A Simulation and Experiments of Rapeseed Logistics Supply System Based on Flexsim Software

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Abstract. An important aspect of rapeseed logistics supply system is to manage the processes of harvesting and transporting from the different rural fields to the processing plants. This paper applies Flexsim simulation techniques to build the simulation model to solve a problem that vehicles coordinate with harvesters and other plant facilities, analyzing the performance of the system in varied configurations and policies for its operations. Studies proved the effectiveness of the methods to increase harvest logistics efficiencies as well as facilities implement. The studies are also useful for other agro plants with similar supply system.

Keywords: Rapeseed, Logistics Supply System, Simulation.

1 Introduction

An important aspect of logistics supply system in agro industries is to manage the process of harvesting and transporting raw materials, from the rural fields to the processing plants (Iannoni et al., 2006). There are many studies and related work that uses simulation models to analyze agricultural products supply chain in agro industries such as sugarcane (Le Gal et al., 2009); cotton (Ravula et al., 2008); cotton-stalk (Tatsiopoulos et al., 2003) and other biomass supply chain issues (Rentizelas et al., 2009; Sokhansanj et al., 2006) etc. The rapeseed harvest logistics include the process from the harvesting to unloading rapeseed or straw in the cranes or conveyors of company. Therefore, trucks or tractors once arriving at the company go through several operations such as net weighing on a scale, sampling tests to determine content quality, unloading on intermediary storage areas or on the cranes and conveyors. The longer waiting times maybe delayed the return of the trucks to the harvesting fields, thereby reducing their availability to transport rapeseed to the company, as well as causing machine and worker idleness in the field (Iannoni et al., 2006).

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The purpose of this paper is to analyze the rapeseed harvesting logistics processes and investigate optimal configurations and policies for their operations so that the machine efficiency maximized, harvesting and transport coordinated and costs of rapeseed supply chain minimized. Due to several sources of uncertainty and the operational complexity in these systems, the method of analysis is based on discrete simulation techniques of Flexsim software. The paper describes the methods developed to identify opportunities for increased harvest logistics efficiencies as well as the process intended to facilitate implementation.

2 The Framework of Modelling Simulation in Case Study

There are two methods of rape harvest: multiple-step harvest and single-step harvest. Trucks of different types from different fields arrive at the weighing location in the processing plant, where data is collected and the net weight is recorded. After receiving a dispatching instruction at the dispatching location, the vehicle proceeds to the assigned unloading line to unload the rapeseed. The dispatching instruction takes into account not only the queuing state of the unloading lines, but also the truck type, the state of the intermediary storage and the quality of rapeseed. In order to avoid congestion and idle of unloading warehouse, an appropriate decision is necessary.

The operating of modelling simulation is determined by time consumption. Generally only if the rapeseed accumulated a certain quantity that transportation start otherwise trucks have to stand idle, so firstly transportation determined by harvesting time, once trucks leave to plants, harvesting have to performed continuously for the next arrival of trucks. If the reception takes too long to delay the return of the trucks to the rural fields, it may cause machine and workers idleness in the fields. As soon as a vehicle finishes the unloading process, it returns to the rural field to be reloaded, and the cycle begins again. The cycle time includes the time spent in the company’s reception area until unloading, the travel time back to the field, the time spent in the field until loading is complete, and the travel time back to the company.

3 Simulation of the System

3.1 Description of Modelling Simulation

The company in case study has 100 vehicles including 3 types and average 25 farmers’ fields operated at the same time every day in the harvest season. According to the proportion the simulation simplified to 40 vehicles and 10 fields every day while the regulations are maintained. In the model the whole process from harvesting at different 10 fields, transporting to the company and unloading them at the different warehouse. There is only one kind of flow-item named rapeseed in the model, but it is processed at the different field with different harvester, so we define 10 item-types represented different rapeseed in the 10 fields. There are ten different types flow-items entered the model at the source that will arrive based on a normal distribution. Item-types will be uniformly distributed from 1, 2 to 10. As flow-items arrive they will be placed in a corresponding queue and wait to be harvested. The unit of flow-item is defined tonne; once a tonne of rapeseed is harvested it will be stored in queue