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## Reply on RC1\_Author comment

Diyali Chattaraj et al.

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Author comment on "Integrated Multi-parametric Analytic Hierarchy Process (AHP) and Geographic Information System (GIS) based Spatial modelling for Water logging Susceptibility Mapping: A case study of English Bazar Municipality of Malda, West Bengal, India" by Diyali Chattaraj et al., Nat. Hazards Earth Syst. Sci. Discuss.,  
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- The population data of Malda district as per the 2011 census will be incorporated in the introduction part. The ward wise population, especially those wards which have newly been formed in order to accommodate the growing population in the study area has already been discussed under section 4.
- The authors have chosen the city of Malda as a study area because of two reasons:
  - The district of Malda is a home to 4.1 per cent of the total state (West Bengal) population and comprises a unique location as it shares the district boundary in north, north-east and south (North and South Dinajpur and Murshidabad); state boundary in the west and north-west (Jharkhand and Bihar) and international boundary in the entire south-east (Bangladesh). English Bazar Municipality (study area) is the one of the oldest municipalities in India as well as the most fastest growing metropolitan area. With the passing of time, the municipality experiences massive refugee influx from the neighbouring districts, states and country.
  - To cope with the growing population during the post-independent period, unplanned extension of built-up areas and metalled roads with no or little provisions for drainage in and around the municipality, has converted many low-lying areas, wetland, and arable land into residential area along Mahananda levee. As a consequence, water-logging is a perennial problem and is set persist throughout the rainy season on the urban fabrics of English Bazar Municipality.

The present study enquires the causes of water-logging and pertains to identify and mapping of the water logging vulnerability and risk zones within English Bazar Municipality premises.

- All the maps, presented in the paper are extracted at 600-dpi resolution. It will be enlarged and rearranged, so that the components are vividly noticeable. Moreover, all the maps, diagrams and tables will be sent to the handling editor of this journal as supplement files for better understanding.

In figure 1 on Malda map (zoom 2), the name of River Ganges will be written.

- The land use land cover map in the raster image will be converted into vector format in order to show the percentage of each land use in relation to its vulnerability, i.e., highly susceptible, moderate and low susceptible to water-logging along with the interpretation and associated attributing factors. Moreover, municipal ward wise area irrespective of all the land use category in relation to its vulnerability (low, moderate and high) can also be displayed.
- The authors have tried earlier to present a water-logged map in respect to normalized difference water index (NDWI) for the monsoon season to show the rainy seasonality in the municipal region, but are unable to extract cloud free satellite image during June to September in 2018.

Some more literatures will be reviewed as well as cited by the authors in the present work to know how monsoon could exacerbate the rate of vulnerability.

- The background of applying the AHP integrated with the GIS will be much strengthened with the help of more literature reviews. Further, to determine the objective and formulate the decision-making process, number of experts comprising hydrologists, engineers, municipal authority were asked during the study to give their assessment and judgement regarding the variables related to water-logging along with their significance in terms of weight. Therefore, the importance of consulting specialists will be mentioned in the present work.
- It would really be interesting to show the relationship between the climate change in the form of frequency and magnitude of rainfall and water-logging situation in the municipality, but there are two limitations:
  - Monthly rainfall data for this micro region (13.25 km<sup>2</sup>) is not provided by the Indian Meteorological Department (IMD) which is considered one of the most authentic weather report organization in India.
  - It would have been much lengthy paper to apply the statistical methods (linear regression etc.) to show the relation between climate change in terms of average annual rainfall and intensity of water-logging.