TEAM
036

ECOLOOP | Multi-Layered Sustainable Farming System

Mohammad Danai Zami, Abdulmalek Almaleh, Ahmed Alharbi, Mohammed Alzahrani
Coach: Dr. Asad Hanif

Problem Statement

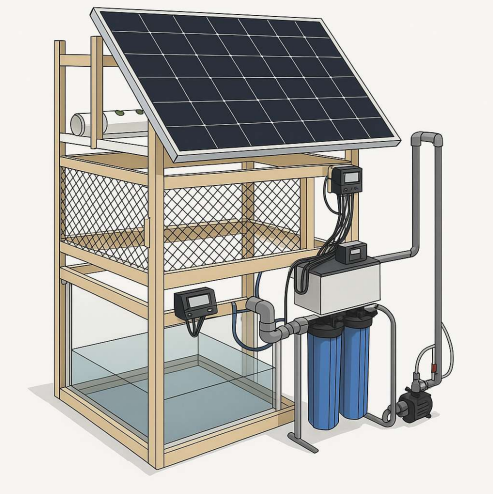
- KSA's water scarcity and climate limit traditional farming.
- EcoLoop integrates fish, plants, poultry, worms, and solar in one closed-loop system.
- Customer needs: easy operation, low cost, water efficiency, climate adaptability.
- Design and validate a compact, climate-adaptive farming system that recycles water, uses solar power, and integrates fish, plants, poultry, and worms into one closed-loop unit.
- Climate model selects PF or PFPW per city/month. 15 cities in Saudi were studied.

$$\text{Maximize } Z = \sum_{i \in I} \cdot \sum_{t \in T} \cdot \sum_{m \in \{A \cdot B\}} \cdot w_m \, x_{i,t,m}$$

Constraints & Specs

- **Key Constraints:**
  - MEWA/SASO Compliance
  - High-Temperature Durability
  - ≥60% Solar Use
  - ≥80% Water Recycling
  - ≤1 hr/week Maintenance
  - Climate-Based PF/PFPW Selection
- **Prototype Specs:**
  - ≤200 W
  - ≥95% Ammonia Removal
  - ≤300 SAR/month
  - ~600 L tank load
  - pH/temp/TDS Sensing
- **Future Specs:**
  - 1000 kg Fish biomass
  - ≥20 kg/m²/month Yield
  - AI Monitoring
  - Nutrient Automation
  - LED Lighting
  - Robotics
  - Modular Expansion

Methodology



- Built a 1×1 m steel tower with stacked fish, plant, and compost tiers.
- Implemented a 300 L/h hydraulic loop with filtration and gravity return.
- Used sensors (pH, temp, DO, level) for real-time monitoring.
- Applied ISE methods to reduce maintenance to ≤1 hr/week.

Conclusion

- Flow (~300 L/h), DO (~6 mg/L), and biofilter cycling validated core performance. Structure passed full water-load testing. Sensors provided reliable real-time data. Safety features were confirmed.
- Next steps:
  - Measure Water Recycling
  - Solar Share
  - Climate Feasibility (PF/PFPW)
  - Growth performance.
- EcoLoop is a compact, climate-adaptive, water-efficient farming system scalable for Saudi needs.