

UNIVERSITI TEKNOLOGI MARA

**MODELLING AND OPTIMISING
THE NEXUS BETWEEN
OPERATING PARAMETERS OF
COMBINE HARVESTER AND
GRAIN LOSS DURING HARVEST IN
MALAYSIAN PADDY FIELD**

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ABSTRACT

Paddy cultivation is one of the largest contributors to feeding Malaysian since it serves as a staple food. Harvesting is the most critical factor that should be given big attention in paddy cultivation since it directly affects the grain loss in the field. During the operation, improper management of some operating parameters, such as combine harvester handling and crop physiological factors, may lead to excessive grain loss. Five operating parameters usually affect the grain loss (GL), namely field speed (FS), grain moisture content (GMC), soil moisture content (SMC), soil compaction (SC), and cutting height (CH). However, the relationship between grain loss and these operating parameters of mechanized rice harvesting in Malaysia is rarely studied. Thus, the study was conducted to investigate the effect of these operating parameters on grain loss during the mechanized rice harvesting operation. Modelling and optimizing the significant operating parameters for predicting grain loss were also developed. Besides that, the simulation of the control system using MATLAB was designed based on the developed predictive empirical model for minimizing grain loss and evaluating the field performance of the rice combine harvester during harvesting operations. Lastly, the spatial variability maps towards the significant operating parameters and grain loss were also visualized. To collect the data, daily paddy harvesting operations with New Holland Clayson 8080 combine harvester were observed at rice granaries in the Sekinchan district of Selangor state of Malaysia through a field observation measurement method on December 2017. The total grain loss was measured based on the header loss test and processing loss test. Results from statistical analysis proved that operating parameters have highly significant effects on grain loss. A new predictive empirical model of grain loss with related operating parameters was successfully developed with a high correlation between the involved parameter using regression analysis of $GL=3.941+0.547FS-0.041GMC+0.01SC-0.018SMC+0.022CH$ ($R^2=0.986$). The optimization was also successfully made by developing a control system and then transforming it into a block diagram with the help of Simulink tools in MATLAB software. The findings also found that the best FS operating in the damp soil condition of 55% moisture content and 469 kPa compaction was 2.23 km/h at 45 cm cutting height. With the best operating field conditions during harvesting operations, the grain loss contributes 4.59%, which equals RM421.66/ha (USD 93.69/ha) income loss. The dispersal of the spatial variability of yield maps displayed the grain loss and other related operating parameters. The developed control system, which is transformed into the block diagram with the help of Simulink tools in MATLAB software, has successfully demonstrated a conceptual model-based design with real-time system execution. Conclusively, this study would be beneficial in assisting rice farmers in predicting grain loss during mechanized harvesting by considering the parameters mentioned earlier. Indirectly, it may also help increase paddy yields by reducing excessive losses during harvesting.

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