Modeling and Analysis of Lean Systems in Agricultural Production

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Resumen

Due to the increase of global demand of agriculture and agro-industrial products, agriculture has undergone some changes in the stages of procurement, planning, planting, maintenance, harvesting, transport and distribution. The use of formal mathematical models have been employed to evaluate and implement improvement policies and strategies in production systems, but not integrating the stages in a single model, allowing agricultural systems to suffer considerably from the waste generated. In this thesis, we present a Mixed Integer Nonlinear Programming Model to solve the planning of agricultural production systems integrating the stages of sowing, crop maintenance and harvesting, minimizing. The objective function seeks to minimize wastes through cost of labor, the use of water, soil and machinery, the variety of products, and the defects and yields of crops. The minimization is inspired by the principles of waste management from Lean Manufacturing, but newly applied in agricultural production, in turn, it has a sustainability approach to the agricultural production process. This model changes the focus from increasing efficiency, to reducing waste generated by production. The proposed approach is validated using semi-real data for the planning of 3-varieties' bananas farms in the Caribbean Region of Colombia. While a deterministic solution is obtained, sensitivity analyses are carried out to evaluate different scenarios for production employing Surface Response Methodology. The results obtained describe a conceptual model and a novel method for planning the production, reducing the use of resources for a sustainable agricultural production from an operational perspective and with tactical aspects.