

# Milk Collection Optimization in Atlántico, Colombia.

**Ronald A. Corcho, Juan G. Villegas and Pablo Maya**

Department of Industrial Engineering

Universidad de Antioquia

Medellín, Antioquia, Colombia

[ronald.corcho@udea.edu.co](mailto:ronald.corcho@udea.edu.co), [juan.villegas@udea.edu.co](mailto:juan.villegas@udea.edu.co), [pablo.maya@udea.edu.co](mailto:pablo.maya@udea.edu.co)

## Abstract

The world's consumption of milk has been growing since the '80s. The Food and Agriculture Organization of United Nations (FAO) Predicts a growth rate of milk production of 2.5% per year for 2020-2030. Furthermore, it estimates that per capita consumption in developing countries (such as Colombia) will increase at twice the rate of production in this period. In the dairy sector of Atlántico (a Northern State of Colombia), inefficiency in the logistics process in milk collection was identified due to the lack of efficient operating models and the atomization of producers (long distances), among other causes. Moreover, in Colombia, the milk collection costs represent 33% of the logistics costs, being above the average in the dairy sector worldwide, that reduces productivity and competitiveness to the sector. The milk collection process, at strategic-tactical level can be tackled as a districting problem with a two-phase approach "group first - route later" as an alternative to the classic vehicle routing problem. This has motivated the current work to solve the milk collection at strategic-tactical level in Atlántico, through a districting design strategy to minimize the distances to be covered in a subsequent routing while consolidating the farms into districts and optimizing the composition of the fleet. A districting strategy prior to the routing process improves efficiency in collection and distribution processes.

In the present work, we propose a multi-objective optimization model with the location-allocation approach, in which once the collection centers are located, the allocation of farms to them is balanced, within a logistic districting context. We combine the milk collection and districting context, to address two objectives that impact the efficiency of the milk collection process, namely: (i) minimize the dispersion measured as the sum of the distances to travel between farms and their assigned collection center, (ii) minimize the cost of the facilities and the vehicle fleet. In addition, we consider some districting and milk collection criteria, constraints, and characteristics to get compact districts considering a limit of distance between the farms and their collection center (center of the district), get balanced districts in relation to the daily milk supply considering capacity constraints of collection centers and vehicles fleet, no load division and heterogeneous fleet. We expect an improvement in terms of costs due to shorter travel distances and better use of the fleet.

## Keywords

Optimization, Milk Collection, Districting, Strategic-Tactical decisions, multi-objective.

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## Biographies

**Ronald A. Corcho** is a Student of Master of Engineering at Universidad de Antioquia, Colombia. Mr. Corcho holds a Bachelor of Industrial Engineering from Universidad del Atlántico, Colombia. He has 3 years of experience in working at data areas in companies of manufacturing and logistics. He has published journal and conference papers in topics like optimization and simulation, and his research interests include optimization, simulation, and districting.

**Juan G. Villegas** is a Professor at the Industrial Engineering Department at the Antioquia University in Colombia. He holds a Master and a Ph.D. in Industrial Engineering, and its main research interest is the application of

optimization models and metaheuristic solution methods in logistics, transportation, energy systems among other areas of application.

**Pablo Maya** is a Professor of the Industrial Engineering Department at the Antioquia University in Colombia. He holds a Master and a Ph.D. in Operations research. His research interests are mainly on the field of applied OR techniques, particularly to problems with potential social impact such as sustainable transport, health services and humanitarian and non-profit logistics.