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Modelling and optimization approaches for smallholders: A systematic review

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1 Introduction

Smallholders are small-scale agriculture models that usually support the life of a single family. They are producing about one-third of the population's food supply [1]. With the increase in population, food production should increase to go with this demand. Food production should be doubled by 2025 [2]. However, increasing yield is not the only problem that smallholders face as they encounter challenges in production, ergonomics, delivery, and increase in raw material price due to many factors [3, 4]. Therefore, there is an urgent need to optimize different fronts in the agriculture supply chain. Unfortunately, many of these challenges are intractable and special algorithms need to be deployed to overcome them [5]. As part of the SMALLDERS initiative [6], our team proposes a system to help smallholders make impactful decisions and rapidly access different scenarios. Specifically, we turned to simulation and optimization to find suitable solutions to the problems at hand while considering the ergonomic and environmental sides.

We present a detailed literature review as it is an efficient technique to review the results among previous studies [7]. This work aims to shed light on the smallholders' problems that the SMALLDERS projects can offer support with, as well as the different methodologies researchers used to tackle these problems. To the best of our knowledge, this is the first work to do so. We detail the methodology used in Section 2.

2 Methodology

We conduct a systematic literature review to recognize the different problems that smallholders face, analyze the methods developed to overcome them, uncover shortcomings of the current work, and propose possible approaches for future work. This work will focus on papers published in peer-reviewed articles and journals extracted from the Web of Science (WoS) and Scopus libraries. The main steps of the search are summarized below.

The first step of the search is to focus on works that fall within the scope of this literature review. We define the following query *(("Smallholders" OR "Short food supply chain") AND ("Modelling" AND "Optimization"))* and search WoS and Scopus for articles that match this query.

After identifying our target papers, we start the filtering process by considering the papers written in English and published in peer-reviewed journals and conferences. We exclude literature reviews to avoid secondary sources and focus on primary work. This leaves us with 86 papers in total. The papers extracted from the previously mentioned libraries can be found in Figure 1. We put the remaining papers through two additional steps of filtering. During the first phase, the paper's abstract is reviewed and off-topic papers are discarded. In the

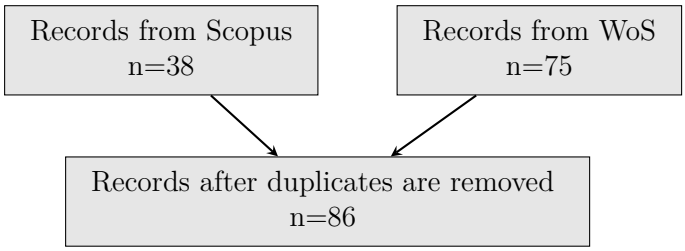


FIG. 1: Number of papers collected

second phase, the papers are read entirely, and irrelevant papers are discarded. The papers are then categorized into two groups according to whether they used simulation or not. Each of these groups will be further divided to account for the different methodologies used, problems tackled, and optimization approaches.

Finally, we implement a forward and backward search by reviewing every paper's selected citations and reference lists. This allows us to widen the search and find additional documents to add to our review.

After collecting all this information, we analyze the trend of methods used and possible shortcomings of research. This would help us identify target solutions and related features to be integrated in our platform.

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