



CROP DISCRIMINATION USING GML AND GEE

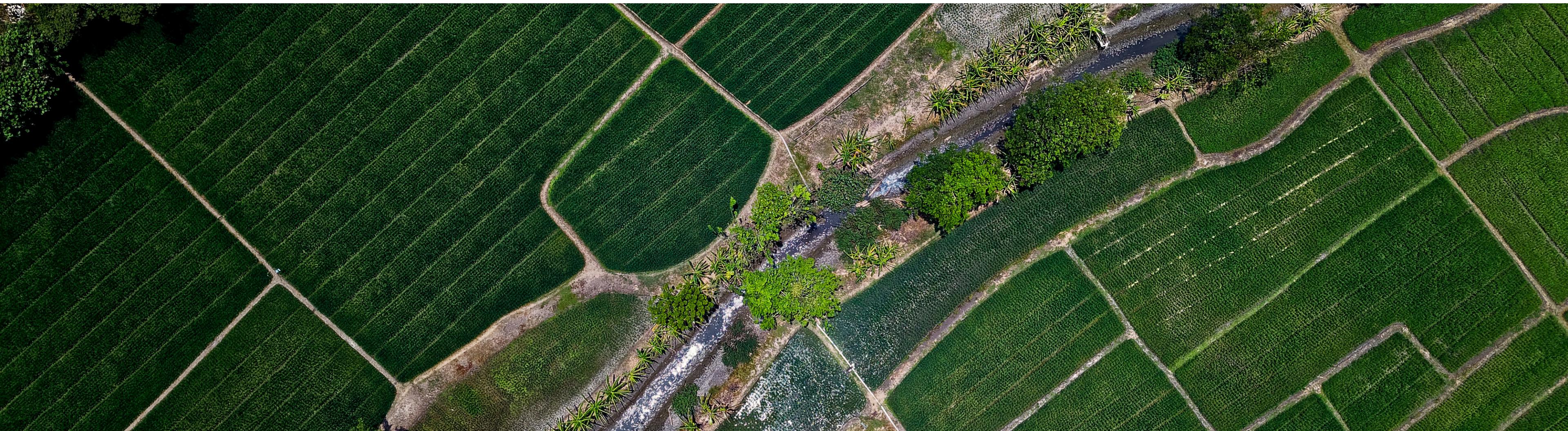
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INTRODUCTION

Crop classification plays a crucial role in agricultural planning, urban development, and environmental monitoring. Remote sensing offers a powerful way to map large areas efficiently.

The main objective is to evaluate how combining optical and microwave datasets improves crop classification and discrimination accuracy during the 2023 cropping season in Udhampur district, using various machine learning models such as Random Forest, SVM, GBM, CART, and KNN.

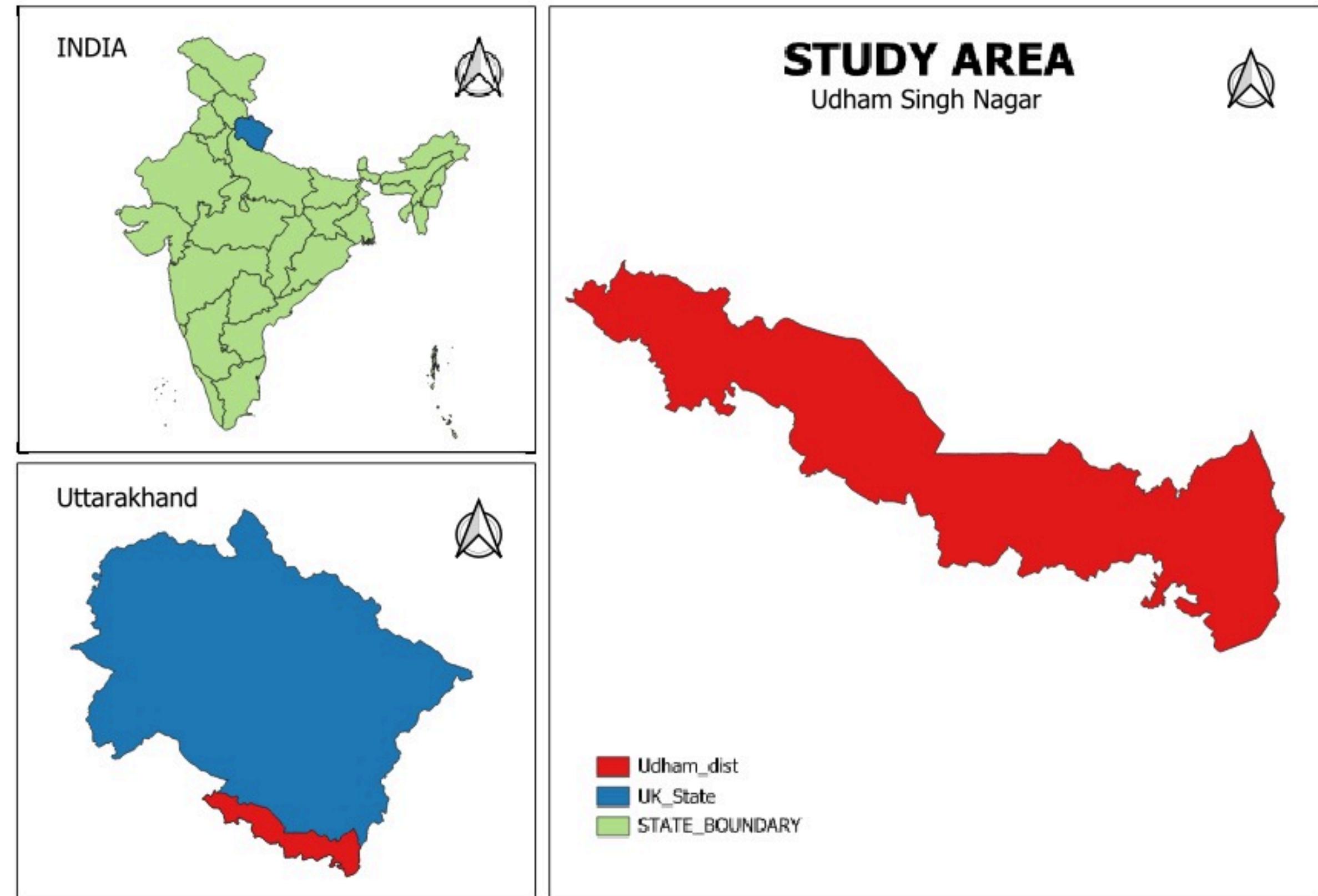


STUDY AREA AND DATASETS

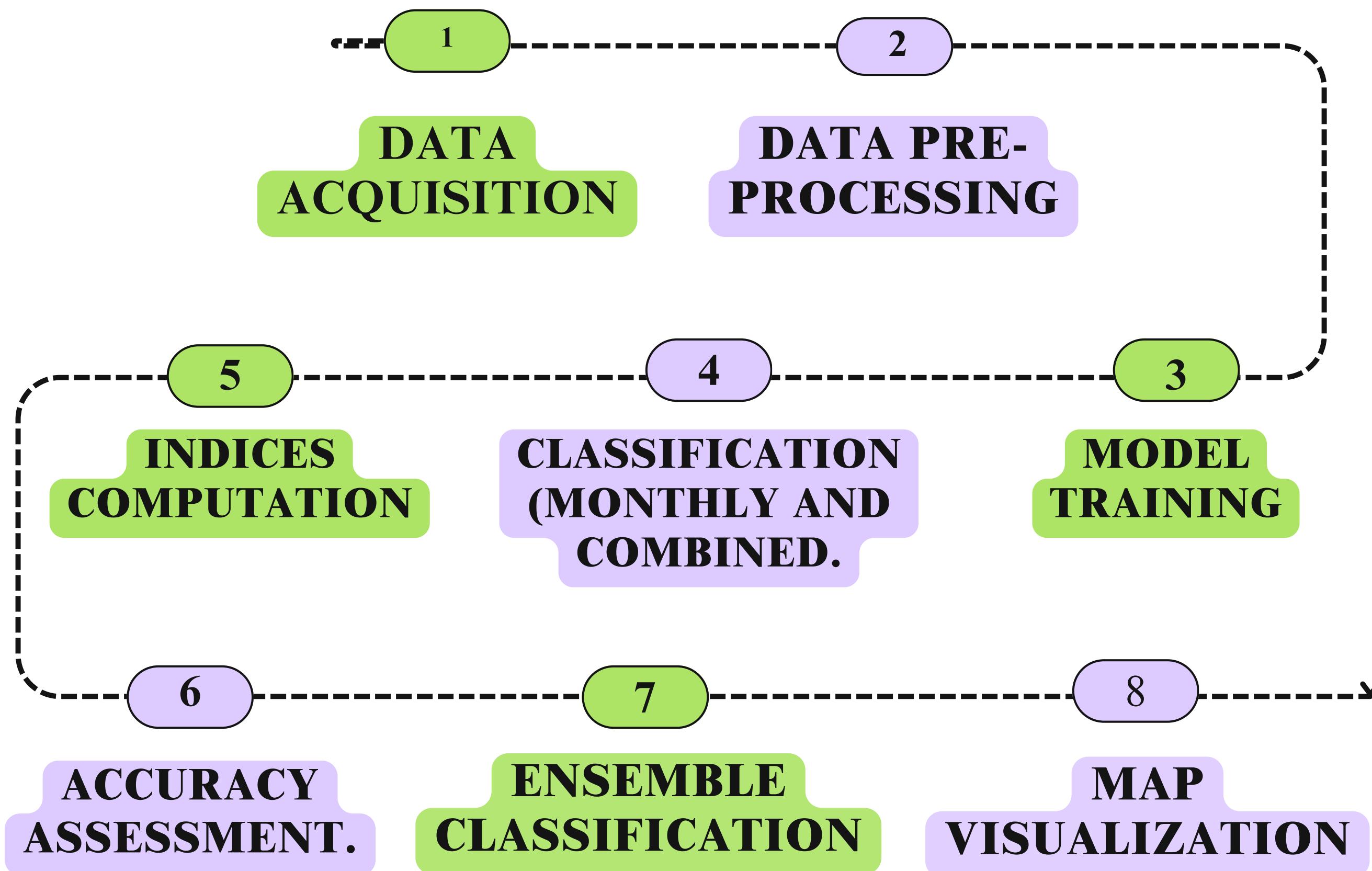
Udham Singh Nagar district, located in Uttarakhand, India.

The datasets used are:

- Sentinel-2 Surface Reflectance imagery
- Sentinel-1 imagery
- Ground-truth data: Field-collected for rice and sugarcane; manually digitized for forests, water, settlements, and barelands.



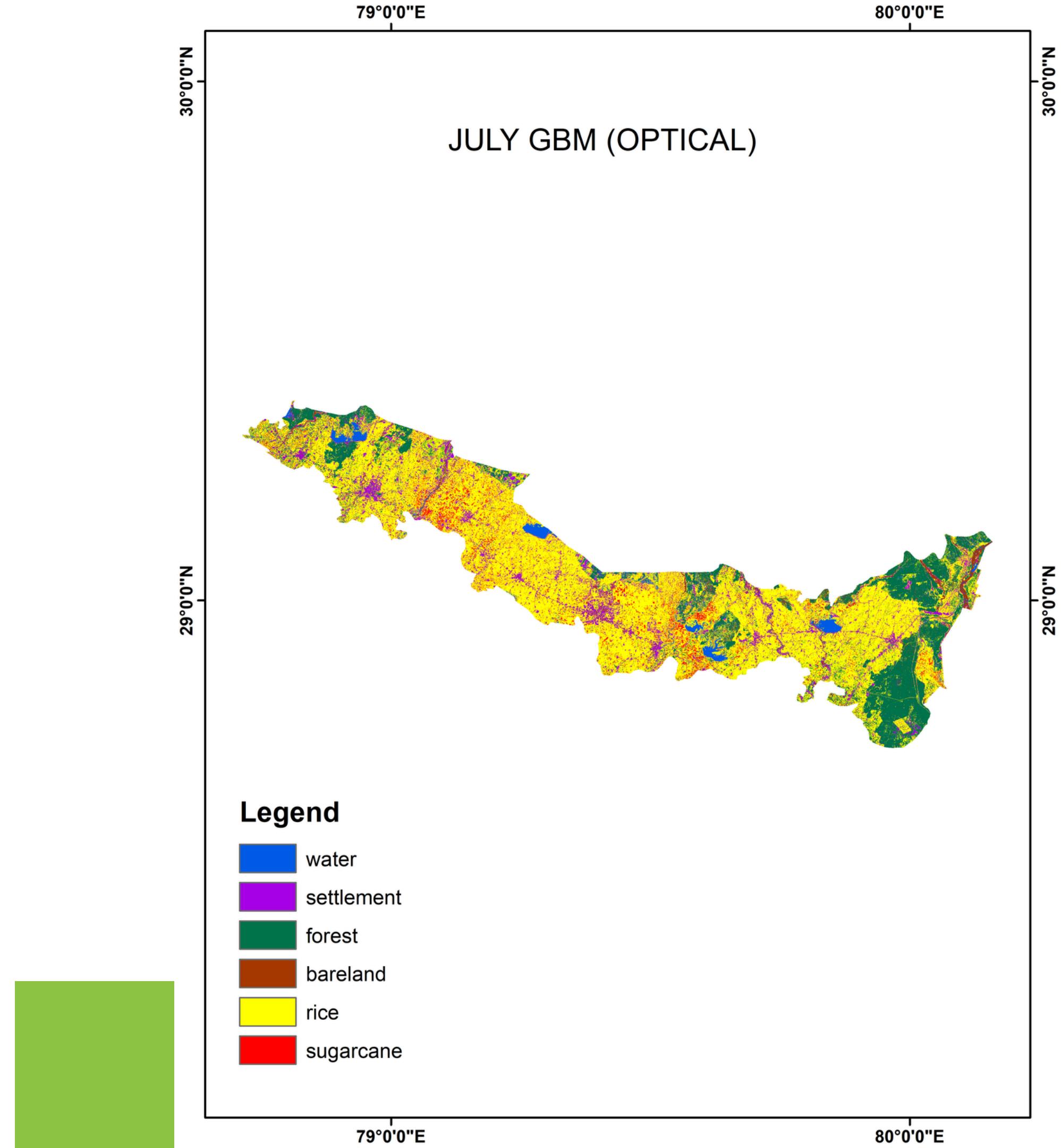
METHODOLOGY



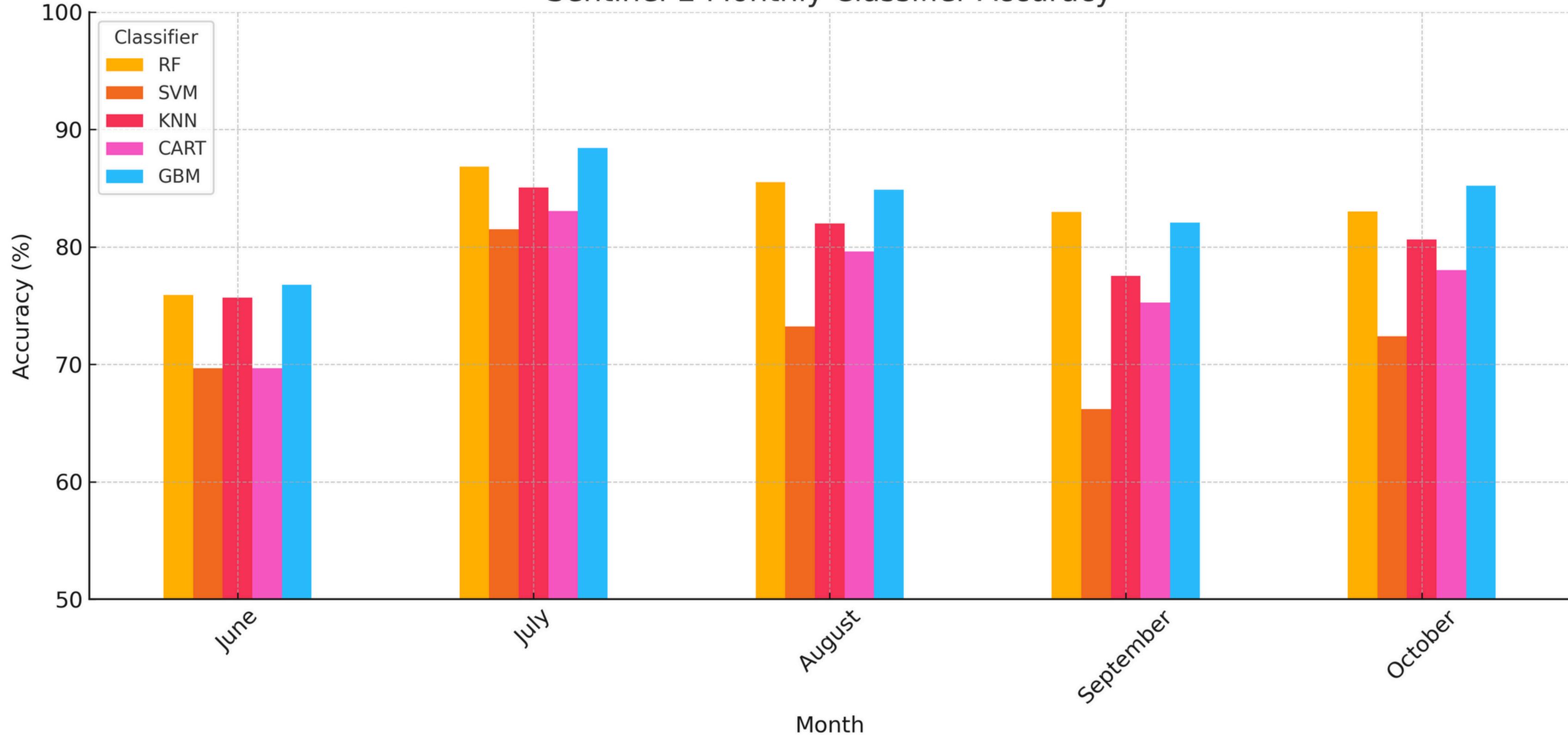
OPTICAL ONLY ACCURACY (MONTHLY)

Monthly classification results using only optical data revealed clear variations:

- Random Forest (RF) and Gradient Boosted Machine (GBM) consistently delivered the highest accuracies, especially during July and August, aligning with the peak crop growth phase.
- GBM achieved a top accuracy of 88.42% in July.
- SVM and CART lagged slightly, particularly during August, September, and October.

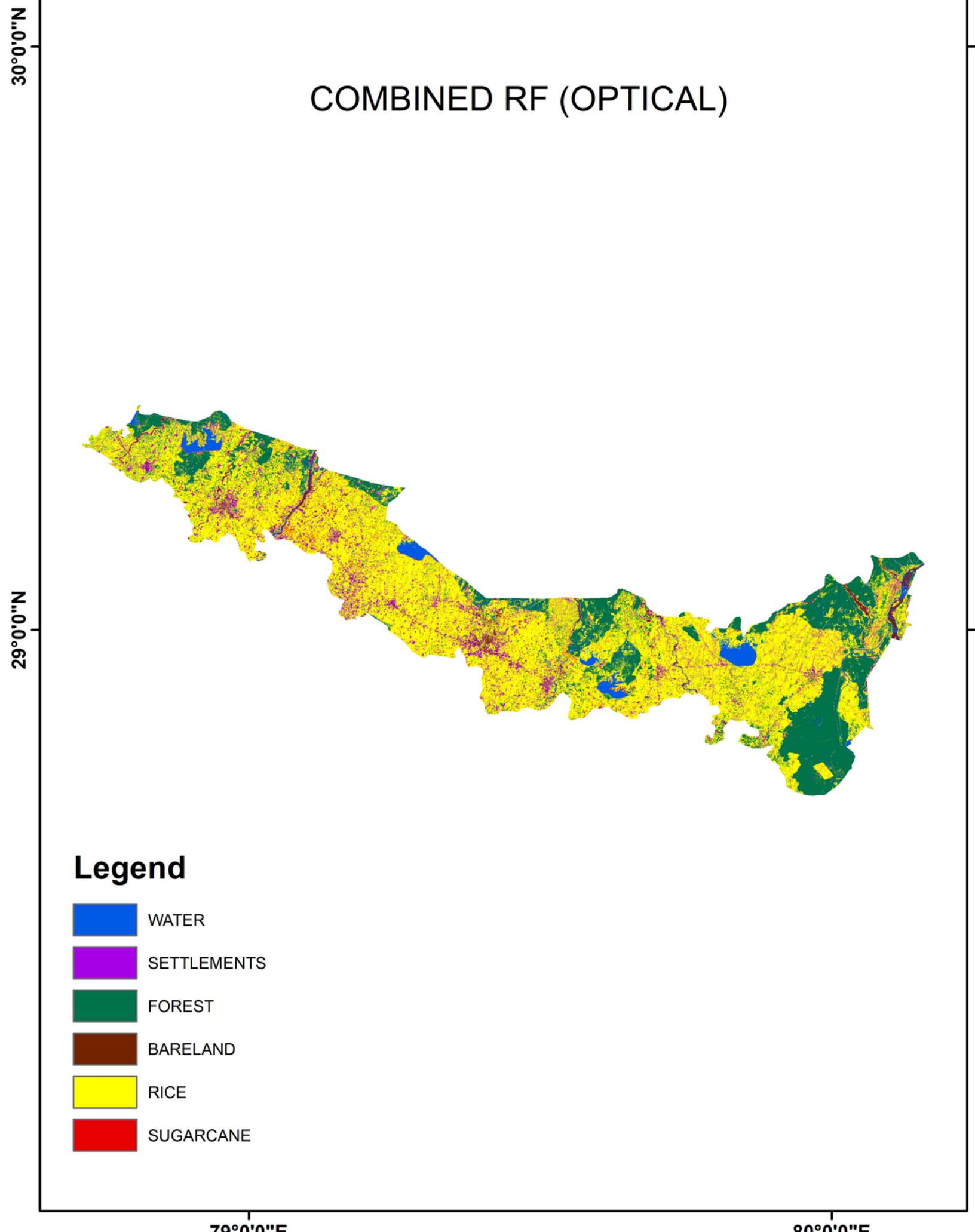


Sentinel-2 Monthly Classifier Accuracy



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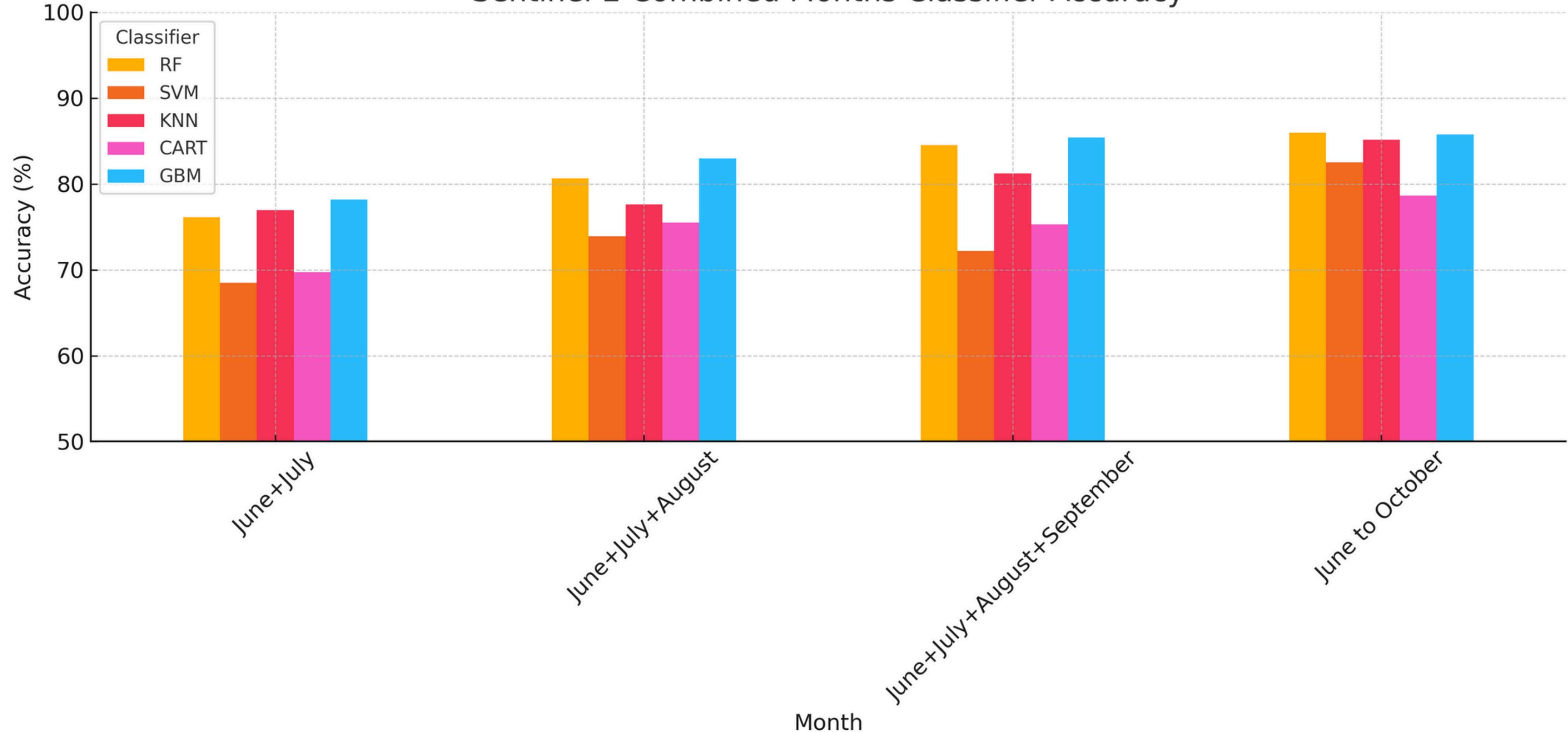


OPTICAL ONLY ACCURACY (COMBINED)

Combining multiple months of optical data had a change in the accuracy significantly:

- June–July composites reached an overall accuracy of 78.19% with GBM.
- Extending to June–October, accuracy rose further, with Random Forest achieving 85.99%, having the highest accuracy for the combined periods

Sentinel-2 Combined Months Classifier Accuracy



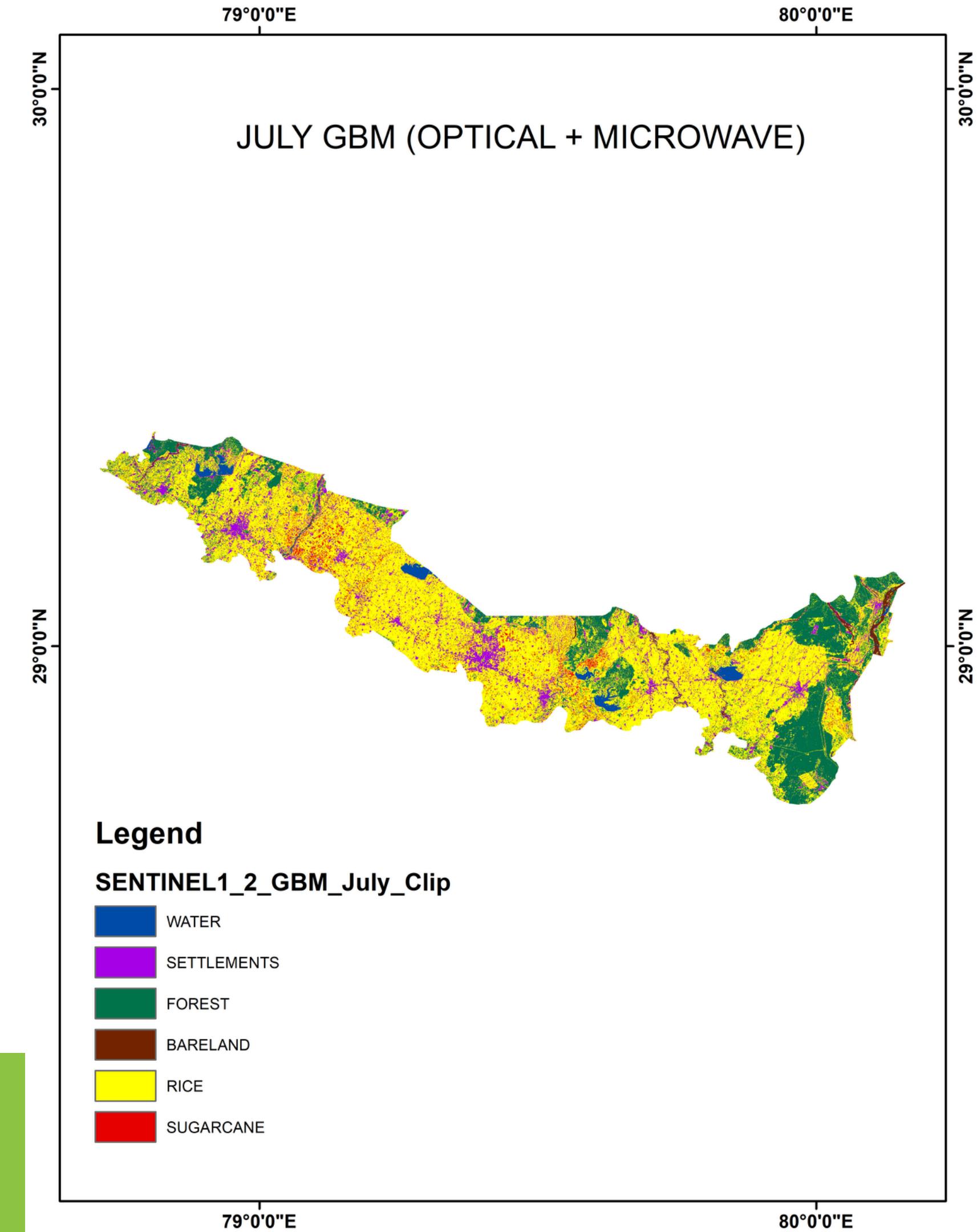
OPTICAL ONLY ACCURACY

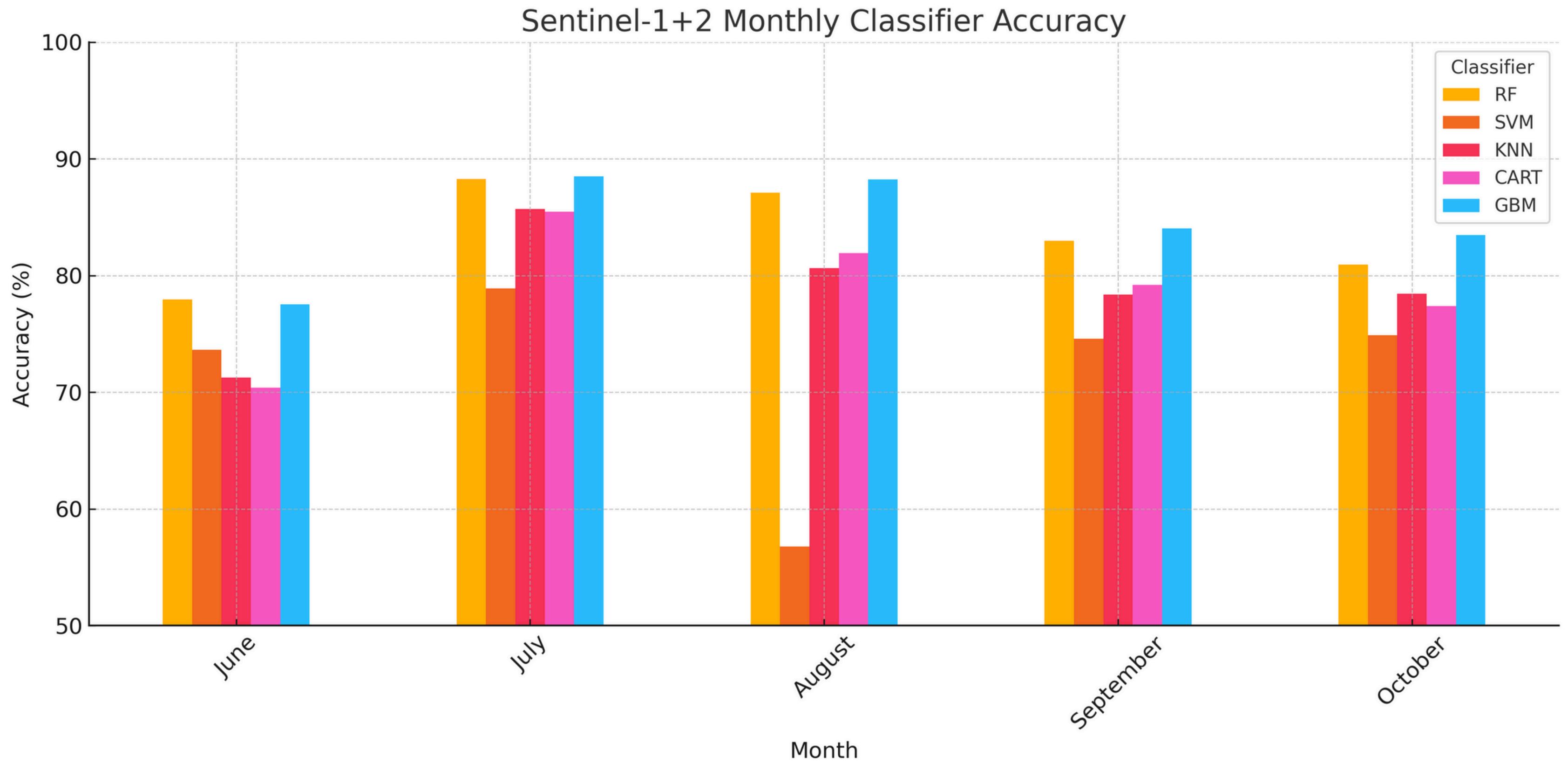
Month	RF Accuracy (%)	SVM Accuracy (%)	KNN Accuracy (%)	CART Accuracy (%)	GBM Accuracy (%)
June	75.91	69.68	75.69	69.68	76.77
July	86.86	81.51	85.08	83.07	88.42
August	85.53	73.24	82.01	79.61	84.87
September	82.99	66.21	77.55	75.28	82.08
October	83.04	72.39	80.65	78.04	85.21
June+July	76.11	68.51	76.95	69.75	78.19
June+July+August	80.65	73.89	77.62	75.52	82.98
June+July+August+September	84.54	72.18	81.23	75.28	85.43
June to October	85.99	82.54	85.13	78.66	85.78

OPTICAL +MICROWAVE ACCURACY (MONTHLY)

Introducing microwave (Sentinel-1) data alongside optical imagery led to clear improvements:

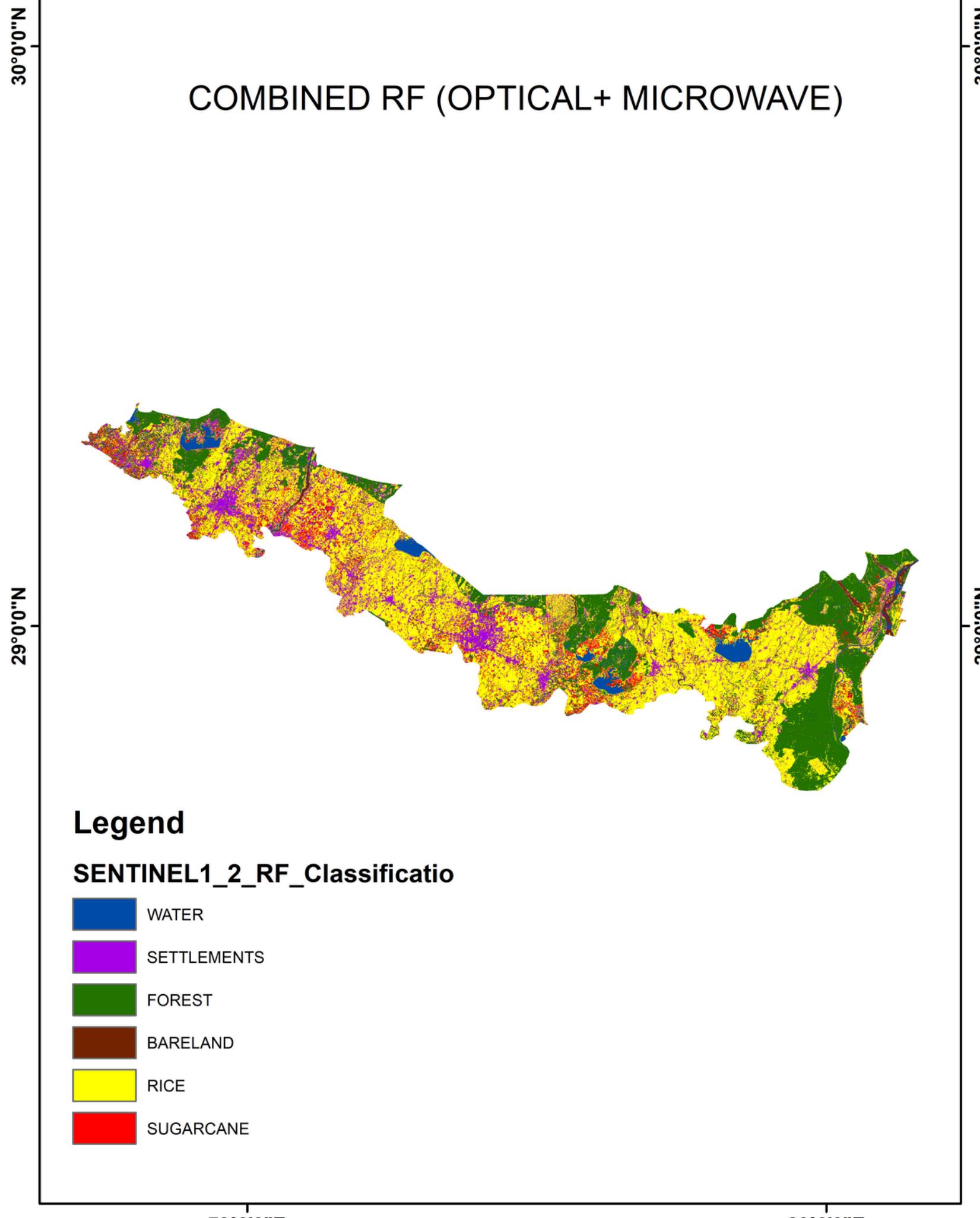
- Overall accuracies improved by 2–4% compared to optical-only results.
- GBM achieved a remarkable 88.49% in July for optical + microwave datasets.
- Microwave data helped reduce cloud interference, strengthening model performance .





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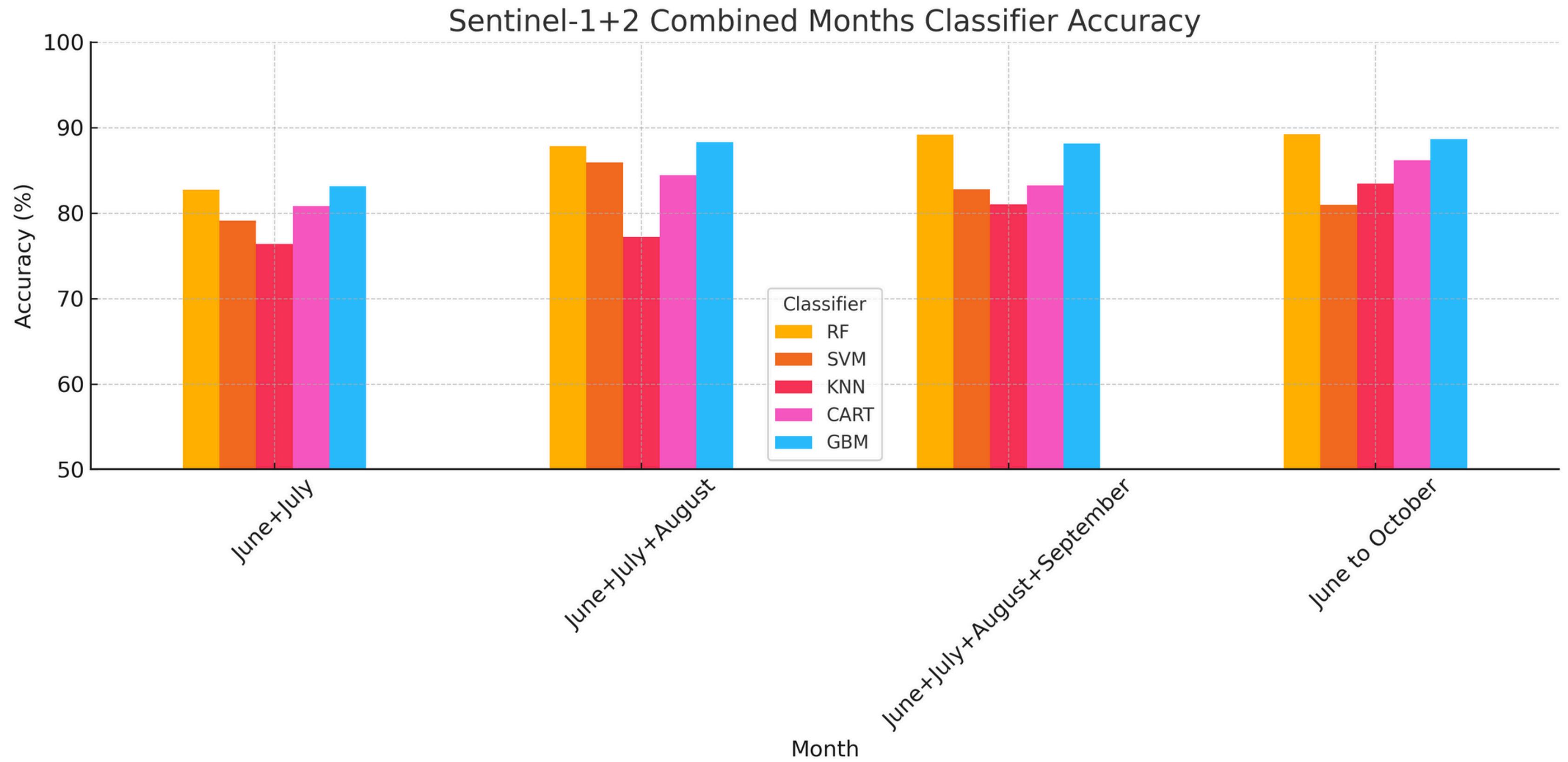
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OPTICAL+ MICROWAVE ACCURACY (COMBINED)

Combining optical and microwave datasets over the full cropping season (June–October) delivered the highest classification performances:

- Random Forest achieved the highest accuracy of **89.21%** for June–October combined periods.
- GBM closely followed with **88.66%**.
- Improvements were more noticeable over longer periods, emphasizing how optical + microwave fusion better captures seasonal dynamics and surface changes.



Month	RF Accuracy (%)	SVM Accuracy (%)	KNN Accuracy (%)	CART Accuracy (%)	GBM Accuracy (%)
June	77.97	73.65	71.27	70.41	77.54
July	88.27	78.89	85.71	85.5	88.49
August	87.1	56.77	80.65	81.94	88.25
September	82.98	74.58	78.36	79.2	84.03
October	80.96	74.9	78.45	77.4	83.47
June+July	82.7	79.11	76.37	80.8	83.12
June+July+August	87.85	85.93	77.18	84.43	88.27
June+July+August+September	89.18	82.78	81.01	83.22	88.14
June to October	89.21	80.95	83.45	86.17	88.66

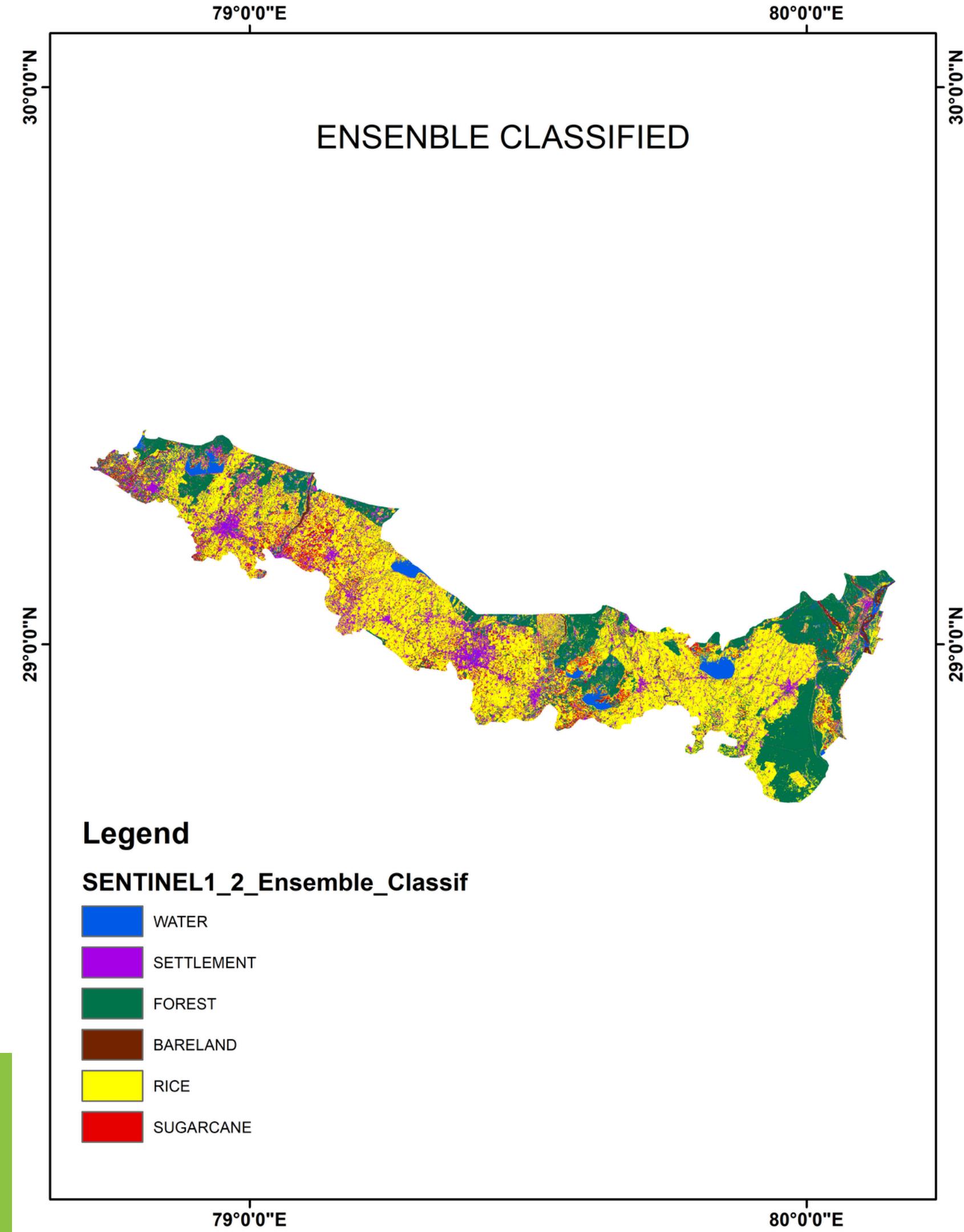
ENSEMBLE CLASSIFICATION

In addition to individual classifiers, an ensemble model was generated by performing a majority voting across the outputs of RF, SVM, KNN, CART, and GBM classifiers.

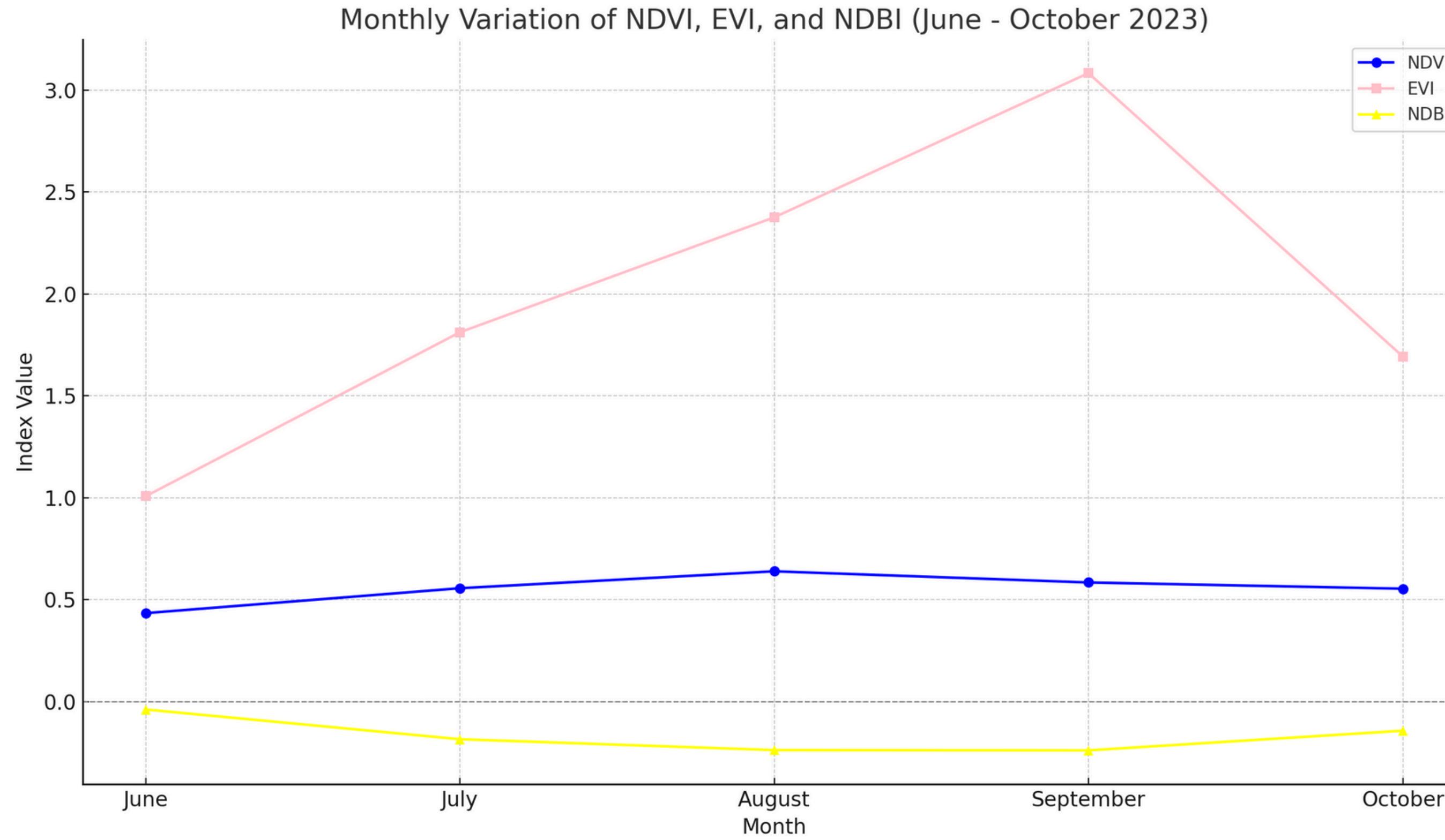
The ensemble classification achieved an overall accuracy of 90.25%.

TOTAL AREA OF CROPS:

- Rice Area: 177,749 ha
- Sugarcane Area: 2,838 ha



INDICES RESULT



CONCLUSION

- Remote sensing with Sentinel-2 and Sentinel-1 achieved high classification accuracy for crop mapping.
- Random Forest and GBM consistently performed best across monthly and combined periods.
- Rice dominated the landscape, covering ~177,749 ha , while Sugarcane occupied ~2,838 ha .
- Ensemble modeling enhanced classification robustness.



An aerial photograph of a rural area. It features a dense network of green fields, some with distinct patterns from crop cultivation. A single railway track runs diagonally across the frame from the top left towards the bottom right. In the bottom left corner, there is a cluster of small houses with dark roofs, likely a village. The overall scene is a mix of agricultural land and early industrial infrastructure.

thankYOU