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# Optimal design of the real agri-foods supply chain with environmental costs

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## ABSTRACT

The supply chain of agricultural products has received a great deal of attention lately due to issues related to public health. Something that has become apparent is that in the near future the design and operation of agricultural supply hains will be subject to more stringent regulations and closer monitoring, in particular those for products destined for human consumption (agri-foods). The supply chain of agri-foods, as any other supply chain, is a network of organizations working together in different processes and activities in order to bring products and services to the market, with the purpose of satisfying customers' demands.This work is concerned with the planning of a real agri-food supply chain for poultry products. For this concrete case we chose two products namely chicken and turkey-cock meat. More precisely the problemis to redesign the existing supply chain and to optimize the distributionplanning. Furthermore, environmental costs of road transportation in terms of CO2 emissions are taken into account in the computations. The proposed integrated approach permits to minimize the total costs of the agri-food supply chain not only in terms of economy but also in terms of public health (ecology).
As mentioned in our paper, the entire problem is decomposed into two problems, and each sub problem is solved in sequential manner, to get the final solution. LINGO optimization solver (Version12.0) has been used to get the solution to the problem.
*Keywords*—Agri_foods Supply chain; distribution network; optimization

## I. INTRODUCTION

This The term agri-food supply chains (ASC) has been coined to describe the activities from production to distribution that bring agricultural or horticultural products from the farm to the table [1]. ASC are formed by the organizations responsible for production (farmers), distribution, processing, and marketing of agricultural products to the final consumers. The supply chain of agri-foods, as any other supply chain, is a network of organizations working together in different processes and activities in order to bring products and services to the market, with the purpose of satisfying customers' demands [2]. What differentiates ASC from other supply chains is the importance played by factors such as food quality and safety [3]. Other relevant characteristics of agri-foods include their limited shelf life, their demand and price variability, which makes the underlying supply chain more complex and harder to manage than other supply chains. Agri-food supply chains (ASC) identified for two types; the first one is the supply chain of fresh agri-foods, and the second one is the supply chain for non-perishable agri-foods. Fresh products include highly perishable crops such as fresh milk, meat, fruits and vegetables whose useful life can be measured in days; non-perishable products are those that can be stored for longer periods of time such as grains, potatoes, and nuts [4].Food safety has become the subject of significant public and regulatory attention in various countries. Food safety is often an experience or credence attribute that consumers cannot detect through search activities prior to purchase[5]. The handling and consumption of poultry meat is recognized as a major cause of foodborne illness in humans globally particularly when eaten raw, undercooked or recontaminated and stored following cooking. This implies that the traditional supply chain practices may be subject to revision and change. One of the aspects that may be the subject of considerable scrutiny is the planning activities performed along the supply chains of agricultural products. This study is an extension of other work but this time I added a special cost due to fuel during delivery of poultry products for the security of health human.

## II. MATERIALS AND METHODS

The mathematical model of Capacitated Centered Clustering Problem (CCCP) and Capacitated Plant Location Problem (CPLP) is given as follows:
solution.

$$\mathrm{Min}\ Z1 = \sum_{k \in K} \sum_{j \in J} \left\| \left(x_i - x_j'\right) + \left(y_i - y_j'\right) \right\|^2 Y_{ij}. (1)$$

$$MIN\ Z2 = \sum_{k \in K} FC_k X_k + \sum_{l \in L} \sum_{v \in V} \sum_{i \in I} \sum_{k \in K} \left( C_{jk}^{v;km} + C_{jk}^{v;\frac{t}{km}} \right) V_{ljk} D_{jk} Z_{jk} \ldots (2)$$

## III. RESULTS

As mentioned earlier, the entire problem is decomposed into two problems; each problem is solved in sequential manner, to get the final solution. Optimization Branch & Bound solver has been used to get the solution to the problem.

The inputs to the phase 1 or CCCP are the coordinates of locations of customer's i (xi, yi), The input data can be taken from the small sized benchmark problems. For this, we used AutoCAD software to position the different customer. After solving phase 1 with the objective of minimization of total cost (Z1), we can get the centroid of each customer clusters with their coordinates (x'j, y'j), total number of customers assigned to each customer cluster (nj). These results (output phase1) are configured in the table I

TABLE : RESULT OF PROBLEM I

| CC N° | $n_j$ | Cluster's centre position | Assigned customers number |
|---|---|---|---|
| 1 | 1 | (8819.19 ; 5632.02) | 5 |
| 2 | 1 | (8854.72 ; 5646.22) | 7 |
| 3 | 1 | (8856.22 ; 5617.00) | 6 |
| 4 | 1 | (8880.51 ; 5638.30) | 8 |
| 5 | 8 | (7758.02 ; 6679.99) | 3/4/11/17/18/102/103/104 |
| 6 | 12 | (9007.11 ; 6033.94) | 10/12/13/14/15/16/20/88/ 89/90/91/105 |
| 7 | 8 | (7540.73 ; 6046.07) | 1/53/54/56/57/58/59/112 |
| 8 | 0 | / | |
| 9 | 7 | 5112.69 ; 5767.09) | 46/64/66/67/68/69/70 |
| 10 | 8 | (7568.44 ; 5825.43) | 2/9/19/49/51/52/55/60 |
| 11 | 10 | (10043.23 ; 9490.09) | 79/80/81/82/83/84/92/93/ 94/95 |
| 12 | 8 | (7478.42 ; 5177.42) | 23/26/30/32/33/34/50/111 |
| 13 | 5 | (7146.53 ; 5353.10) | 21/22/27/47/65 |
| 14 | 10 | (7532.64 ; 4847.30) | 24/25/28/29/31/35/36/37/ 38/48 |
| 15 | 0 | / | |
| 16 | 12 | (10685.80 ; 9767.27) | 71/72/73/74/75/76/77/78/ 85/86/87/110 |
| 17 | 10 | (7726.06 ; 9343.55) | 96/97/98/99/100/101/109 |
| 18 | 10 | (6974.03 ; 4724.97) | 39/40/41/42/43/44/45/61/ 62/63 |
| 19 | 1 | (747842 ; 5177.42) | 113 |

TABLE: RESULT OF PROBLEM II

| Slaugh terhou se | Location decision | Alloca ted cluster | Corresponding capacity for Product1 | product2 |
|---|---|---|---|---|
| 1 | opened | 2 | 680 | 20 |
| | | 3 | 680 | 20 |
| | | 11 | 420 | 16 |
| | | 13 | 375 | 19 |
| | | 14 | 395 | 21 |
| | | 16 | 395 | 15 |
| | | 19 | 454 | 05 |
| 2 | closed | none | 0 | 0 |
| 3 | opened | 12 | 380 | 19 |
| | | 18 | 340 | 28 |
| 4 | closed | none | 0 | 0 |
| 5 | opened | 1 | 680 | 20 |
| | | 9 | 405 | 16 |
| 6 | closed | none | 0 | 0 |
| 7 | opened | 4 | 680 | 20 |
| | | 5 | 370 | 24 |
| | | 6 | 430 | 10 |
| | | 7 | 400 | 19 |
| | | 10 | 380 | 22 |
| | | 17 | 295 | 14 |

## IV. DISCUSSION AND CONCLUSIONS

In recent years, many companies (production or service) are trying to reactivate their logistics networks.

The objective of this work is to reform the distribution network of chicken meat in city of Tlemcen, because of different retailers claim on the market instability of the chicken's meat (prices, lags behind the delivery, food safety ...).

To this aim, a two-step mathematical model has been built and solved in a sequential manner. Once the customers have been grouped into clusters, the slaughterhouses to set up, to close or to reopen have been located, and the clusters of retailers have been allocated to them. LINGO 12 has been used to solve the three programs and to obtain exact solutions by using Branch and Bound with default parameters of the solver..

## V. REFERENCES


[1] Performance indicators in agri-food production chains. In: Quantifying the Agri-Food Supply Chain. Springer, Netherlands (Chapter 5), pp.49–66

[2] Christopher. M., 2005.Logistics and Supply Chain Management. Prentice Hall, London.

[3] Salin, V., 1998. Information technology in agri-food supply chains. International Food and Agribusiness Management Review 1 (3), 329–334.

[4] Omar ahumada and al, application of planning models in the agri-food supply chain : A review,European journal of operational reseearch 195(2009) 1-20.

[5] E. Tsola, E.H. Drosinos, P. Zoiopoulos , Impact of poultry slaughter house modernisation and updatingof food safety management systems on the microbiologicalquality and safety of products, Food Control 19 (2008) 423–431.