Solid Earth
Discussions

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Interactive comment on "Assessment and Monitoring of Land Degradation Using Geospatial Technology in Bathinda District, Punjab, India" *by* Naseer Ahmad and Puneeta Pandey

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Answers to Comments of Referee 2 1. Comments of Referee: Abstract: The abstract is well written. However page 1, line 8 , how was severity measured in this study. This should be deïňĄned in quantitative term and should be mentioned in the abstract. The abstract is a synopsis of the whole research. Author's Response: The severity of land degradation was estimated quantitatively by analysing the physico-chemical parameters in the laboratory to determine saline/salt free and calcareous/sodic and further correlating them with satellite based studies. The pH varied between 7.37 to 8.59; Electrical Conductivity (EC) between 1.97 dS/m and 8.78 dS/m and the Methyl orange/Total Alkalinity area in the range of 0.070 to 0.223 (HCO3-) g/L as CaCO3. The

spatial variability of these soil parameters have been depicted through soil maps generated in GIS environment. Author's changes in the manuscript: Incorporated in lines 8-13. 2. Comments of Referee: Introduction The introduction needs improvement. Start with line 27 and move lines 23-26 to other part of the introduction. Author's Response: The introduction has been improved according to the Referee's comments in the revised version. The Introduction section starts with line 27 as suggested. Author's changes in the manuscript: Line 27 has been moved to the beginning of Introduction as Line 26-29 followed by rest of the Introduction. 3. Comments of Referee: The title suggests that we are dealing with land degradation and not land use/land cover change per se. This should reïňĆect in the introduction. Author's Response: Line 29 of Page 1 to Lines 1-6 of Page 2 talk about land degradation and land use change. Author's changes in the manuscript: No corrections made. 4. Comments of Referee: What is the gap in knowledge and how does this paper ïňĄll that gap? Author's Response: Integration of remotely sensed data with ïňĄeld based data to determine the severity of land degradation is an important aspect of the present study. However, as far as land degradation assessment through geospatial technology is concerned, not much study has been done in the Bathinda region of Punjab, a north-western state of India. With the onset of GIS technology, mitigation of soil degradation could be handled by land suitability spatial models and land use change. A link can be established between land use change and land degradation; as well as land use change and spatial distribution of soil contaminants through geostatistical and non-geostatistical interpolation methods in GIS environment. Therefore, an attempt was made to fulfill the gap by using interpolation method for assessment of land degradation severity and the correlation between digital number (DN) of satellite data and the parameters of the soil. The present study was carried out with the objective of integrating remote sensing data and ïňĄeld-based soil data to assess severity of land degradation in the Bathinda District, Punjab. Author's changes in the manuscript: Section 1.1 of Page 4 (Lines 1-11).

5. Comments of Referee: Is the contribution of this paper to knowledge in term of methodology or what? Having gone through the whole paper, I guess the major is-

sue is in the area of methodology. (i.e Integration of remotely sensed data with ïňĄeld based data to determine the severity of land degradation). This can be included in the introduction. Author's Response: Section 2.6 and 2.7 in methodology describes the integration of remotely sensed data with field based data to determine the severity of land degradation. A brief paragraph about the integration of remotely sensed data with the field based data such as pH EC and alkalinity was discussed in Section 2.6 regarding the determination of severity of land degradation using Inverse Distance Weighted (IDW) interpolation method. Section 2.7 Author's changes in the manuscript: Line 12-21 of Page 6 (Section 2.6) 6. Comments of Referee: Study Area Detailed description of the research context is required at this stage, particularly to help readers who are not familiar with the study area. Author's Response: A detailed description of the study area with the environmental problems persisting in the area have been added in Section 2.1 (Lines 22-31, page-3). Author's changes in the manuscript: The text has been included in lines 22-31 of Page 3. 7. Comments of Referee: Figure 1 as indicated in the paper now is on data collection issues and not the study area per se. The location map needs to show the location of Bathinda District, Punjab, in relation to India. The main map should be Bathinda District, and the smaller map should be India. The location map is meant to orientate the reader. Author's Response: The study area map was corrected accordingly with a larger map of Bathinda and a smaller one of Punjab and then India. Author's changes in the manuscript: The location map has been revised as suggested and presented as Figure 1. 8. Comments of Referee: Methodology Data collection and analysis What informed the choice of Land Sat 7 and 8 images used and the year selected? Please discuss? Author's Response: The satellite image Landsat 8 was chosen for the study for two reasons: to prepare land use land cover (LULC) map at reasonably good spatial scale (resolution of Landsat 8 in visible and near infrared (NIR) band is 30 m and 60m respectively); and also for correlation analysis, it was necessary that the time lag between field sampling and satellite data procurement should be as minimum as possible. Landsat 7 was chosen for change detection studies because decadal change detection required older dataset to get most

up-to-date change detection output. Author's changes in the manuscript: No change done. 9. Comments of Referee: I see that the soil samples were analysed for chemical properties only, and not physico-chemical soil properties. Why only three soil quality parameters? One would have expected that more soil quality parameters be included in the analysis. Here, I suggest that textural properties as well. Author's Response: The three soil parameters were selected based on the problems of soil persisting in the study area. However, I do agree that textural properties could have been included, but it is not possible at this stage. We shall take this suggestion into consideration for future research. Author's changes in the manuscript: None 10. Comments of Referee: Next, why 21 soil sample points? Was this a function of cost or time? Please argue this out. Author's Response: 21 sample points were selected based on land use land cover features present in the study area. Besides, the study was a short term one (carried out over a period of six months); hence, it could be considered a function of time. Author's changes in the manuscript: None

11. Comments of Referee: Also give the coordinates of the sample points in table 5. Author's Response: The coordinates of sampling points have been added to Table 5. Author's changes in the manuscript: Table 5 of Page 16-17 incorporates the geographical coordinates as well.

12. Comments of Referee: Data Analysis To me, there is a confusion on the table of correlation. It is important to clarify whether DN used in the correlation matrix is the same as values of band 5 (Near infrared band) of the pixels for 2014 image. The correlation analysis needs to be tested statistically at 0.5 level of signiïňĄcance. Author's Response: The DN values used in the correlation matrix are the same as the values of near infrared band (Band 5) for the geographical coordinates of the sampling sites. The correlation analysis carried out was Pearson's correlation analysis at 0.5 level of signiïňĄcance. 13. Comments of Referee: The signiïňĄcance of the correlation coefïňĄcients between DN/pH; EC/pH,DN/EC should be tested for signiïňĄcance here. Author's Response: The correlation analysis between band 5 and pH and EC values

has been given in Table 6. Author's changes in the manuscript: The correlation analysis has been already given as Table 6. Discussion for the same has been given in lines 11-17 of Page 22.

14. Comments of Referee: A fundamental issue that I think is lacking in this paper, and which I believe readers of this work would like to see is a map shown the severity of land degradation. This is missing and can be done within the GIS environment using geostatistical analyst in Arc GIS. This appears to be the missing link in the paper and should be included in the revised version of the paper. Author's Response: Section 3.5 of the manuscript deals with soil map showing severity of land degradation in GIS environment. Digital soil mapping was used for the prediction of spatial variability of individual soil properties in large areas over space, where maps are generated in digital format in a rapid, effective, efficient, and low cost manner (Sheng, 2010). Severity of land degradation was shown as spatial distribution of pH, EC and Alkalinity in quantitative terms via Inverse Distance Weighted (IDW) interpolation methods using statistical analyst in Arc GIS. Based on the pH values, a soil map for sampling sites as shown in Figure 6(a) was composed in ArcGIS 10.1 software. Similarly on the basis of EC and Alkalinity values, soil maps were composed respectively as shown in Figure 6(b) and 6 (c) depicting the severity of land degradation in terms of salinity. Author's changes in the manuscript: Suggestions incorporated in Section 3.5 (Page 17-19).