

Gestion de chaîne logistique sous incertitude : Application au contexte de l'agri-food

Managing supply chain under uncertainty: Application to the agri-food industry

Laboratoire : IMT Atlantique, LS2N, UMR CNRS 6004

Début : Octobre 2019

Financement : Financement IMT Atlantique 50%

Cofinancement : Rennes SB (50%)

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Mots clés en français: agri-food, incertitude, optimisation de la chaîne logistique, application à l'industrie laitière

Mots clés en anglais: Agri-food industry, Uncertainty, Supply chain optimization, Application to dairy industry

Context

Agri-food is one of the major economic sectors in Europe and beyond. Given the evolution in the agricultural sector, the new challenges it faces, and the uncertain conjuncture of most agricultural real-life applications, managing agricultural supply chains efficiently has become an attractive topic for researchers and practitioners. The agri-supply chain typically consists of growers/farmers, cooperative, transformer (processor), distributors (retailers), and customers (Hovelaque et al. 2009; Zhu et al. 2018). This is also the typical configuration of the dairy industry (Ivanov et al. 2016). For instance, the worldwide leader Lactalis collects milk from individual milk producers and cooperatives and

transforms it to a wide variety of products (drinking milk, yoghourts, cheese, butter, cream, milk powder, etc.). These products are then commercialized under different brands and via a complex network of retailers and distributors.

Different operations research tools have been proposed for application in agri-supply chain management at different decisional levels, from growers to consumers (Borodin et al. 2016, Ivanov et al. 2016, Magale et al. 2017, Zhu et al. 2018).

This project pertains to the stream of research on the application of operations research methodologies to handling uncertainty occurring in the agricultural supply chain management with a focus on the dairy industry. The selection of the dairy industry is motivated by:

(i) its strategic importance in the worldwide economy in general, and in Pays de la Loire and Brittany in particular,

(ii) the high level of uncertainty about the availability and the quality of milk collected,

(iii) the high diversity of dairy products offered to the customers, which creates a high uncertainty in market characteristics (price and demand),

(iv) the emergence and success of Bio products in the dairy industry, which changes the market structure and increases the market uncertainty, and

(v) our privileged contact with Lactalis (partner of Rennes SB) which shall enable us to build real case studies and to use real data provided by the company. It is noted that the discussion with Lactalis has already been engaged.

The team of IMT Atlantique/LS2N has already worked on dairy supply chain optimization (Ivanov et al. 2017), presented some results on similar problem in other sectors of food supply chain (Magale et al., 2016) and published a state of the art article on decision aid models in food supply chain (Zhu et al. 2018).

The competences of IMT Atlantique/LS2N and RSB researchers are complementary. The group of IMT Atlantique is known for their results in the optimization of replenishment planning under uncertainty of lead times (see for example Borodin et al. 2016b). The team of RSB worked a lot on lead time quotation, pricing, and capacity decisions under demand uncertainty (Albana et al. 2018) and other issues of planning under demand uncertainty (Aouam et al. 2018).

Objectives

We aim to develop optimization models for the dairy industry in order to provide the managers with aid-decision tools to cope with the following decision problems:

- Managing and optimizing milk supplies for different factories. In particular, how to design supply contracts and how to manage milk procurement given the changing regulatory framework, the necessity to offer attractive prices to milk producers, and the uncertainty on both quantity and quality of milk collected?

- How to allocate the available quantity of milk to each type of final product and, consequently, which quantity to produce for each product while taking into account both supply and market uncertainties? This decision is complexified by the necessity of considering shelf life constraints, on the one hand, and respecting the contractual terms agreed with the distributors, on the other hand.
- How to understand the customers' preferences to Bio products and their willingness to pay and consequently, how to adapt the production strategies to serve different customer segments profitably through bio-based product differentiation and segment pricing.

Relation with the literature

In the survey by Zhu et al. (2018), the authors conclude that a majority of the reviewed papers focus on deterministic issues although uncertainty is a key feature of food supply chain.

Borodin et al. (2016a) reviewed more than one hundred papers in the field of operations research applied to agri-supply chains. They found that only a few papers dealt with the dairy industry. In addition, the authors concluded that while the effect of weather and price uncertainties have been widely studied, there is a need to consider new uncertainties factors such as the quality of incoming products. This factor plays a key role in our problem since there is generally a high variability in the quality of milk collected which has a considerable impact on production planning.

(Ivanov et al. 2017) consider supply chains in the Australia dairy industry in the presence of disruptions and elaborate possible recovery policies to preserve the resilience.

Wiedenmann and Geldermann (2015) highlighted the importance of supply contracts in hedging against uncertainty in agribusiness. Managing supply contracts is very challenging in our context since firms must comply with a changing regulatory environment and are subject to many constraints such as the necessity of collecting all the quantity of milk produced by some suppliers.

An evident gap in the agri-supply chain literature is also the lack of studies on the impact of customers' preferences to bio products on the purchasing and production strategies of the firms, especially in the dairy industry. Our work shall try to fill the gap.

Required skills: Industrial Engineering; Stochastic modelling; Optimization

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