

HBKU Thematic Research Grant 3rd Cycle— Project Highlight

Project Title: Production of biodegradable mulching film coupling biochar and limestone for implementation in arid land agriculture



LPI: Dr. Jayaprakash Saththasivam

Executive Summary

Crop cultivation in arid and semi-arid regions such as Qatar and the wider MENA area faces serious constraints, including scarce rainfall, extreme heat, saline and nutrient-poor soils, and limited irrigation infrastructure. These challenges, combined with restricted access to advanced agricultural technologies, reduce productivity and exacerbate environmental stress. To address this issue, the project proposes the development of an innovative biodegradable mulching film incorporating cellulose, biochar, and limestone. Derived from recycled food and beverage paper packaging waste, cellulose provides the film's structural matrix, reinforcing circular economy principles. Biochar, sourced from organic waste, enhances soil fertility, water retention, and carbon sequestration, while limestone improves thermal stability, mechanical strength, and soil pH regulation. Together, these components create a sustainable soil cover that conserves moisture, stabilizes temperature, and enhances nutrient availability, thereby boosting crop yield and resilience. This eco-friendly alternative to plastic mulch offers multiple co-benefits across sectors—from recycling industries and agricultural producers to environmental agencies—by promoting low-waste, climate-smart agriculture. Ultimately, the project demonstrates a scalable pathway toward improving water use efficiency, soil health, and crop productivity in dryland farming through biodegradable, cellulose-based mulching technologies.

Expected Outcome

This project will produce a biodegradable mulching film prototype made from cellulose, biochar, and limestone, optimized for arid land agriculture. The outcomes include laboratory- and pilot-scale validation demonstrating enhanced soil health, water retention, and crop productivity under desert conditions. The research will generate comprehensive technical reports, scientific publications, and techno-economic analyses to evaluate cost-effectiveness and scalability. Additionally, a patent disclosure is anticipated for the film's composition, fabrication method, and agricultural application, contributing to sustainable, circular-economy practices and potential commercialization of biodegradable mulching technology.

Collaborating HBKU entities:

| | | |
|---------------------------------|---|------------------------------------|
| Dr. Gordon McKay (CSE, HBKU) | Dr. Snigdhendubala Pradhan (QEERI, HBKU) | Dr. Rajesh Govindan (CSE, HBKU) |
|---------------------------------|---|------------------------------------|

