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Machine Learning Approaches for Mapping Silica Sand Deposits using Spaceborne Remote Sensing

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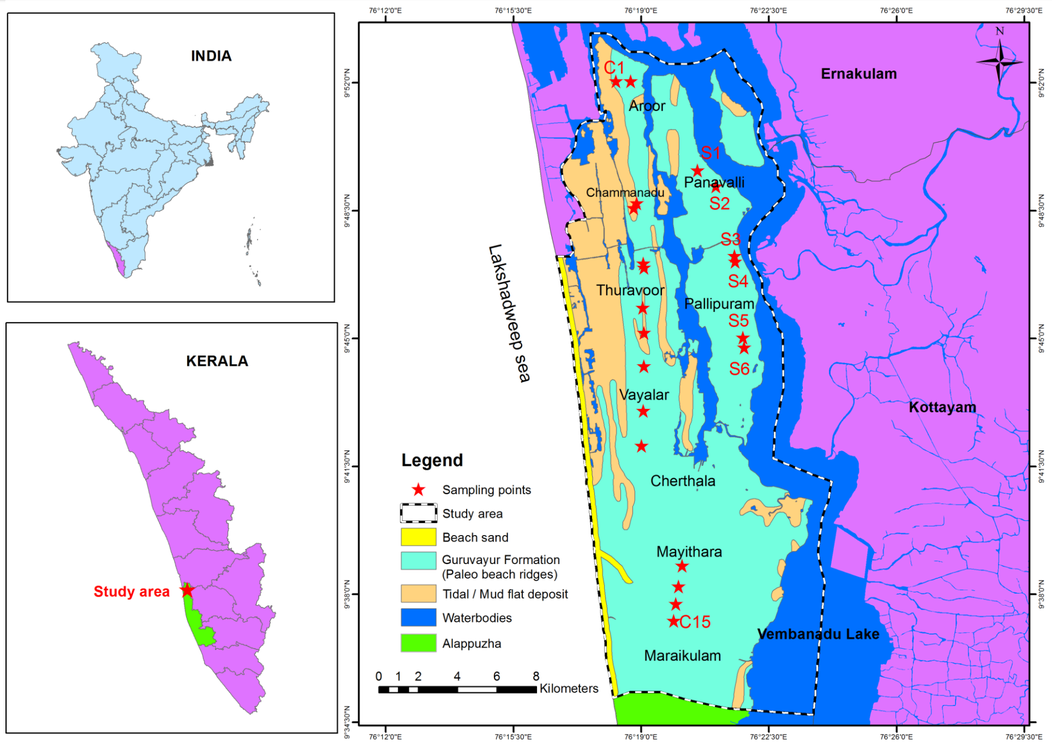
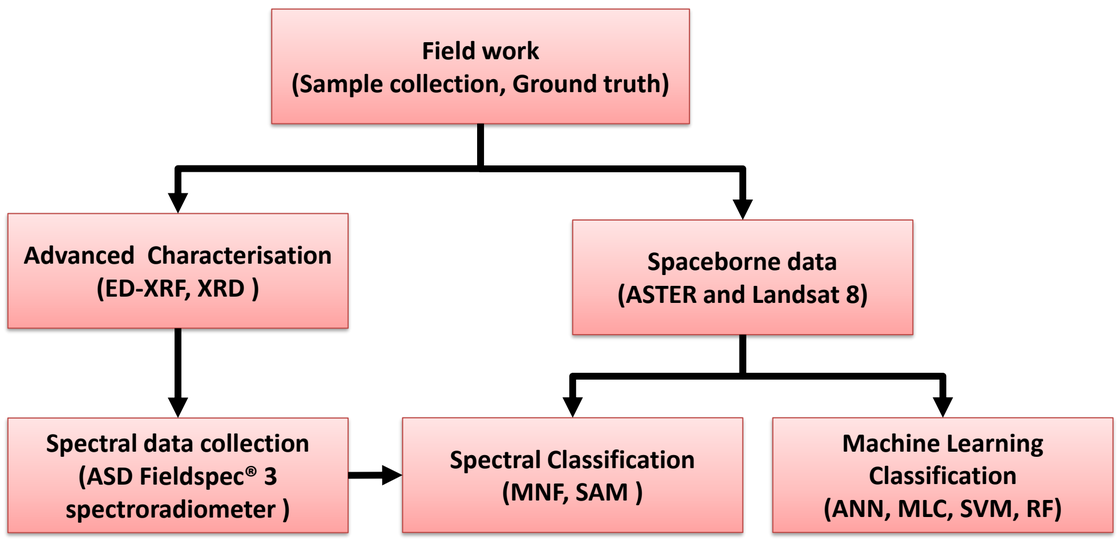
INTRODUCTION & AIM

The Alappuzha district in Kerala, India, has large deposits of high-grade silica sand mainly used for glass manufacturing. The primary objective of the study is to map these mineral deposits using multispectral satellite data and machine learning algorithms (MLAs). Moreover, advanced characterisation was carried out using ED-XRF and XRD, followed by spectral library generation using proximal Vis-NIR spectroscopy.

METHOD



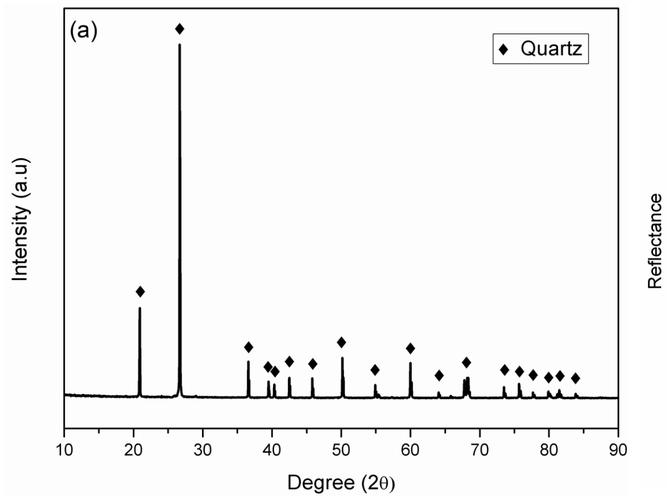
A narrow stretch of land extends over 32km from Arookutti to Cherthala, sandwiched by Vembanad Lake on one side and Lakshadweep Sea on another side, situated in the Alappuzha district in Kerala, India.

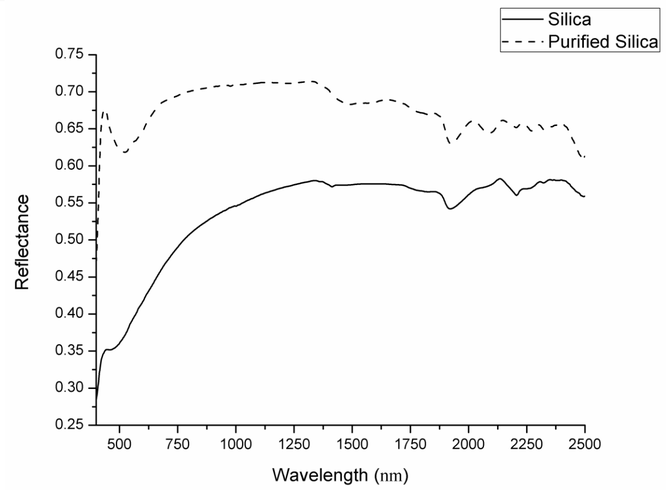


CONCLUSION

Remote sensing exploration of silica sand deposits was successfully done from spaceborne satellite data. The SAM spectral classification technique and machine learning classifiers generated images showing the potential targets of mineral occurrences. The high accuracy confirms the ability of MLAs to map mineral sands using multispectral datasets by providing the best hyperparameters and an accurate selection of training sites. This study facilitates time and resource savings over geological mapping in this field, which allows eco-friendly and sustainable mineral exploration.

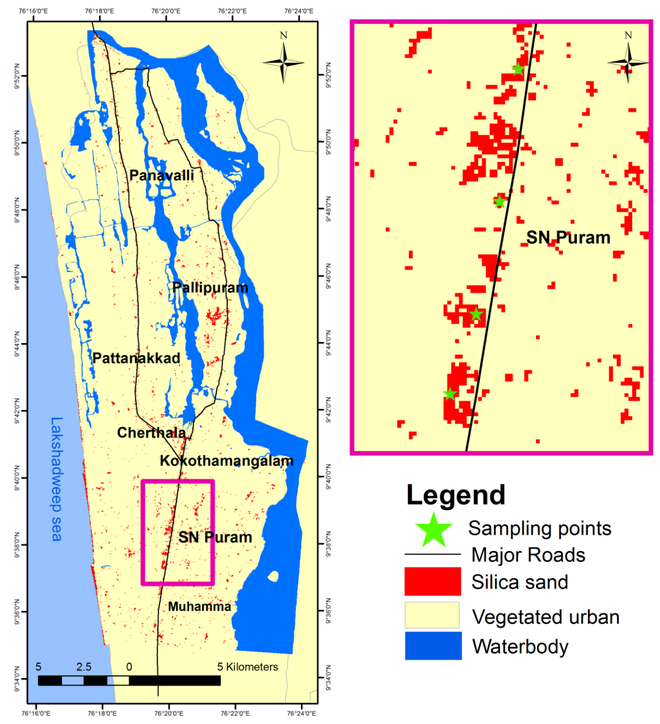
RESULTS & DISCUSSION



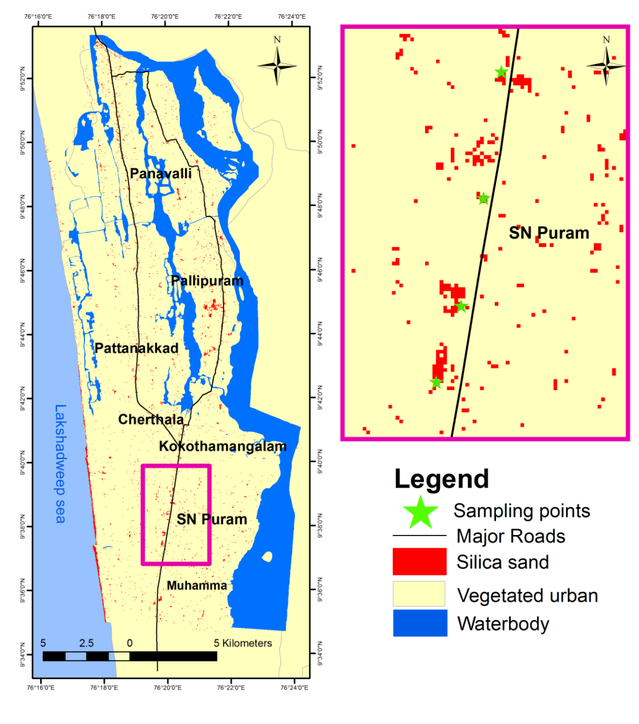


- The samples collected from Cherthala show a silica sand content of 93.93-97.94%.
- ED-XRF shows SiO_2 content of 96.93-99.13%.
- The X-ray diffraction (XRD) analysis reveals diffraction peaks characteristic of quartz.

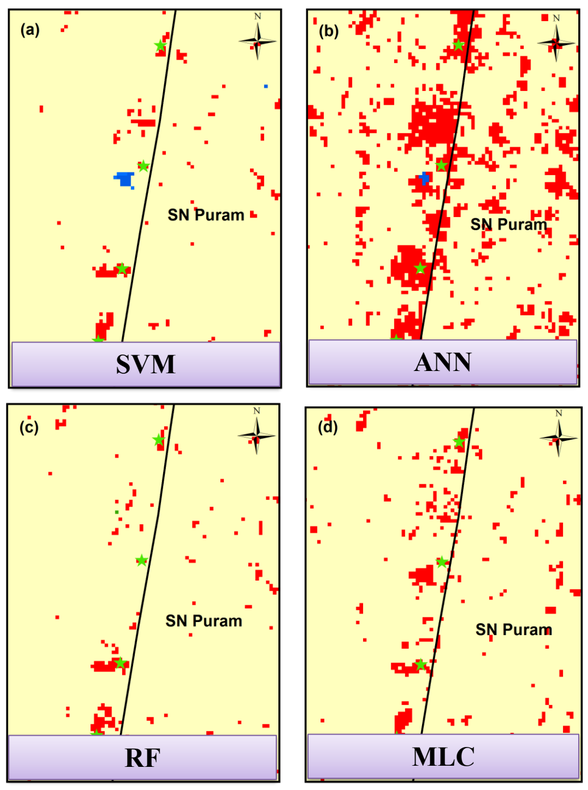
SAM classified image: Landsat 8



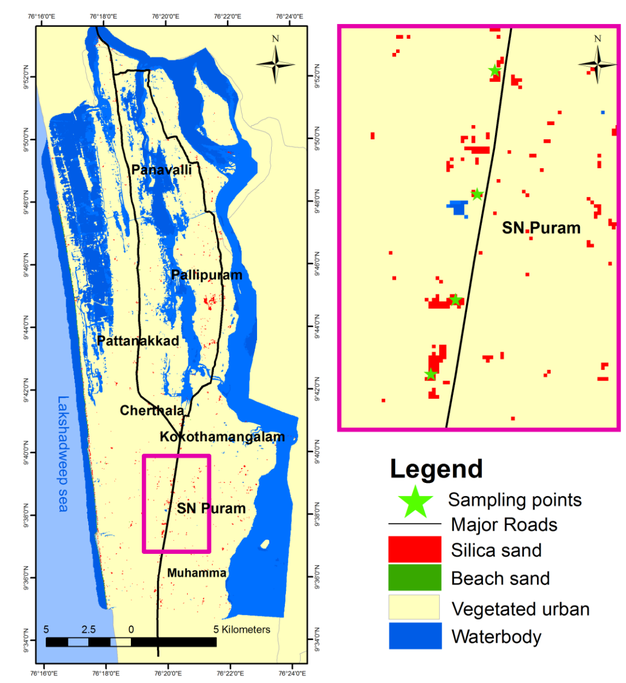
SAM classified image: ASTER



Comparison of Machine Learning Classifiers



SVM classified image: Landsat 8



Machine Learning Classifiers	Overall accuracy (%)	Kappa coefficient
Artificial Neural Network	96.99	0.94
Random Forest	97.76	0.96
Support Vector Machine	97.82	0.96
Maximum Likelihood Classifier	95.71	0.92

SVM outperforms other algorithms with an overall accuracy of 97.82% and Kappa coefficient of 0.96.

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