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Interactive comment on "Challenges of soil carbon sequestration in NENA Region" *by* Talal Darwish et al.

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Reply to Reviewer 1

1. Reply to the general comments ……...however, the conclusion that the potential for carbon sequestration in NENA region is low needs some careful consideration: (a) due to the vast geographic area the NENA region is extended over, which make any slight potential per hectare is significant at regional level, and (b) because there are no scenarios presented to check what would be the potential if some sustainable soil/land management practices are introduced in the region. Therefore, a careful consideration should be given to this conclusion, which might also influence important decisions to be made as sustainable soil and land management are considered within the climate

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Discussion paper

change context.

We completely agree with the reviewer note about the sensitivity of the issue and that we shall create a positive attitude towards the efforts of international community to improve land stewardship and strengthen governance to improve C sequestration in NENA region despite the difficult situation in this part of the world, where the majority of lands represents deserted and rainfed areas. Therefore, the conclusion was changed into the following text with several scenarios included briefly here but elaborated in the results:

NENA area consisting of 14% of the earth surface area contributes only 4.1.% of total SOC stocks in -topsoil. The soil resources of NENA region are developed under dry conditions with prevailing of rainfed agriculture. Achieving land degradation neutrality and food security depends much on land stewardship and sustainable management of soil resources. The land capability model showed that most NENA countries (17 out of 20), suffer from low productive lands (>80%). The current mapping of SOC and SIC density showed that 69% of soil resources present a SOC stock below the threshold of 30 tons ha-1. The density varied between $\approx$ 10 tons ha-1 in shrublands and 60 tons ha-1 for evergreen forests. Highest stocks were found in forests, irrigated crops, mixed orchards and saline flooded vegetation. The moderate density ($\approx$30 tons ha-1) in urban areas indicates that some urban growth was at the expenses of prime soils. The stocks of SIC were higher than SOC density, indicating the calcareous nature of soils. In subsoils, the SIC ranged between 25 and 450 tons ha-1, against 20 to 45 tons ha-1 for SOC.

Although OC sequestration in the NENA region is problematic, this task is still possible, requiring the protection of the topsoils and sustainable land management. Practices of conservation agriculture (no-tillage, intercropping and agro-pastoral system, winter soil cover, proper rotation...) could be effective as the presence of residues reduces the evaporation, as well as water and wind erosions and promote the aboveground biomass production. This is especially relevant to soil classes that are susceptible

to degradation. In semi-arid regions, the introduction of legumes, as part of a cereal-legume rotation, and the application of nitrogen fertilizers to the cereal caused a notable increase of SOC, after 10 years. A faster result was achieved through winter cover crop consisting of fruit trees-legume-barley intercropping system.

Some scenarios include the following:

A. In a 10-year rotation of wheat- legume (vetch) in northern Syria, the application of nitrogen fertilizers to the cereal caused a notable increase of SOC, in the top 1m of soil, equal to 0.29 Mg ha-1 year-1 (Sommer et al., 2014).

B. Similarly, the growth of intercropped legumes as winter cover crop (Vicia sp., Lathyrus sp.) alone or with barley (Hordeum vulgaris), between cherry trees in semi-arid Lebanese area (Jourd Aarsal, eastern Lebanese mountains), increased SOC significantly notably when legumes were mixed with barley (Darwish et al., 2012). Results showed that the sites were supplemented with OM varying between 140 and 250 kg ha-1season-1 resulting from the decomposition of plant root residues. The above ground plants biomass provided the orchards with 95-665.7 kg ha-1season-1 of OM. Plant residues provided additional feedstuff for small ruminants; the soils were enriched with OM and fixed nitrogen with more efficient use of surface soil moisture.

Reply to specific comments -The term resilience is used in various contexts throught out the manuscript (resilience to erosion, resilience to degradation), please check if the proper term would be "resistance".

The term resilience was changed into resistance.

Specific corrections In the abstract: the first word should be "Near" not "North" please spell out SIC please elaborate little on the socio-economic constraints

Done

page 5: please check 60% of Jordan is medium productive is very high figure given that 90% of the country receives less than 200mm of annual rainfall.

In this paper potential soil productivity was modeled based on the USDA model (1999). The potential medium productivity is based strictly on soil properties. But, with lack of water in drylands and prevalence of rainfed agriculture, the soil cannot show its potential for food production. Similarly, irrigation with brackish and saline water restricts crop productivity. When properly irrigated, these lands can provide moderately good harvests. I visited Jordan several times and undertook field visits to classify soils and assess land degradation and saw vast good lands cropped with barley because of lack of irrigation water. Often, even barley fail in central and east Jordan (<50 mm rain) and land is immediately converted into grazing land for small ruminants. The soil studies done by John Ryan more than 45 years ago on the red soil of Jordan showed relict soils carrying properties of higher rainfall not relevant to actual climatic conditions. . .The same was confirmed by: Lucke, B., Kemnitz, H., Bäumler, R., Schmidt, M. (2013): Red Mediterranean Soils in Jordan: New insights in their origin, genesis, and role as environmental archives. âĂŘ Catena, 112, 4âĂŘ24 DOI: 10.1016/j.catena.2013.04.006

page 11, second paragraph, need to link conservation agriculture with residue management, which is elaborated later but need to be emphasized here as well.

Done

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