Seasonal dynamics of geomorphic units and potential denitrification rate in a large lowland tropical river

A Case Study on Padma River, Bangladesh

Md. Ataul Gani

Dr. Gretchen Gettel, Dr. Hans van der Kwast, Dr. Anne van Dam
Prof. Michael McClain, Prof. Ken Irvine

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Geomorphic units and Denitrification

Geomorphic units (GUs) are the building blocks of the rivers which can contribute to nutrient retention, thus ecosystem structure and functioning as well as services, but there is little understanding of their role, especially in large lowland tropical rivers

Denitrification is a natural biogeochemical process by which nitrogen is lost from the land-water interface as a gaseous form thus, prevents nitrogen transport to the downstream ecosystems.

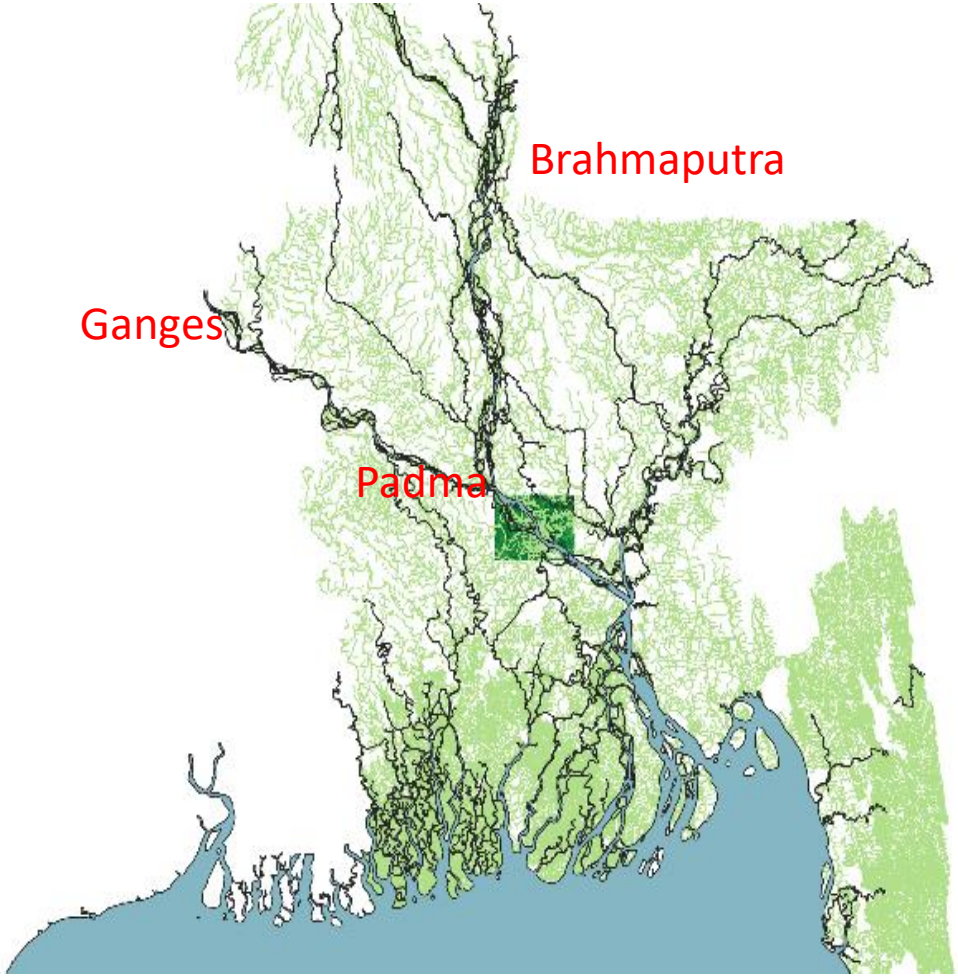
- Understanding the seasonal variation of GUs and the denitrification rate of a river will be helpful in planning river restoration and ecosystem management programs

Study area

The Ganges and Brahmaputra join and flow as the Padma River

The study area ⟶ 50 km long

Max discharge: 800000 m^3/s



Channel morphology

Straight line ⟶ meandering ⟶ braided ⟶ straight again

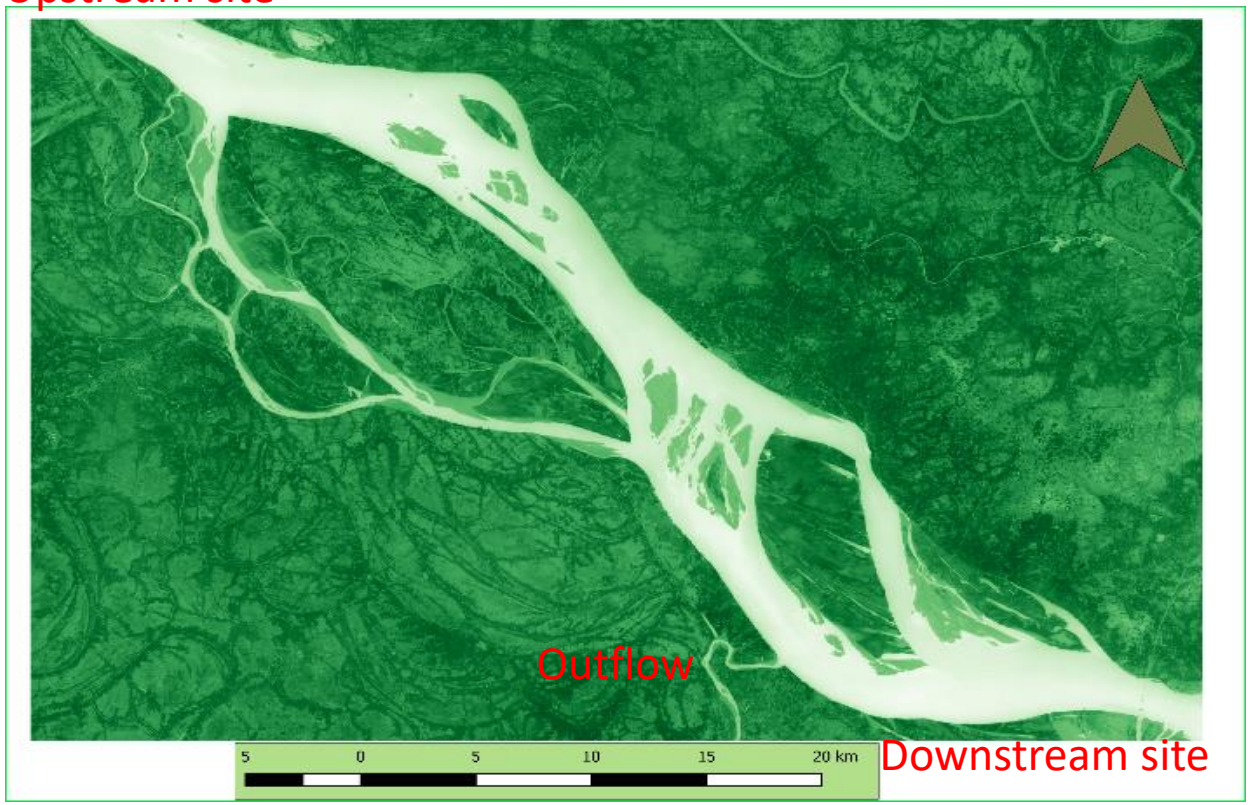
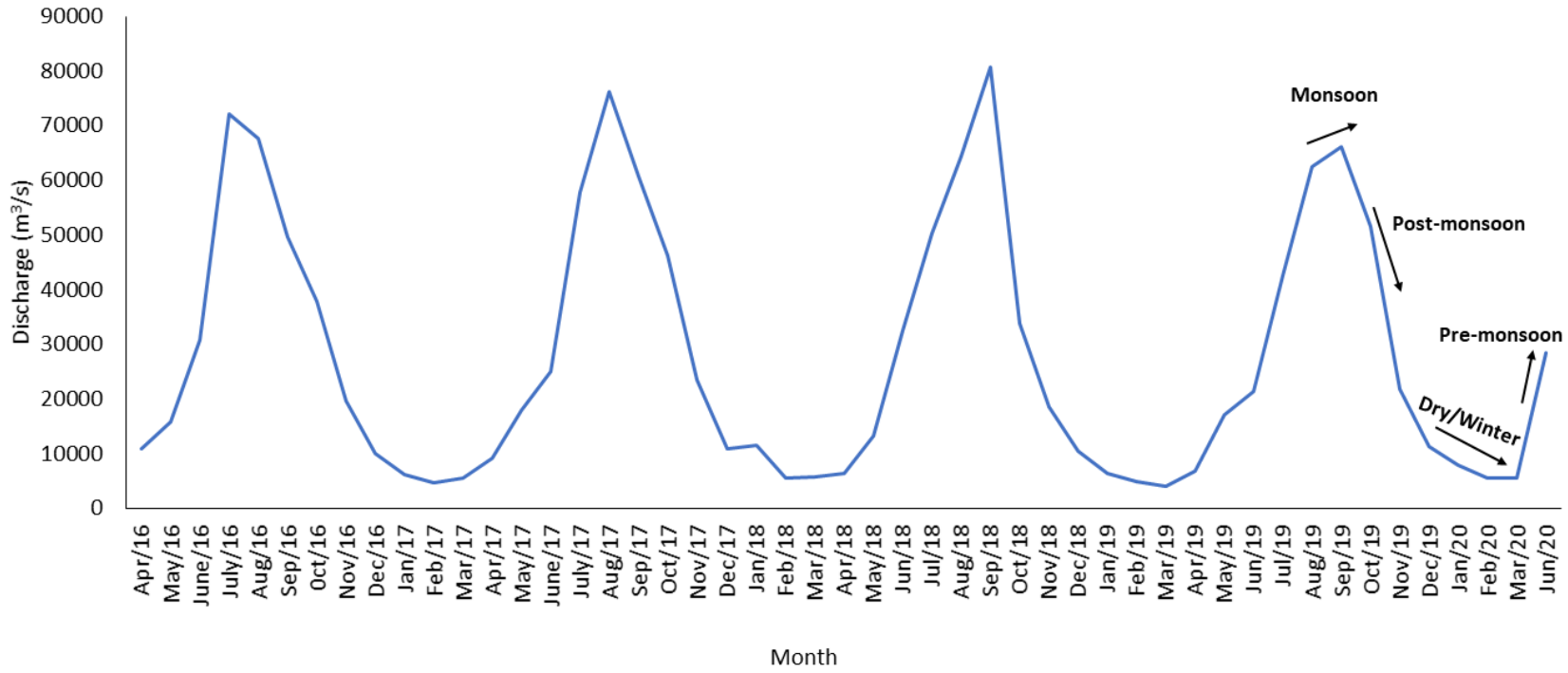


Image processing, data analysis and modelling



Remote sensing data - Sentinel 2 (2019-2020)

LULC types-Random forest

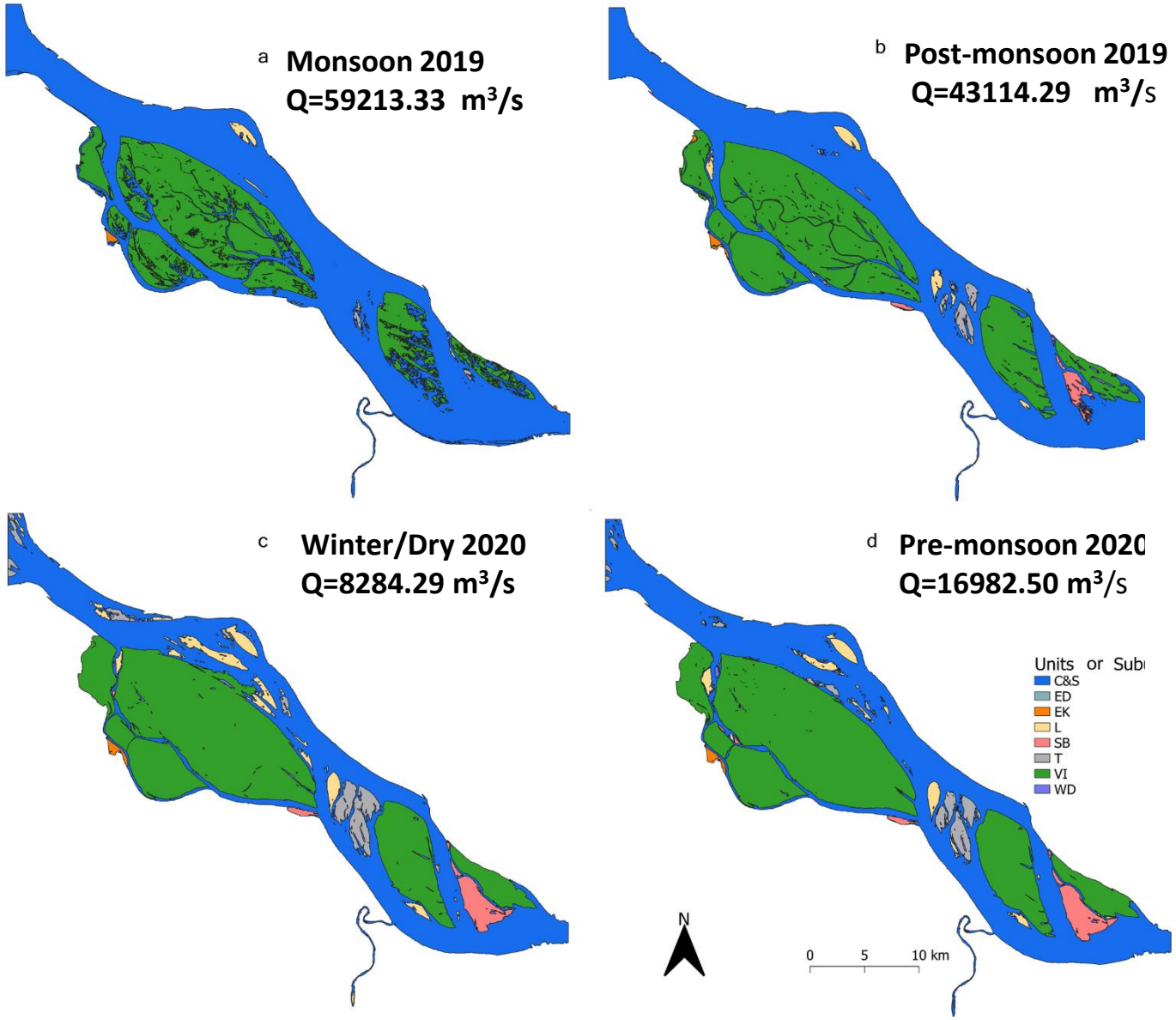
Image processing and analysis- QGIS

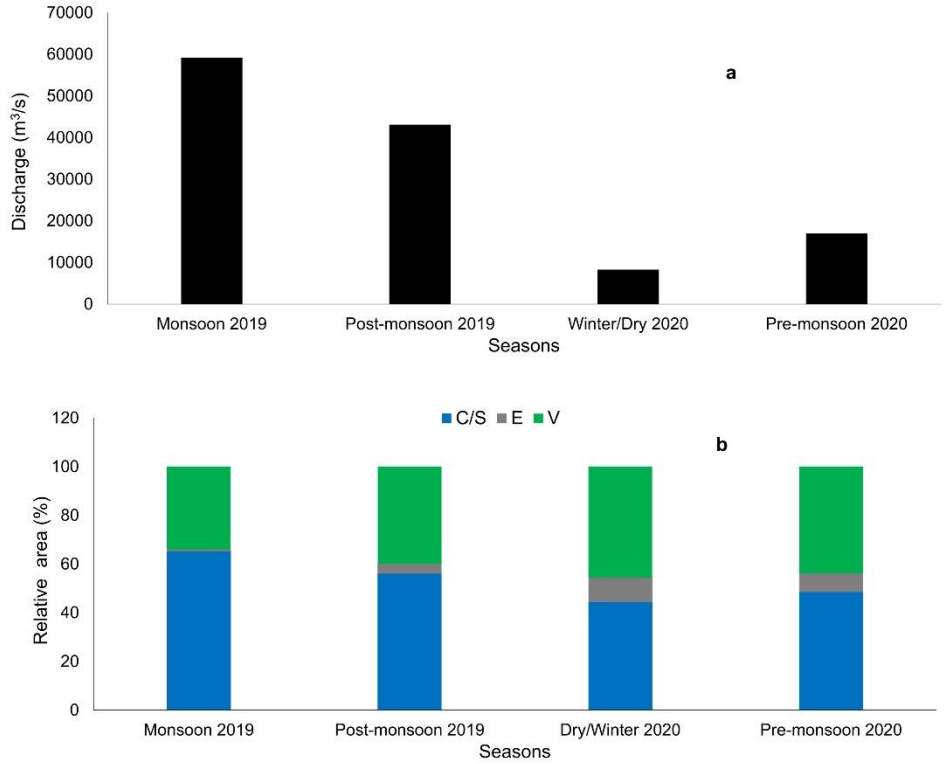
Measurement of denitrification potentials- DEA (Denitrification enzyme assay)

Classifying and analysing of GUs- NDVI

Data analysis and modelling- R

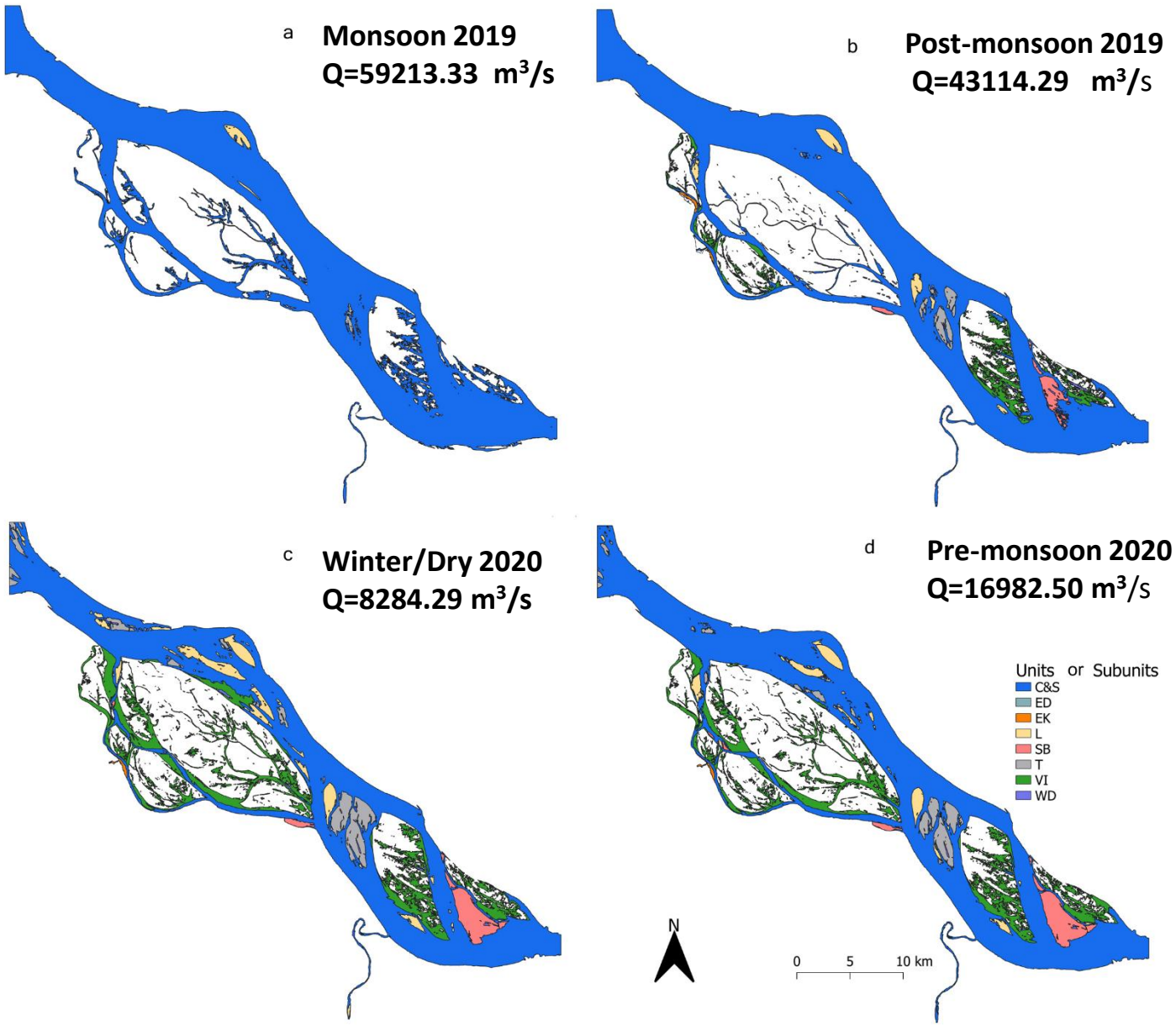
Geomorphic units (GUs) of Padma River





C&S=Main and Secondary channel; EK=Unvegetated Bank; L= Longitudinal Bar; T= Transverse Bar; SB=Side Bar VI= Island; ED; Dry channel; WD= Water Depression

Nutrient retention/export relevant GUs of Padma River

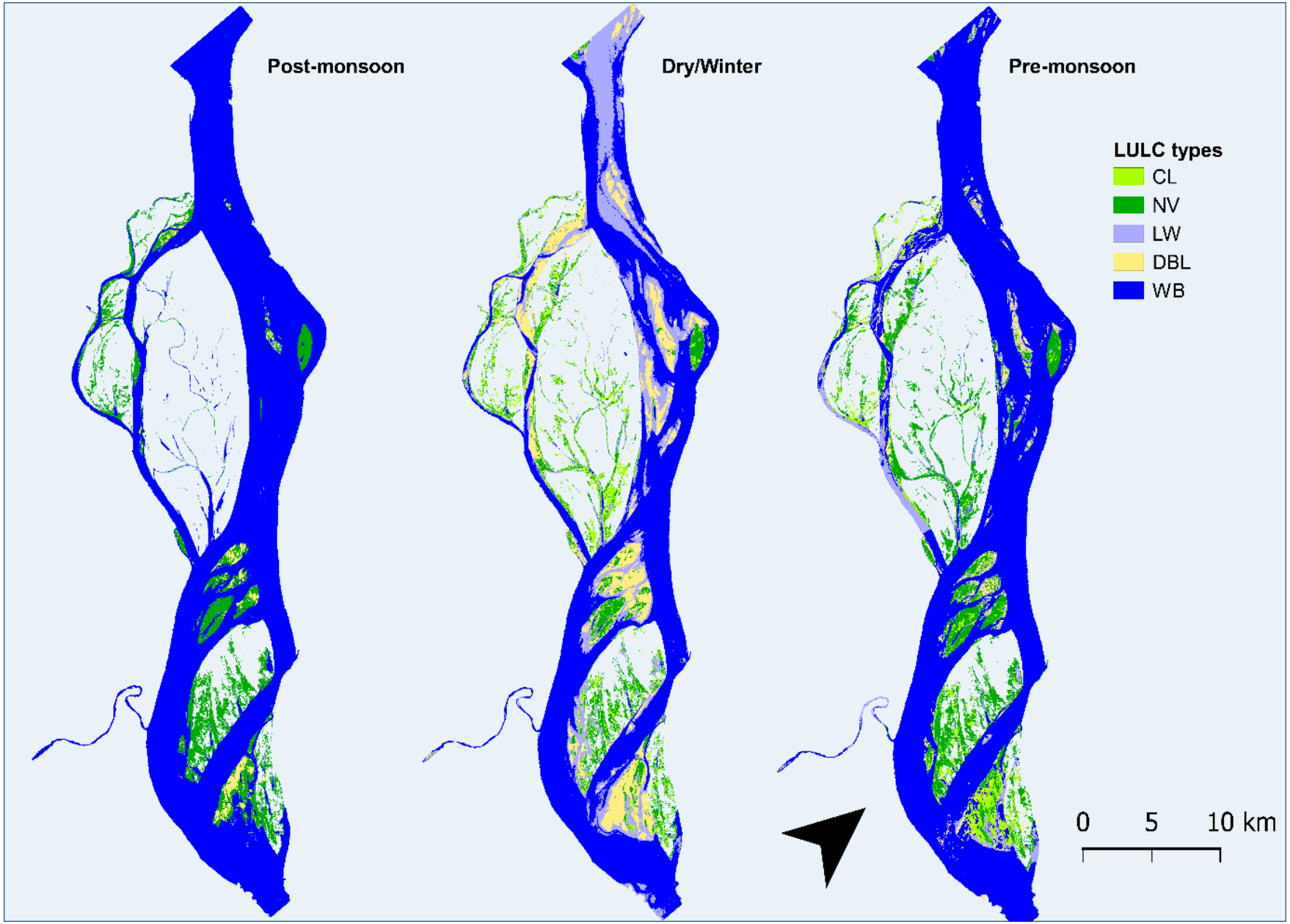


- ✓ Nutrients come to the system through water and sediment supply and inundation occurs during monsoon; based on this assumption nutrient retention/export-related geomorphic units (NREGUs) were identified

C&S=Main and Secondary channel; EK=River Bank; L= Longitudinal Bar; T= Transverse Bar; SB=Side Bar VI= Island; ED; Dry channel; WD= Water Depression

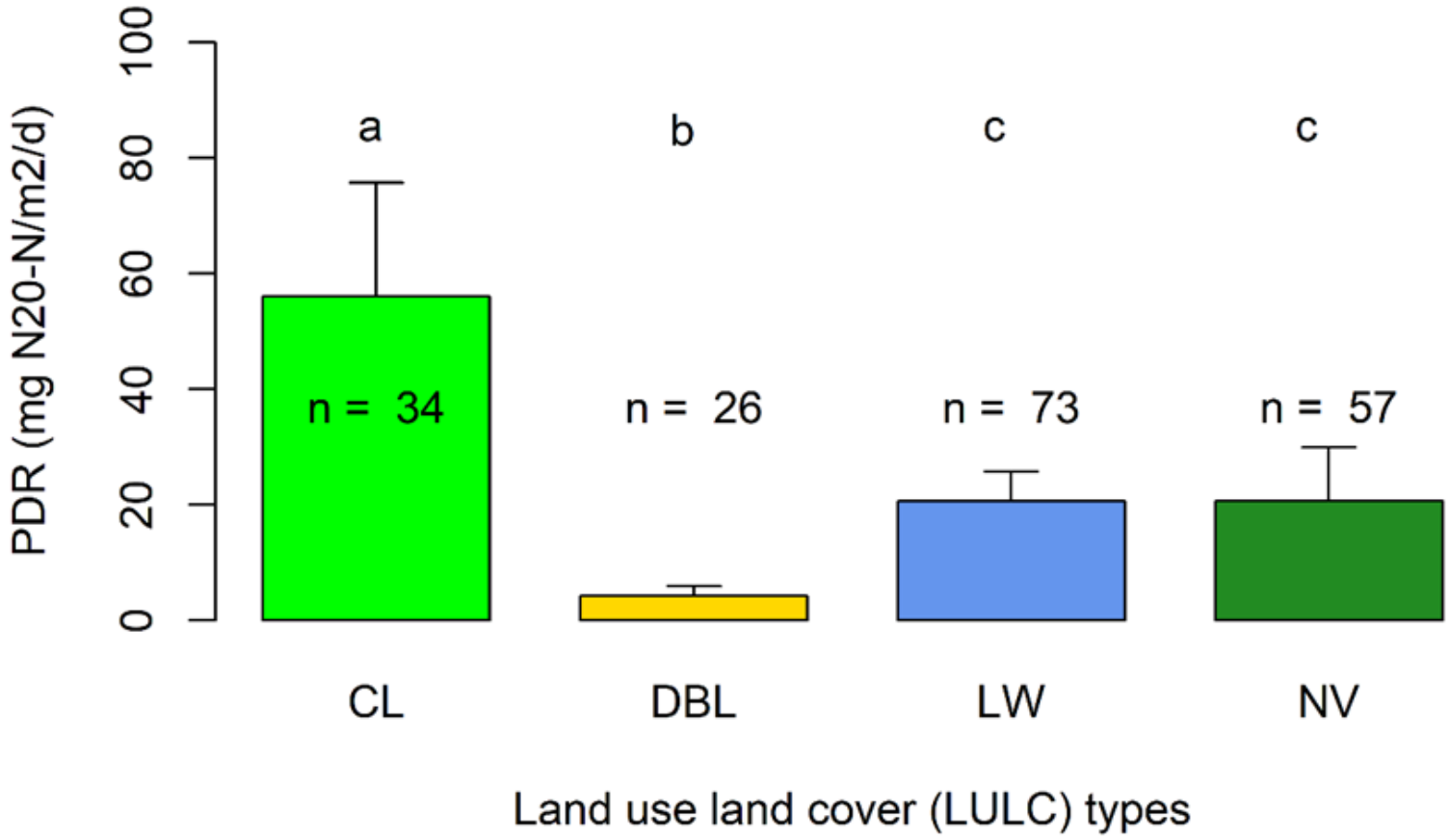
Seasonal variation of LULC (land use land cover) types

- CL=Crop land,
- DBL=Dry bare land,
- LW=Land with water
- NV=Natural vegetation
- WB= water body



Potential denitrification rate (PDR) in different LULC types

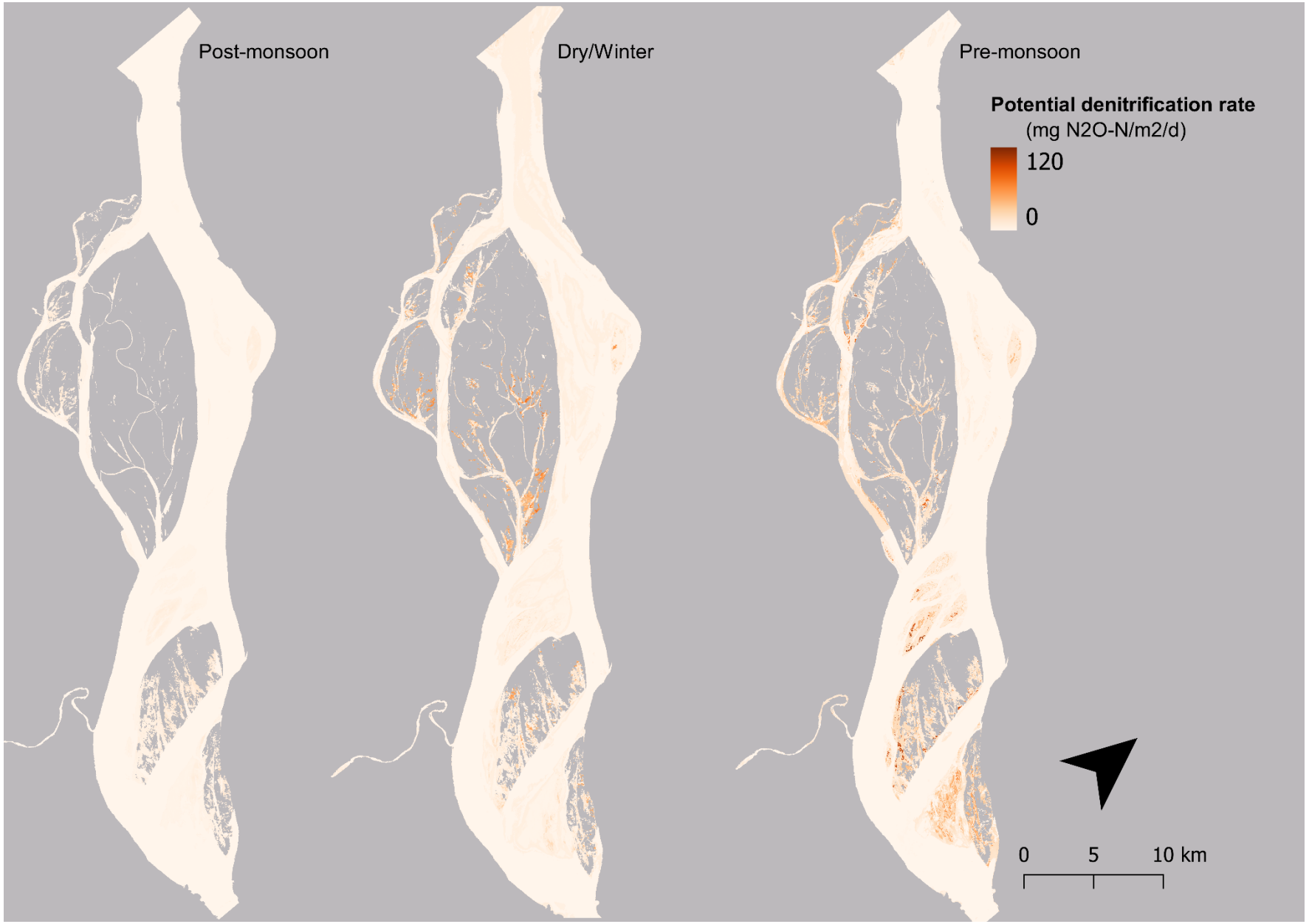
- CL=Cropland,
- DBL=Dry bare land
- LW=Land with water
- NV=Natural vegetation



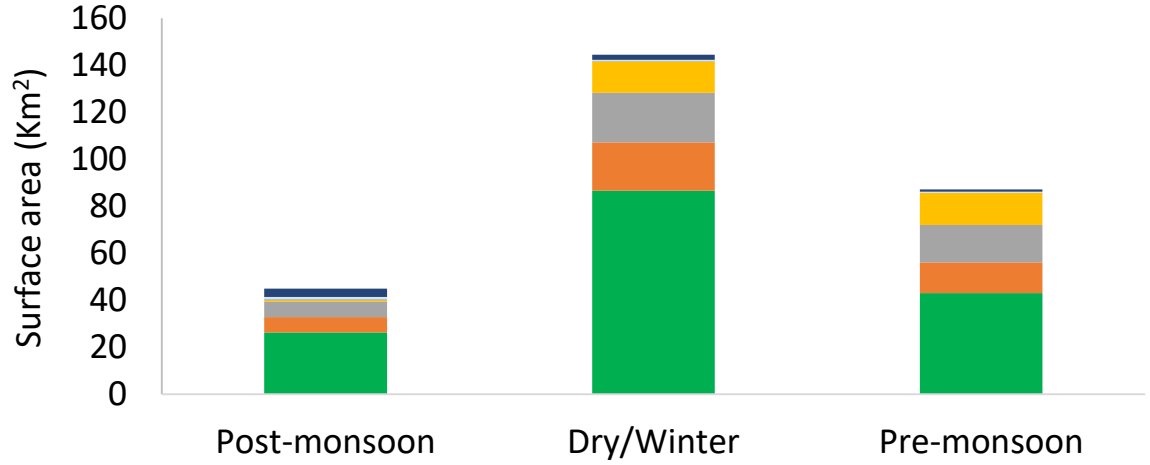
Spatiotemporal distribution of potential denitrification rate (PDR)

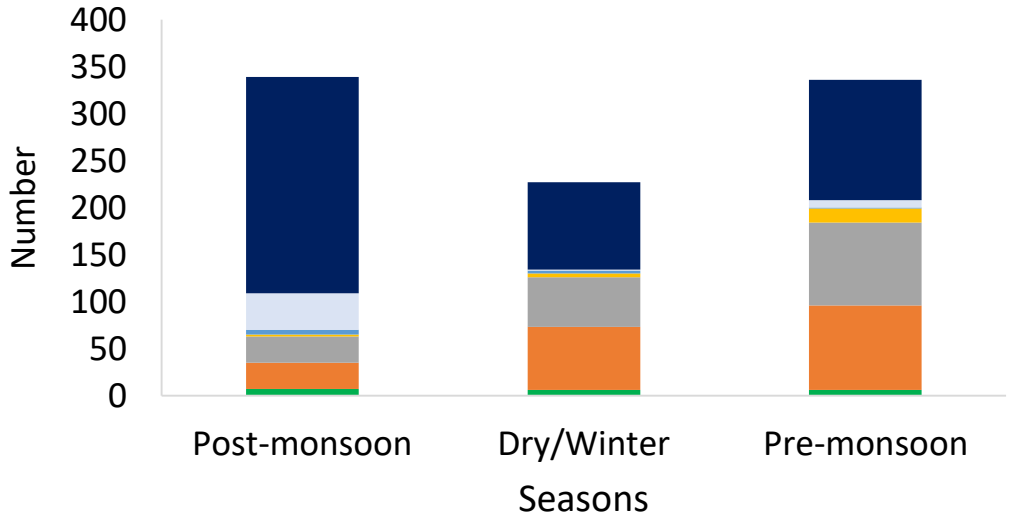
Linear mixed model

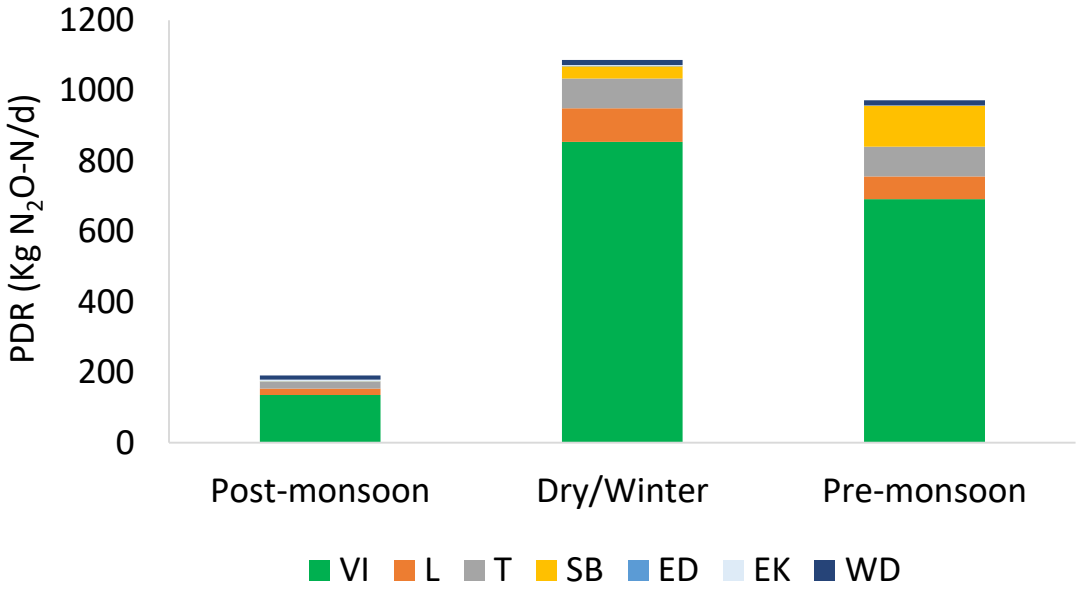
- Sentinel 2 band 11
- Normalized difference vegetation index (NDVI)
- Land use land cover (LULC)



Impact of geomorphic units on potential denitrification rate (PDR)







Significance and scope for the future research

- Seasonal variation in discharge regulates GUs of Padma River, which was responsible for altering the potential denitrification rate as the retention process
- Channelization, dredging, sediment extraction, etc., are going on in Bangladesh and different parts of the world
- And mainly concerned with increasing river depth for navigability and preventing bank erosion.
- Thus might play a vital role in the restructuring of river geomorphology, resulting in an impact on nitrogen (nutrient) retention

Significance and scope for the future research

- The study showed that an alteration of GUs could impact the potential denitrification rate as nitrogen retention, which might have consequences for the downstream part of the river, especially coastal areas regarded as high risk of eutrophication.

- In addition, without considering river health, the effect of implicating different river management projects such as capital dredging can be explained to some extent by applying the present modelling approach in different parts of the country.

THANK YOU