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Mini Review

A Review of Optimization Researches in the Field of Agricultural Supply Chain

Armin Cheraghalipour* and Emad Roghanian

Department of industrial engineering, KN Toosi University of Technology, Iran

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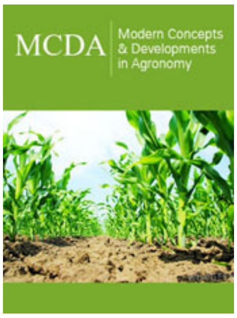

***Corresponding author:** Armin Cheraghalipour, Department of Industrial Engineering, KN Toosi University of Technology, Tehran, Iran

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Abstract

The position of the agricultural sector as a driving force for economic growth and development in the urban and rural structure is one of the issues that has always been the subject of expert opinion. A considerable amount of perishable products especially in the food and agriculture is corrupted annually due to the lack of an effective mechanism in the supply chain. This forces researchers to plan and design mathematical models to improve this situation. One of the most important tools in this field is supply chain network design, which the researchers are trying to improve in the current human society by extending this tool for the agriculture sector. For this purpose, in this research, we will briefly review some of the work done. Finally, research gaps are provided for future research.

Introduction

In today's world, one of the basic problems of mankind is supplying food needs, so that food security and quality assurance have become important goals of governments. In particular, agricultural production has received special attention in developing countries [1]. Crops are those agricultural products that have less than one year of planting and flowering (end of life). In fact, their lifecycle lasts less than a year; most crops are stored for several months and only a part of the crop is directly consumed after harvest; Therefore, most small and large producers prefer to stock these relatively sensitive crops for several months to provide fruit in early spring, as well as reasonable prices due to market demand; Therefore, it is necessary to have suitable places for storing high volume of manufactured products and having a schedule. Also, because most warehouses are traditional, so every year a large volume of products made with great effort and expense, these warehouses suffer a severe loss of quality [2]. The agricultural supply chain today has played an important role in supply chain issues because of its unique characteristics such as the importance of food quality, supply, climate change and price changes [3]. These products are categorized in terms of shelf life into perishable and non-perishable (such as grain and nuts) and in terms of life cycle into agricultural and horticultural products [4]. In recent years, the importance of fresh fruit has grown substantially with increasing demand from concerned consumers for a healthy diet. This has made the quality and availability of fruit throughout the year a significant issue [5]. Only in the past ten years has the agri-food industry in general and the fresh fruit sector been specifically recognized and discussed in the supply chain as a key concept for competitiveness [6,7]. For the first time, Ahumada and Villalobos conducted a study of model planning in the agricultural supply chain. They have presented their research overview of articles available since 1985 focusing on various crops including perishable, non-perishable, and most vegetables [8]. Audsley [9] also did research with an operation research model in the agricultural sector but limited to examining developments in the United Kingdom [9]. Furthermore, Zhang [10] presented an interesting version of mathematical models for the crop industry including fruits, vegetables, grapes, ornamental plants, tree nuts, berries and dried fruits [10]. On the other hand, Shukla and Jharkharia provided a summary of the existing literature from 1991 to 2011 on the production of fresh produce such as fruits, flowers and vegetables [11].

The main feature of their paper is to focus on the articles studied in the field of perishable, non-perishable and fresh produce. They also categorized the literature studied by geographical area and journal. To focus more on supply chain features, Farahani et al. [12] provided examples of decisions made in generic supply chains, while Tsolakis et al. [13] presented the type of decision making in agricultural supply chains. The process of this investigation continues, and more attention is being paid to this issue by 2019. For example, over the past two years, Cheraghalipour et al. [2] have done several important researches in the field of citrus [3,14,15] and rice [7] supply chains, which considering the high assumptions have led to the complexity of their model and proximity to the real world. In their recently published work [15], they attempt to optimize total costs of the chain, demand responsiveness, and CO2 emissions reduction. They used a novel multi-objective metaheuristic called tree growth algorithm [16,17] to solve their model (Figure 1). Due to the large number of articles in this field, some of the other articles are reported in Tables 1 & 2 [18-24]. On the other hands, Figure 2 is illustrated to realize the research labelled in Table 2 [25-35].

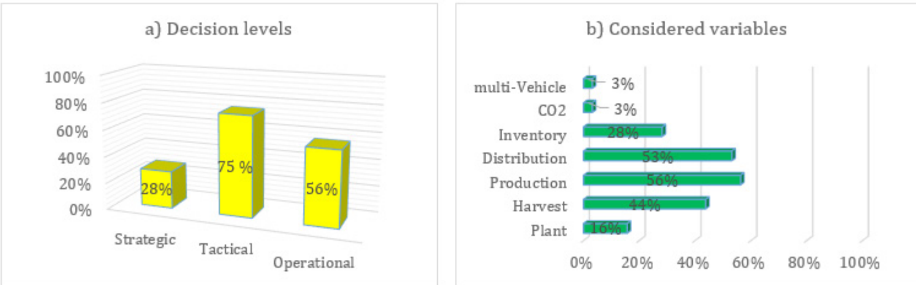

Figure 1: Percentage of research in Table 1 that considers its assumptions.

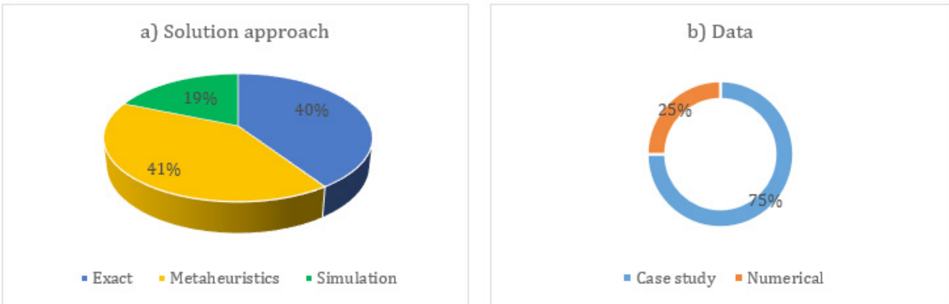

Figure 2: Percentage of research in Table 2 that considers its assumptions.

Table 1: Classifying related work on agricultural supply chain in terms of decision levels and variables.

Reference	Decision Levels			Considered Variables						
	Strategic	Tactical	Operational	Plant	Harvest	Production	Distribution	Inventory	CO_2	Vehicle
[18]		*	*	*	*					Single
[19]		*			*					Single
[20]		*					*	*		Single
[21]		*					*			Single
[22]		*					*			Single
[23]	*			*	*	*				Single
[24]			*		*	*				Single
[25]	*	*				*				Single
[26]		*	*		*	*				Single
[27]	*	*				*	*			Single
[28]		*	*			*	*	*		Single
[29]		*	*							Single
[30]	*	*		*	*	*				Single
[31]			*				*	*		Single

[32]	*	*					*	*		Single
[33]		*				*	*			Single
[34]		*	*		*		*			Single
[35]		*	*		*					Single
[36]		*	*			*	*			Single
[37]			*					*		Single
[38]		*				*				Single
[39]			*		*					Single
[40]	*			*		*				Single
[41]		*				*	*			Single
[42]		*				*				Single
[43]		*	*		*					Single
[44]			*				*	*		Single
[3]	*	*	*		*	*	*	*		Single
[45]		*	*			*	*			Single
[46]		*	*		*	*	*			Single
[7]	*		*	*	*	*	*	*		Single
[15]	*	*	*		*	*	*	*	*	Multiple

Table 2: Classifying related work on agricultural supply chain in terms of solution approach, network flow and data.

Reference	Solution Approach			Network Flow			Data	
	Exact	Metaheuristics	Simulation	Forward	Reverse	Closed loop	Case study	Numerical
[18]	*			*			*	
[19]		*		*			*	
[20]	*			*			*	
[21]			*	*				*
[22]		*		*				*
[23]		*		*			*	
[24]	*			*			*	
[25]	*			*			*	
[26]	*			*			*	
[27]	*			*			*	
[28]	*			*			*	
[29]		*		*			*	
[30]		*		*			*	
[31]		*		*				*
[32]			*	*				*
[33]		*		*			*	
[34]		*		*			*	
[35]	*			*			*	
[36]		*		*				*
[37]		*		*				*
[38]	*			*			*	
[39]			*	*			*	

[40]	*			*			*	
[41]	*			*				*
[42]			*	*				*
[43]	*			*			*	
[44]	*			*			*	
[3]		*		*	*	*	*	
[45]			*	*			*	
[46]			*	*			*	
[7]		*		*			*	
[15]	*	*		*	*	*	*	

As is displayed in this Figure 2, metaheuristics approach covers 41%, exact method covers about 40%, and simulation aid about 19% of these researches [36-42]. Also, most of these research (75%) consider case study to accumulate data for their model parameters [43-46]. Besides, Table 2 shows that all of these researches considered forward flows, while only two researches considered reverse flows or closed-loop network. To summarize, it can be mentioned that we have briefly reviewed the research until 2019 in the field of agricultural supply chains. After descripting the main subject, we attempt to find the behavior of 32 researches in terms of various assumptions such as decision levels, considered variables, solution approach, network flows, and type of data. After reviewing and summarizing, the following gaps were identified for future research.

A. Due to the above-mentioned gaps, the future works can cover strategic level in their research formulation.

B. The future works can more emphasis to some variables such as multi-vehicle, CO2 emission, and planting crops.

C. They can consider reverse flows and closed-loop structure in their network design.

D. Based on the reported results, they can use metaheuristic algorithms for large size problems.

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