UNIVERSITI TEKNOLOGI MARA

FIELD PERFORMANCE EVALUATION OF AUTOPILOT AND MANUAL STEERING SYSTEMS OPERATIONS OF A TRACTOR-MOUNTED SOIL ECa SENSOR IN OIL PALM PLANTATION

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ABSTRACT

Nowadays, the advancement of precision farming continuously reshapes the landscape of agricultural operations productivity. Precision farming gives many benefits to the farmers' community in managing and monitoring their farmland by using modern equipment and technologies. The autopilot steering system is one of the precision farming technologies in the driving of machinery that has been implemented in modern driving modes of tractors in developed countries. However, further evaluations of this system become a prime interest, especially in regards to its application in the areas which are different from its country of origin. Thus, this study evaluated the operations of tractor-mounted soil ECa sensors with manual and autopilot steering modes on immature oil palm areas. A New Holland TD5.75 tractor with an engine power of 75 horsepower equipped with a Trimble autopilot-automated steering system was used in the study. The tractor pulled a Veris 3100 soil ECa sensor to measure the soil ECa at the study area. A combination of ArcGIS with Microsoft Excel was employed to develop a simple approach for evaluating the straight-line accuracy of the tractor when moving with an autopilot steering system. The results showed that both steering modes generated slightly different patterns of spatial variability on the interpolated soil ECa maps. However, autopilot steering mode consumed lower human energy expenditure of operator at 0.44 kcal/min as compared with the manual steering. Besides that, it also offered a higher effective field capacity of operation with 5.13 ha/h compared with the manual steering. The error in positioning straight-line accuracy of the operation of the tractor-mounted soil ECa sensor with autopilot steering was at average 7.78 cm that indicating an acceptable range of straight-line error. Conclusively, the operation of the tractor with autopilot-steering showed good results to be implemented as an alternative tractor's driving system for operating the Veris 3100 soil ECa sensor on immature oil palm areas. In general, this technology had a great potential to be introduced in the Malaysian oil palm plantation industry in an effort to enhance the infield operations with the up-to-date technology and create more enjoyable working environments in the plantation.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

In the past decades, there has been considerable autonomous farm machinery as one of the phases of industrial revolutions for the agriculture sector through field performance, yield productivity, and costs management. The development of autonomous farm vehicles focuses on reducing the working hour, avoiding hazardous and tedious work thus overcoming the unskilled tractor operator during field performance. The farm machinery is designed to perform various field operations and always operated on unplanned and changing terrain at optimum vehicle speed requirements. Meanwhile, human operators were used intelligence to combine several job functions, visual and audio, motion and experience to operate the farm vehicle.

The use of farm machinery in oil palm operation has been giving a significant impact on the oil palm industry by increasing productivity per day and reducing costs in past decades. There are several common types of machinery or mechanization used in oil palm operation such as motorised cutter, mechanical harvester, transporter, crop care and fruit collector. The use of machinery has proven that the machinery has reduced the time for ploughing, harvesting and evacuating the oil palm Fresh Fruit Bunch (FFB), collecting loose fruits, fertilizer application and pest and disease control during field operation (Samsudin *et al.*, 2018). The machinery also helps to increase farm productivity and field operation become more efficient. In return, it gives high profitability toward the economy of growth especially in the exportation of Malaysia of crude palm oil global.

As reported by MPOB, (2019) the oil palm planted areas (including matures and immatures palm) for 2018 in Peninsular Malaysia is 2.7 million hectares and East Malaysia (Sabah and Sarawak) is 3.1 million hectares. Statistics data shows the total oil palm has planted in 2018 was 5.8 million hectares higher compare with the previous two and four-year records in 2016 (5.7 million hectares) and 2014 (5.3 million hectares). Due to this increment of oil palm land title, the machinery used in oil palm operation should be expanded to facilitate the high demand and preference. Meanwhile,