

Geotechnologies and the Environment

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Geospatial Technology to Support Communities and Policy


Pathways to Resiliency

 Springer

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Chapter 12

Application of Digital Technologies & Remote Sensing in Precision Agriculture for Sustainable Crop Production



Mohammad Usama

Abstract Soil is an abiotic component of environment which provides habitat for soil microflora and fauna which is very essential for good health. Anthropogenic activities can alter soil and affect health of soil. These activities include excess use of chemical fertilizers, pesticides, irrigation, faulty agricultural practices, modern machinery, shifting cultivation etc. Alternative exists in the form of precision agriculture, as it will help in practicing agriculture in a way that will contribute towards sustainable rural development. The challenge for rural India is to feed more people from shrinking agricultural land and without having much negative consequence on our environment. This may be possible through precision agriculture as we have the correct information collected through satellite as well as aerial imagery about weather conditions and the needs of our agricultural land and also about crops in terms of requirement of fertilizers, pesticides, irrigation facility etc. By adopting precision agriculture, we would be able to rejuvenate and maintain good soil health. So, precision agriculture can be called the future of sustainable agriculture in India and around world, as this only has the potential to feed the millions of people with least negative consequence on Human life and Environment.

Keywords Precision agriculture · Sustainable agriculture · Artificial intelligence · Drones · Global positioning system · Sensors · Fertilizers; yield · Machine data · Internet of things · Satellite imagery

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12.1 Introduction

Farmers in India and all over the World have a responsibility to feed the exploding population from shrinking agricultural land. According to the report published by FAO, arable land is shrinking per person as it was 0.38 hectares in 1970 and 0.23 hectares at present, but in the future by the year 2050, it may further decline up to 0.15 hectares. Agricultural revolutions are seen to influence food production which is very vital for feeding ever growing human population. During the period between 1900 and 1930 in first agricultural revolution every farmer was producing food which could feed around 26 people. In 1960, feeding capacity of each farmer increased to 156 people after green revolution started with genetic modifications. But the challenge to feed world population will become more difficult as it may reach 9.6 billion mark by the year 2050. So, it is required that food production needs to be doubled to feed everyone. The solutions exists in the form of new technological developments in the form of precision agriculture as it is considered as third agricultural revolution which could feed around 265 people on the same acreage. Food production will reach the optimum level without facing the challenges associated with traditional and modern agriculture. There are various practices which are adversely affecting soil and degrading its fertility and characteristics. Precision agricultural revolution involves use of satellite as well as aerial imagery for weather prediction, observing crop health indicators and application of fertilizers at variable rates in an agricultural field.

Machine data was aggregated for collection of soil data and more precise topographical mapping and planting. According to Grand View Research the market of Precision agriculture is increasing and it may rise from \$9.65 billion in the year 2019 to \$12.9 billion in the year 2027. According to World Economic Forum estimate crop yield may increase globally between 10% and 15% by the year 2030, if about 15–25% of farms are practising and adopting precision agriculture. This will also bring 10–20% reduction in water use and curtail greenhouse gas emissions.

Agriculture has been an essential component of human life and has been facing challenges in form of population growth, scarcity of arable land and natural hazards. It has been reported that soil erosion is 100 times faster than its formation. One-third of arable land is lost by Earth and if trend continues in this direction, then it may become unproductive by the next 60 years. The majority of agricultural land is located in three continents of world i.e. Africa, America and Asia, which accounts for nearly 37.2% of the land mass or over 48 million km² land globally. Despite producing sufficient food, about 800 million people do not have adequate supply of food. In this respect, Precision agriculture involving uses of technology like artificial intelligence, drones, IoT, mobile computing, robots etc. will be the future for sustained and enhanced agricultural production. Farm Robots and automation will lead to smart farming. The goal of digital technologies in farm should be that farming should be sustainable and scalable. Through the use of Big data analytics farmers can be alerted about pest infestation and drought without having need of regular manual check up of farm. Precision agriculture is striving to make farming more