DEVELOPING INTELLIGENT WEED COMPUTER VISION SYSTEM FOR LOW-LAND RICE PRECISION FARMING

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ABSTRACT

Weeds infestation is one of the major problems facing rice production in Africa. Losses of rice caused by weeds yearly have been estimated at 2.2 million tons in Sub-Saharan Africa, the losses which are estimated at $1.45 billion. Weeds reduce the economic value of rice by causing an increase in the cost of production. Concerns have been raised on the health implication of herbicides, weeds seed in food crop and their effect on the environment, therefore, leading to the need for site-specific means of herbicide application to target only the weeds and ensure minimal seed contamination. This paper addresses these problems by the use Faster Regions with Convolution Neural Network (faster R-CNN) and Fuzzy Logic Controller (FLC) to develop an intelligent weed recognition system for better yield and return of investment in rice production in Sub-Saharan Africa. Faster R-CNN is a type of Artificial Neural Network (ANN) which uses convolutional features to map obtained features from an input image in order to identify the region of interest from the bounding box drawn around the weed image. As of the time of this research, the faster R-CNN method provides a faster means for real-time recognition as compared to other methods of ANN. The result of the recognition will be fed into the FLC to control the volume and time of spraying of the herbicides in low-land rice precision farming. The successful development and pilot testing of the anticipated intelligent computer vision system for rice weed control is expected to provide a faster and more efficient means of weed management for low-land precision farming for better food security in Sub-Saharan Africa.

KEYWORDS: *Weed, Site-specific, Artificial neural network, Deep learning, Faster R-CNN, Fuzzy logic control, Food Security*

INTRODUCTION

Rice (*Oryza sativa*), a plant species, is a seed of grass species grown as an annual plant. Rice is one of the world's three leading food crops and provides twenty per cent of the calories consumed worldwide by humans. It is one of the most consumed staple food among Africans and Asians, far more than half of the population of the world(Maclean, Hardy, & Hettel, 2013). Rice is an important staple food consumed by Nigerians. Rice is farmed in about 1.7 million hectares of the estimated 4.6 million to 4.9 million hectares' potential land for its production. The production environment for rice in Nigeria is the rain-fed lowland, rain-fed upland, irrigated lowland, deep water/floating and mangrove swamp (Nwilene et al., 2008).

There is three important periods of rice growth. The first is the vegetative phase in which foundation is laid and most farm operations are accomplished. The second is the reproductive phase which deals with building up stores, the panicles of the rice and the leaves develop to flowers. The third stage is the maturity phase when the flowers are fully matured and rice is ready for harvest. The difference in all the rice varieties of the world is the vegetative phase as the other two phases reproduction and maturity are fixed (Warda, 2015). There are different constraints which affect rice productivity such as weed infestation, poor extension system, low yield, poor milling, and poor drainage (Nwilene *et al*., 2008).

Weed is any plant that grows in an unwanted place. Akobundu *et al.* (2016) suggested that human disturbance of natural way of vegetation to meet recreational and agricultural activities led to the idea of weed. Civility and increase in knowledge of the nature of weeds have led to the identification, study