Project Overview
This project aims to optimize natural dye extraction protocols, enhance dye performance through value addition, design and fabricate a pilot-scale extraction machine for technology transfer. The innovation bridges the gap between laboratory-scale research and industrial application, supporting eco-friendly dye production, SME competitiveness, and sustainable development.

Technical Feasibility
Conventional dye extraction techniques achieve yields of 5–30%, with poor reproducibility and limited scalability. The proposed pilot machine is designed for a throughput capacity of 30–40 kg/day, achieving extraction efficiencies of 25–60%. Fabrication will use durable and cost-effective materials (mild steel and stainless steel), with CAD-based design ensuring functionality and safety. The project advances from TRL 4 to TRL 6, validating performance under pilot-scale conditions.

Economic Feasibility

The global natural dye market is growing due to eco-conscious consumer demand. The project budget is estimated at ₦60,000,000 over 18 months. Commercialization opportunities include:

- Sales of fabricated machines to SMEs.
- Supply of eco-friendly dyes to textile, cosmetic, and food industries.
- Technology licensing and training services.

✓ *Viable, with strong revenue potential for SMEs and reduced dependence on imported synthetic dyes.*

Environmental Feasibility

Synthetic dyes contribute 17–20% of global industrial water pollution. Plant-based dyes offer biodegradable, non-toxic alternatives. The pilot machine integrates solvent recovery and energy efficiency, reducing environmental footprints and supporting SDGs 9, 12, and 13.

✓ *Environmentally sustainable, aligned with green innovation policies.*

Social Feasibility

The project strengthens green value chains by:

- Creating new income opportunities for farmers cultivating dye plants.
- Preserving indigenous knowledge and practices.
- Supporting SMEs in eco-friendly textile and craft production.

✓ *Socially beneficial, with strong community impact.*

6. Risks and Mitigation

- Biomass supply variability → Structured farmer cooperatives.
- High initial machine cost → Modular, scalable design.
- Market adoption → Awareness workshops and stakeholder engagement.

✓ *Risks are manageable with defined strategies.*

Conclusion

This project is technically sound, economically viable, environmentally sustainable, and socially beneficial. By developing optimized protocols and a functional pilot-scale machine, it enables technology transfer, SME empowerment, and sustainable dye production.