessary information. Some explanation will be elaborated below.

2. For example, in Fig. 2b the authors recognise the presence of two layers of SMC values. They try to explain this considering that an insufficient profile water supplementation is responsible for the appearance of a turning point. What about texture? The authors say that the soil texture in the Loess Plateau is derived from parent materials and has not changed significantly for a century. I am not familiar with that area but looking at the paper of Li and Shao (2006), it is clear that (apparently in a very similar area) both bulk density and porosity depend on soil depth (see table 2 of their paper). In other words, even if the analysis of Li and Shao is based only on two soil layers (0-20 and 20-40 cm), for the same type of vegetation there is a decreasing trend of porosity (increasing obviously for bulk density) with depth. This means that the turning point of Fig. 2b can be strongly related with soil properties. In fact, as Li and Shao pointed out, change of soil bulk density and porosity may affect soil water-holding capacity and consequently soil water conditions for different vegetation succession stages. Do the authors have evidence of it? Can they plot vs soil depth for the soils sampled in their catchments?

Reply: Undeniably, soil properties such as bulk density and soil porosity change with depth. These properties may influence soil water conditions. Nevertheless soil properties have limited effects on soil water conditions in the Loess Plateau. As showed in previous studies in W2 (Zhang et al., 2006; Zhao et al., 2009), SMC of different vegetation type in W2 undulated slightly from top down when water resource was plentiful, and no stable decreasing trend was found. This indicated that water supply was the main factor shaping the turning point. The effect of soil properties on SMC is limited.

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While water supply was limited (due to decreased water supply resulting from steep slope), SMC exhibited great differences with depth in different vegetation. Therefore in this watershed water supply and evaprtranspiration was the main factor affecting SMC under dry condition instead of soil properties. Refer to Supplement figure 1 and 2 for SMC in soil profile. In our study, SMC decreased linearly about 5% in 0-40cm (0-70cm for 5 year stand) soil depth. The shortage of rainfall in combination with steep terrain in the W2 makes the rainfall and evaprtranspiration the main factors affecting SMC. Therefore the turning point of Fig. 2b was not decided by soil properties.

3. The same findings come texture properties from the measurements undertaken by Li and Shao (2006) about hydraulic conductivity (Ks) for the surface layer 0–20 cm and the subsurface layer 20–40 cm. In other words, Ks decreases with depth in the first 40 cm and this would justify the higher amount of SMC found by the authors in the deeper layer. Do authors have measurements of Ks for their soils in order to support their assumptions?

Reply: As elaborated above, SMC in W2 fluctuated around water-holding capacity from top down when water resource was plentiful. Decreasing Ks with depth will only decrease SMC at depth when water is in short supply. In this case SMC is mainly depended on the amount of water supply, and Ks is just an indirect factor. And even Ks is uniform in the soil profile, decreasing trend of SMC with depth will also occur when water is in short supply. In addition, decreasing Ks with depth would have the same effect on SMC of plantations with different stand ages, and this will lessen the SMC difference resulting from Ks.

Referance Zhang, B. Y., Xu, X. X., and Bai X. H.: A study on soil moisture under different vegetations in loess hilly region, Agricultural Research in the Arid Areas, 24(2): 96-99, 2006. Zhao, P. Y., Xu, X. X., Liu P. L., et al.: Spatial variation of soil moisture on the grass and shrub land under simulated rainfall in Loess area, Science of Soil and Water Conservation, 7(3): 24-29, 2009.

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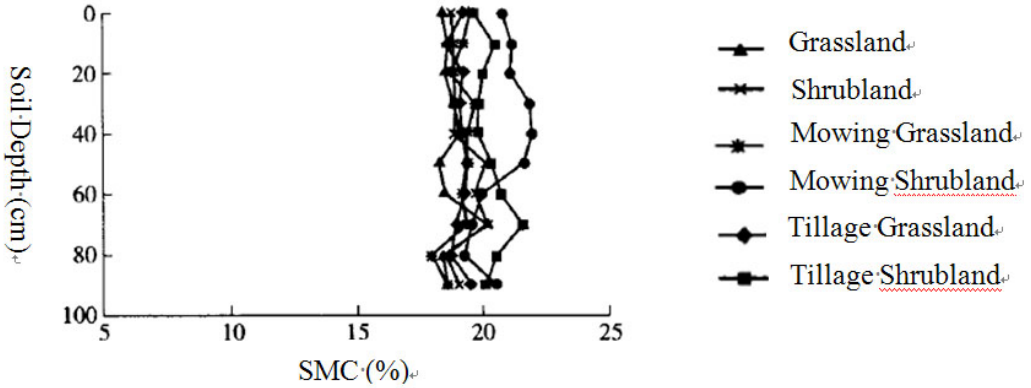

Fig. 1. Supplement figure 1 Variation Characteristics of SMC under different treatments in gentle slope (Zhao et al., 2009)

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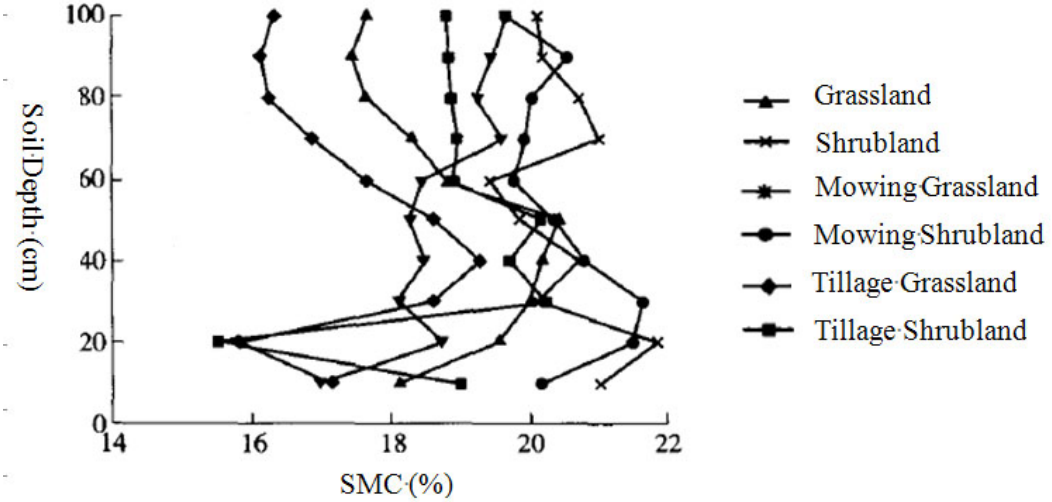

Fig. 2. Supplement figure 2 Variation Characteristics of SMC under different treatments in steep slope (Zhao et al., 2009)

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