Oil-palm die within 1-2 years. symptom of these

Oil-palm (Elaeis guineensis) trees are animportant economic crop which are the source of palm oil, a widely usedvegetable oil in the world.

Its other major uses include furniture, plywood, paper etc. Crop diseases are the major source of food insecurity and famine ata global scale. Not only that, farmers also have to face disastrousconsequences as their livelihood is dependent on healthy crops. Like most of the crops oil-palm trees are alsoprone to diseases. Common ones includeGanoderma butt rot and Oil palm wilt caused by fungus (Turner, 1981). These devastating diseases cause direct lossof stand and reduction in yield. Trees with the symptoms of these diseases diewithin 1-2 years. Symptom of thesediseases include pale yellow foliage of leaves.

With the progress of diseasethe palm show retarded growth with leaves turning brown and spear leavesremaining unopened, ultimately causing the death of palm (Hushiarian, Yusof, & Dutse, 2013). Theinfected tree has to be quarantined and removed to prevent the spread ofdisease (Singh, 1991). Early detection of the diseased trees is vitalto manage the disease effectively and to prevent the spread of disease. Manualinspection of the palms in order to monitor their health is very time consumingand expensive.

Remote sensing provides time and cost efficient solutions forprecision agriculture. A lot of research has been done on oil-palmmanagement using satellite based remote sensing data for identifying and countingoil-palm trees in a farm (Shafri, Hamdan, & Saripan, 2011; Srestasathiern& Rakwatin, 2014) andidentifying diseased regions in image (Santoso, Gunawan, Jatmiko, Darmosarkoro, &Minasny, 2011; Zulhaidi, Shafri, & Hamdan, 2009).

Thesetask require high accuracy and precision and it is more challenging usingsatellite based data due to cloud cover being one reason amongst other and alsoaccess of high resolution imagery is costly. Aerial images are the goodalternative when it comes to high spatial resolution.

The use of Aerial imagery for precisionagriculture has increased due to the availability of high resolution imagerythrough UAVs and airborne source (Berni, Zarco-Tejada, Suárez, González-Dugo, &Fereres, 2009; Rokhmana, 2015). Technological strategies using machine vision and artificialintelligence are being investigated to achieve intelligent farming using highresolution aerial images. For managing oil-palm plantation, machine learning has been used for identifying and counting oil-palm trees in afarm using aerial imagery (Malek, Bazi, Alajlan, AlHichri, & Melgani, 2014; Miserque Castillo, Laverde Diaz, & Rueda Guzmán, 2016). Deeplearning is a subset of machine learning which deal with the set of algorithm inspiredby the working of brain, known as artificial neural networks.

In remotesensing, Deep learning has been used in many applications like buildingdetection (Vakalopoulou, Karantzalos, Komodakis, & Paragios, 2015), road detection (Mnih & Hinton, 2010), vehicledetection (Chen, Xiang, Liu, & Pan, 2014) , imageclassification (Li, Fu, Yu, Gong, et al., 2016) and sceneclassification (Hu, Xia, Hu, & Zhang, 2015) usingremote sensing imagery. Convolutional Neural Networks (CNN) are acategory of Neural Networks that have proven very effective in areas such asimage recognition (Krizhevsky, Sutskever, & Hinton, 2012; LeCun, Kavukcuoglu, & Farabet, 2010). Inprecision agriculture CNN has been used for disease management

in detection of Ceratocystis wilt in Eucalyptus cropsfrom aerial images (Souza et al.

, 2015). In case of oil-palms CNN have been used to countthe trees in remote sensing images (Cheang, Cheang, & Tay, 2017; Li, Fu, Yu, &Cracknell, 2016) howeverno effort has been applied for detecting diseased oil-palm trees using CNN. Thisstudy is an attempt to evaluate the performance of convolutional neuralnetworks in detecting diseased oil-palm trees in Aerial images of theplantations in Ecuador and Indonesia.