Title: **"Computational Fluid Dynamics Simulations for Assessing Microclimate in Agroforestry Systems"**

The study aims to utilize advanced modeling techniques to analyze the intricate interactions between shading effects, vegetation, airflow, and microclimatic parameters. By employing CFD simulations, this research seeks to provide a detailed understanding of the spatial and temporal variations in temperature, humidity, soil moisture content, soil temperature and wind flow patterns within agroforestry canopies.

Objectives:

1. Develop a computational model representing the geometry and characteristics of agroforestry canopies.
2. Simulate airflow patterns, temperature distributions, and humidity gradients within the agroforestry systems.
3. Investigate the impact of tree density, species composition, and canopy structure on microclimate.
4. Validate the CFD simulations through comparison with field measurements and data collected from selected agroforestry sites.
5. Explore the potential of CFD for predicting microclimatic conditions under different scenarios within agroforestry systems.

Methodology:

1. Acquire detailed data on agroforestry canopy structure, including tree density, species composition, and spatial arrangement.
2. Develop a computational model using OpenFOAM CFD software to represent the geometric and physical properties of the agroforestry canopies.
3. Implement simulations to analyze airflow, temperature, and humidity patterns within the simulated canopies.
4. Validate the CFD model by comparing simulated results with field measurements from selected agroforestry sites.

Expected Outcomes:

1. Comprehensive insights into the microclimatic dynamics within agroforestry systems through CFD simulations.
2. Identification of key factors influencing microclimate, including tree density, species composition, and canopy structure.
3. Validation of CFD simulations through comparison with field measurements.
4. Guidelines for optimizing agroforestry system design and management practices based on CFD modeling outcomes.