



Logistics Challenges in Distributing Crop Protection Chemicals (CPCs)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The secondary distribution network refers to the comprehensive set of activities involved in the management and execution of the post-production supply chain, encompassing storage, transportation and distribution. Secondary distribution involves the coordination of various elements, such as inventory management, order fulfillment and transportation, to ensure timely and cost-effective delivery of goods to end-users. Efficient distribution network ensures timely availability of these products, enabling farmers to address pest infestations promptly and prevent significant crop losses. This manuscript on examining the issues faced by supply chain partners in the secondary distribution network for Crop Protection Chemicals (CPCs) is highly significant for the scientific

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community. It sheds light on crucial aspects of logistics management, secondary distribution networks and supply chain challenges in the agricultural sector. The use of the Garrett Ranking Technique for analysis adds a methodological strength to the study. Overall, this manuscript provides valuable insights for researchers, policymakers, and industry professionals in the field of agrochemicals and agricultural supply chains. Based on the results, the issues faced by supply chain partners are identified and ranked on the basis of Garrett Ranking Technique. Implementing barcode scanners, negotiating transportation rates and automating customer notifications can significantly reduce operational costs and improve accuracy.

Keywords: Crop protection; logistics management; secondary distribution network; lead time; supply chain management.

1. INTRODUCTION

The UNFPA's state of world population report 2024 projects that, with a growth rate of 1.2 per cent, India's population would reach 1.428 billion in 2024. By 2030, India is expected to have more than 1.5 billion citizens, making it the most populated country in the world [1]. Agrochemicals are the last and most important inputs in agriculture for crop protection and increased yield. India is currently the world's fourth largest producer of agrochemicals, trailing only the United States, Japan and China, and it has risen to become the world's 13th largest pesticide exporter [2]. Pesticides are classified based on their pest targets, such as fungicides, insecticides, herbicides and rodenticides. For example, fungicides kill fungi, insecticides kill insects and herbicides destroy weeds. Pesticides are divided into two chemical classes: organic and inorganic [3]. India is the fourth largest producer of agrochemicals and it is a net exporter of agrochemicals and ranks 13th in the world for pesticide and disinfectant exports. During the fiscal year 2014-18, agrochemical exports increased at a CAGR of 12.8 per cent. In the fiscal year 2019-20, agrochemical exports increased by 11 per cent and imports increased by 4.4 per cent [4]. Major players operating in India crop protection chemicals market include BASF SE, Bayer AG, FMC Corporation, UPL Ltd, Rallies India Limited, Nagarjuna Agrichem Ltd, Crystal Crop Protection Ltd, Excel Crop Care Ltd etc. [5]. The secondary distribution network refers to the comprehensive set of activities involved in the management and execution of the post-production supply chain, encompassing storage, transportation and distribution. Efficient distribution networks ensure that pesticides reach a wide array of agricultural regions, including remote areas where farming activities are prevalent. This ensures accessibility to farmers who rely on pesticides to protect their crops from pests and diseases [6]. By

guaranteeing the availability of pesticides at the right time, the distribution system supports optimal agricultural productivity and helps farmers respond swiftly to pest infestations. This timely access is critical for maintaining the health of crops and securing the livelihoods of rural farming communities [7-10]. This study was carried out with the aim of examining the issues faced by supply chain partners in secondary distribution network for CPC products.

2. MATERIALS AND METHODS

The study required collection of data from C&F agents and dealers. The South-1 Zone is selected as study area which includes Kurnool, Hyderabad, Khammam, Vijayawada and Guntur depots, as the South-1 zone has a varied geographical locations, with semi-urban regions like Kurnool, Khammam, and Guntur, as well as urban regions like Hyderabad and Vijayawada. For carrying out the study, data was collected from five C&F agents and 100 dealers. The number of dealers from each depot was selected by using proportionate random sampling method based on the number of dealers under each depot. Hence, the sample consists of 100 dealers and five C&F agents. Primary data was collected through well designed and pre tested schedule, which consists of closed ended questions, through indepth personal interview method and by observation method. Secondary data with regard to storing capacities, utilization of warehouses and their scientific storability, handling costs and storage costs was collected from the concerned warehouse records and past records maintained by the respective C&F agents of the warehouse and from records maintained by the dealers.

3. RESULTS AND DISCUSSION

The data collected has been analyzed using Garrett Ranking Technique. The data with regard

Table 1. Issues faced by C&F agents

Factors	Score	Rank
Handling of damages and leakages	71.4	1
Non-availability of skilled labour to load and unload	66.8	2
Handling of returned products because of technical defect by the farmers	52.2	3
High inventory costs during off-season	48.6	4
Damages and leakages of the products during transportation	33.4	5
Forecasted demand not matching with actual demand	25.6	6

Table 2. Issues faced by dealers

Factors	Score	Rank
Wastage due to humidity and heat	59.35	2
Handling leakages and spills	72.15	1
Competition from other brands	51.52	3
Seasonal demand	37.98	4
Lack of knowledge about all the products	27	5

to the issues faced by these two supply chain partners in distribution of CPC products has been gathered and analyzed which are presented in the Table no. 1 and Table no. 2.

The responses of C&F agents regarding the issues faced by them in distribution of CPC products was analyzed using Garrett Ranking Technique. According to the data presented in the Table no.1, the most important issue faced by C&F agents is handling of damages and leakages of the products. The damaged and leaking products have to be allocated a specific place in the warehouse and they have to be returned to the company. This requires lot of documentation and physical handling which involves a substantial amount of time. Non-availability of skilled labours to load and unload CPC products is 2nd most important problem faced by C&F agents as the untrained labour will handle the product very roughly which leads to damages and leakages. The 3rd, 4th, 5th and 6th constraints faced by C&F agents include handling of technically defective products returned by the farmers, incurring high inventory storage costs during off-season, damages and leakages to the product during transportation and overstocking and understocking due to discrepancies in the forecasted demand with the actual demand.

The responses of dealers regarding the issues faced by them in distribution of CPC products was analyzed using Garrett Ranking Technique as was with the issues faced by C&F agents. According to the data presented in the Table no. 2, the most important issue faced by dealers is handling leakages and spills. As the pesticides

are considered as toxic materials, the leaking and damaged products have to be allocated a specific place in the store. Sometimes it can lead to health hazards. Wastage due to humidity and heat is 2nd most important problem faced by dealers as it will spoil the products and will increase storage and handling costs. The 3rd constraint faced by the dealers is competition from other brands. If the competitor's products are aggressively promoted, the demand for the products of the study firm will fall and there will be huge unsold inventory left with the dealers. The 4th and 5th constraints faced by dealers include seasonal demand for agri-inputs and lack of knowledge about all the products, to make right recommendations to the farmers.

4. CONCLUSION

Secondary distribution network is crucial for managing demand and supply, as well as for controlling costs in whole of supply chain. For timely delivery of pesticides to rural areas, a robust distribution network is required. The identification of issues faced by supply chain partners in secondary distribution network is essential to improve efficiency, improve storage conditions, accurate demand forecasting and faster methods for handling returns and damaged goods. Examining these issues will ensure timely and safe delivery of agrochemicals to farmers, increasing agricultural productivity and supporting the sector's growth.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image

generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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