SYNOPSIS OF THE PROPOSED RESEARCH PROJECT FOR

“Bangladesh Space Research and Remote Sensing Organization (SPARRSO)”

FELLOWSHIP: 2025

1. Title of the Research:

“Remote Sensing-Based Rice Monitoring and Forecasting in Bangladesh Using NDVI and Rainfall Data”

2. Introduction:

Rice is the principal food crop of Bangladesh, covering approximately 75% of total cropped area and contributing significantly to both national food security and rural livelihoods (BBS, 2023). However, rice production is increasingly threatened by climate-induced variability, including erratic rainfall, floods, and droughts. Traditional monitoring techniques often fail to provide timely or spatially comprehensive information needed for early intervention (Chen et al., 2011; Torbick et al., 2017).

Remote sensing, particularly through the use of vegetation indices like the Normalized Difference Vegetation Index (NDVI), offers a powerful alternative. NDVI measures the "greenness" or photosynthetic activity of vegetation, which correlates with crop health and biomass (Gaikwad et al., 2025; Huang et al., 2021). Coupled with rainfall data, NDVI can be used to detect crop stress, monitor seasonal growth, and predict yield at large spatial scales (Pettorelli, 2013).

This research aims to harness the potential of NDVI and rainfall correlation to improve the monitoring and forecasting of rice crops across Bangladesh's diverse agro-climatic zones.

3. Objectives:

- To monitor the spatial and temporal growth patterns of rice crops using NDVI data.
- To assess the impact of rainfall variability on NDVI and rice growth stages.
- To develop a predictive model for rice yield estimation based on NDVI and rainfall correlations.
- To provide early warning information for crop stress and production shortfall risks.

4. Methodology:

4.1 Study Area:

The study will focus on Bogra, Comilla, and Barisal districts, representing key rice-growing regions in the Rajshahi, Chattogram, and Barisal divisions. These areas cover diverse agro-ecological zones and include all three major rice seasons—Aus, Aman, and Boro—making them suitable for analyzing seasonal variations in NDVI and rainfall.

4.2 Data Collection:

The study will use NDVI data from Sentinel-2 and MODIS, and rainfall data from BMD and CHIRPS. Crop yield and calendar information will be collected from DAE and FAO. Field observations from local extension offices will support ground validation.

4.3 Tools and Software:

- Google Earth Engine – for satellite image processing and NDVI time series
- QGIS – for spatial analysis and visualization
- Python (NumPy, Pandas, SciPy, Matplotlib) – for statistical modeling
- Statistical Analysis – Regression, Pearson correlation, RMSE.

4.4 Working Procedure:

4.4.1 NDVI Time Series Analysis:

NDVI data from MODIS (16-day composites) and Sentinel-2 (10m resolution) will be used to generate weekly vegetation curves for each rice season. NDVI peaks and patterns will be used to identify sowing, tillering, and harvest stages (Waldini et al., 2021).

4.4.2 Rainfall Pattern Analysis:

Daily rainfall data from CHIRPS and BMD will be aggregated into weekly totals. Anomalies in rainfall (drought/flood spells) will be identified and cross-compared with NDVI trends (Usman & Nichol, 2020).

4.4.3 NDVI–Rainfall Correlation:

Statistical correlation will be established between cumulative rainfall and NDVI values during critical growth stages (e.g., panicle initiation, flowering). Similar methods were validated by (Usman & Nichol, 2020) in Pakistan.

4.4.4 Yield Estimation Modeling:

A multiple regression model will be developed using NDVI and rainfall data as independent variables and field yield data as the dependent variable. Previous studies (Manjunath et al., 2002) have used similar models for yield prediction.

4.4.5 Visualization & Early Warning System:

Maps and dashboards will be created to show real-time vegetation health and highlight at-risk areas, similar to those used by the FAO's Agricultural Stress Index System (ASIS).

5. Budget (Estimated in BDT):

Item	Details	Estimated Cost
1. **Field Data Collection**	3 districts × 3 rice seasons (travel, survey)	120,000
2. **Data Handling**	Internet, storage, and backup	10,000
3. **GIS and Remote Sensing Tools**	Free (GEE, QGIS, Python)	0
4. **Printing and Dissemination**	Reports, maps, visuals	15,000
5. **Technical Support/Assistance**	Local data and modeling help	25,000
6. **Miscellaneous**	Contingencies	30,000
Total Estimated Budget		**200,000 BDT**

6. Expected Outcome:

The study is expected to enable real-time monitoring of rice crop health by integrating NDVI and rainfall data across selected districts. It will develop a predictive model for rice yield estimation based on the correlation between NDVI and rainfall. The research will identify climate-induced crop stress zones to provide early warnings and support timely interventions. Additionally, spatial maps and visualization tools will be created to assist agricultural planning and decision-making. The study will enhance the capacity for data-driven crop monitoring, contributing to food security efforts. Finally, the framework developed will be scalable nationwide and adaptable for monitoring other major crops.

7. Contribution & Socio-Economic Importance

This study will enhance rice monitoring and yield forecasting using NDVI and rainfall data, helping to ensure food security in Bangladesh. It will enable early detection of crop stress, reduce production losses, and support timely decision-making for farmers and policymakers.

The findings can be used to develop digital advisory tools for farmers, improve government planning for grain storage and distribution, and support climate-smart agriculture. Overall, the research promotes sustainable farming, stabilizes yields, and contributes to economic resilience in rural communities.

8. Future Plan:

In the future, the model will be expanded to cover all 64 districts and include major crops such as wheat, maize, and jute. Machine learning techniques like Random Forest and XGBoost will be integrated for

improved yield forecasting. Collaboration with DAE, BMD, and BRRI will support the development of a national crop monitoring dashboard. A mobile app will also be created to provide farmers with NDVI alerts and yield forecasts. The research findings will be shared through publications and presentations at national and international conferences

9. References:

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