Chapter 11

Precision Agriculture to Ensure Sustainable Land Use for the Future:

Precision Agriculture and Arable Land Use

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ABSTRACT

Global food security is coupled with the preservation and safe use of arable land resources. Land use competition in terms of commercial land use and urbanization has imparted enormous pressure on soil resources. The arable land of the world is already shrinking due to land degradation and desertification while our efforts to ensure commercial land availability is making the current scenario even worse. Soil degradation has put millions of acres of land as devoid of sustainable use over the past few decades and research shows that situation is going to be worse day by day. Precision agriculture can not only ensure the optimal use of available land but also can increase the restoration potential of global agriculture sectors. Integrated nutrient and pest management along with zero tillage, organic farming, and vertical plantation can be visualized as insurance of land and water conservation for the future. This chapter is an effort to contribute comprehensive information regarding the role of precision farming in the restoration and optimal use of global land resources.

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INTRODUCTION

Precision agriculture is the series of advanced methods for farm management and crop production which uses information technology-based platforms to check and ensure that crops are receiving the right amount of nutrients, water, and other necessary plant supporting elements. This technique was evolved to ensure the economic and environmental gains as well as sustainable development (Carolan, 2017). This technology used information technology, hi-tech drones, and remote sensing and is widely adopted by the world as it has numerous advantages like high profitability, the supply of the right amount of nutrients and essential chemicals to the crops and reduced labor cost, etc. (Miller et al., 2017). This technology is transforming farming-related data into useful information which is helpful for decision-making in agriculture (Liu et al., 2017). The need for precision agriculture was sensed when the problem of food security and agricultural soil productivity emerged as an issue of concern worldwide. Its emergence may be the result of climate change phenomena followed by excessive emission of greenhouse gasses (Yohannes, 2016). Many factors contribute in worsening the situation like households, and their household size (Oluyole et al., 2009), farm size (Sikwela, 2008), low annual production (Alem, 2007), age of household head, livestock ownership (Bogale & Shimelis, 2009), and agricultural practices for conserving natural resources (Beyene & Muche, 2010). Moreover, extreme weather conditions, insect-pest attacks, and rapid population growth are also among the common causes of food insecurity in third world countries (AFI, 2012).

Precision agriculture involves the use of hi-tech and most modern technology, agricultural equipment and implements for the improvement of agricultural productivity, yield and optimization of soil nutrients, moisture, and other agronomic practices (Chivenge & Sharma, 2019). The most common practices used in this technique are minimum or zero tillage which also gives rise to a new idea of organic agriculture, a very profitable business. There are many advantages of zero tillage like an organic matter of the soils under zero tillage is significantly high as compared to the soil receiving tillage regularly (Landers, de Freitas & Boddey, 2017) as well as improve soil health and productivity (El-Shater et al., 2016). Integrated nutrient management (INM) is also practiced in precision agriculture, it also has the advantages of improved soil as soil undergoing INM practices has fewer weeds and require fewer nutrients than those without INM (Singh & Prasad, 2016). Integrated pest management (IPM) is also associated with integrated nutrient management (INM). The supply of the right amount of nutrients also interferes with weed growth (Méndez-Vázquez et al., 2019). Other activities included in PA involve practices like laser land leveling, hoeing, water, and nutrient application and management. The main theme of precision agriculture is the site-specific allocation of all the available resources to ensure their optimum use (Chivenge & Sharma, 2019).

Arable lands are the soils that have the potential to grow crops but left fallow or not used for crop production permanently (Han et al., 2017). Arable lands can be used for crop production and other agricultural uses but nowadays facing several problems - (i) soil salinity due to the use of brackish water, excessive fertilizers application, etc., (ii) high temperatures induced land degradation, erosion, excessive tillage practices, and waterlogging, (iii) exhaustion of soil fertility due to continuous crop cultivation and other organic, inorganic pollutants (Baude et al., 2019; Sharma & Shehrawat, 2019). The practices in PA can help tackle these issues as adopting precision agriculture helps boast soil physical, chemical, and biological properties. This improvement in soil properties happens because of the microbial diversity and population improvement, soil aggregation, and nutrient holding capacity (Wallor et al., 2018). Nowadays, GPS, GIS, GNSS, remote sensing, satellite imagery, and drones are also used for the

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