

AgroStock: A location-based decision AI predictive platform for agricultural trade and inventory optimization in Sri Lanka

A. M. K. C. Wijebandara, S. L. Vithana, A. K. K. A. Hemachandra, N. T. Weerawarna

*Department of Information and Communication Technology, Faculty of Technology,
University of Colombo, Sri Lanka*

The agricultural industry in Sri Lanka experiences devastating post-harvest losses, causing 30%-40% annual loss, particularly affecting smallholder farmers with limited market access and inadequate demand forecasting capabilities. The research objectives were to develop a comprehensive location-based AI predictive platform that reduces post-harvest wastage by 20% while improving farmer profitability through integrated digital solutions, establish direct market connectivity, eliminate intermediary dependencies, and create secondary market mechanisms for surplus produce management following circular economy principles. This investigation reveals how traditional supply chains create substantial information asymmetries through heavy reliance on intermediary networks. The "AgroStock" platform introduces a web-based, location-aware AI solution that combines GPS-enabled tracking with hybrid AI models trained on local market data to predict weekly demand for carrots, pumpkins, onions, and tomatoes. The methodology integrates participatory design with system development and field observations utilizing stakeholder interviews, surveys, and market data analysis from the Veyangoda Economic Centre. The solution merges ARIMA statistical analytics (30%) with Gemini AI predictive analytics (70%) through a weighted ensemble approach, achieving superior forecasting accuracy. Individual model performance shows ARIMA at 96.80% and Gemini AI at 98.33%, while the combined approach demonstrates 99.14% accuracy with a Mean Absolute Percentage Error of 0.861%, representing 66.6% improvement over the individual models. The platform enables informed production decisions through location-based supply pattern analysis and facilitates direct farmer-buyer connections via real-time inventory management. Field validation demonstrates measurable economic impact with projected 15% farmer profit margin improvements and 25% inventory turnover enhancement. The secondary market mechanism redirects 60-80% of surplus production to food processors, compost makers, and animal feed suppliers, promoting circular economic principles. This opens opportunities for future researchers to feed data and test this approach for other crops in Sri Lankan agriculture. This scalable digital solution addresses critical supply chain gaps, contributing to sustainable development through systematic waste reduction and enhanced market connectivity.

Keywords: *AgriTech AI, Predictive analysis, Post-harvest loss, Digital marketplace, Supply chain optimization*