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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 thank Anonymous Referee #1 for contribution and insightful comments on our manuscript. We would like to take this opportunity to answer his questions and explain our points of view:

1. Soil moisture is rather dynamic and this nature makes regional comparisons difficult unless soil moisture is monitored continuously over time. It is unclear how the researchers teased out the effects of event rainfall on soil moisture sampling.

Reply: Regional and continuously monitor of soil moisture content (SMC) is time-consuming and very difficult, and therefore this kind of research is usually infeasible. But the soil moisture status of actual vegetation can give us some clues to its dynam-

ics. Unique terrain conditions (steep slope) and rainfall characteristics (violent and short duration) in the Loess Plateau lessen the effects of event rainfall on soil moisture sampling greatly especially in the up-slope. Under extensive monsoonal climate influence and undulating terrain, rainfall here tends to be violent and falls in a particularly short time, accompanying with steep terrain, rainfall runoff forms rapidly. The effects of event rainfall on SMC are limited to the top layer of the soil. The SMC in our study was influenced by combined effect of several event rainfalls. Furthermore to eliminate the effect of event rainfall, sampling was preceded at last after 5 days of the rainfall.

2. A dry region can experience a wet period. Soil antecedent soil moisture conditions are needed to be considered for cross site comparisons, especially for this type 'snap shot' comparison exercise.

Reply: Our study was just preceded in growing season and different results may be achieved in different seasons. Though SMC may undulate greatly across one year, its variation is one year cycle. This study focused on the SMC of late growing season. Through the depletion of the growth season, the effect of plantation on SMC was cumulated and can be detected easily. SMC in late growth season is also important for vegetation growth. It is very difficult to accomplish the whole task at one stroke; therefore further study is in need to explain the seasonal and annual dynamics of SMC after planting. But regional variation of SMC in growth season studied in this paper is also valuable. "Soil antecedent soil moisture conditions are needed to be considered for cross site comparisons, especially for this type 'snap shot' comparison exercise." Unlike some other relatively stable soil properties, soil antecedent soil moisture conditions especially on regional scale is difficult to obtain, but this will not restrain us from getting some restricted conclusions. Because not only can studies be based on proof analysis, they can also base on general knowledge and some previous studies. In our study, we focused on the accumulative effect of plantation on SMC. The selection of similar sites with different stand age eliminated a lot of soil moisture variation resulting from terrain variation. In the analysis, we analyzed the data synthetically combining different

kind of knowledge (climate, soil, plant and etc.). For example, in the south watershed, SMC was near field hold capacity (from previous study) and varied slightly from the top down. According to previous research soil moisture can be replenished well, therefore in this region SMC was decided mostly by soil properties. This can be proved by the positive relationship between soil organic matter (soil organic matter is important for soil water hold capacity and water retention ability) and SMC. Now that plantation can improve soil properties, SMC will probably increase with stand age. Nevertheless, this conclusion is conditioned, in other time of the year when rainfall is less; SMC may be influenced greatly by plantation transpiration.

3. The authors concluded that soils under plantation forests had higher soil moisture. The authors attribute this observation to that forest soils had higher soil water holding capacity and water retention capacity. Do you have soil physical property data to support such claim? Even they do, would the higher evapotranspiration rates (compared to croplands or grasslands) from forests result in lower soil moisture and runoff?

Reply: Perhaps formulation in our manuscript is unclear. We didn't mean soils under plantation forests had higher soil moisture than croplands or grasslands. Our conclusion was that the SMC in high rainfall area may increase with stand age due to the improvements of soil water holding capacity and water retention capacity after planting. In our study, soil organic matter was used to support the claim, although soil water holding capacity and water retention capacity haven't been measured. Our conclusion is not only based on the result of our study, but some results of previous studies were used for reference. Take SMC of W1 for instance, in the study of Li and Shao (2006) in the Loess Plateau, the increase of soil organic matter leaded to the increase of soil porosity, water-holding capacity, aggregate stability and saturated hydraulic conductivity, therefore SMC should be correlated to soil organic matter positively under plentiful supply of rainfall. In our study, SMC in W1 was close to water-holding capacity, and SMC was positively correlated with soil organic matter significantly. This was in accordance with previous deduction. It is recognized that soil organic matter

of Robinia pseudoacacia L. plantation can increase with stand age significantly when turning cropland to Robinia pseudoacacia L. plantation (Qiu et al., 2010). Therefore SMC will probably increase with stand age. Compared to croplands or grasslands, forest probably reduces runoff not only in high rainfall but also in low rainfall area. In most of the Loess Plateau, higher evapotranspiration rates of plantation did result in lower SMC. But in this study, we didn't intend to compare plantation of R. pseudoacacia with croplands or grasslands, and we wanted to know how SMC will change with stand age.

4. Would it be possible that the observed higher soil moisture in forests was due to the fact that the forests were located in a higher rainfall areas? A multivariate analysis is warranted to tease out the causal effects of climate change vegetation cover.

Reply: All of our observations are R. pseudoacacia plantations. In W1, several plantations were close in distance and were all in up-slope, therefore rainfall was the only source of SMC and it was almost the same in different plantations. A multivariate analysis is difficult to be implemented due to limited amount of data. Proper qualitative analysis may make up this restriction.

reference

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