APPLICATION OF REMOTE SENSING IN AGRICULTURE

NISHANT K SINHA, M MOHANTY, J SOMASUNDARAM, SHINOGI K C, K M HATI, and R S CHAUDHARY
1ICAR-Indian Institute of Soil Science, Bhopal, Madhya Pradesh

Remote sensing is the process of acquiring information about the Earth's surface by measuring its reflected and emitted radiation without coming into direct contact with the object. In much of remote sensing, the process involves an interaction between incident radiation and the targets of interest (Figure 1).The most useful electromagnetic radiation in remote sensing includes visible light (VIS), near infra red (NIR) and shortwave infrared(SWIR), to thermal infrared (TIR) and microwave bands (Figure 2). Passive remote sensing sensors record incident radiation reflected or emitted from the objects while active sensors emit their own radiation, which interacts with the target to be investigated and returns to the measuring instrument.

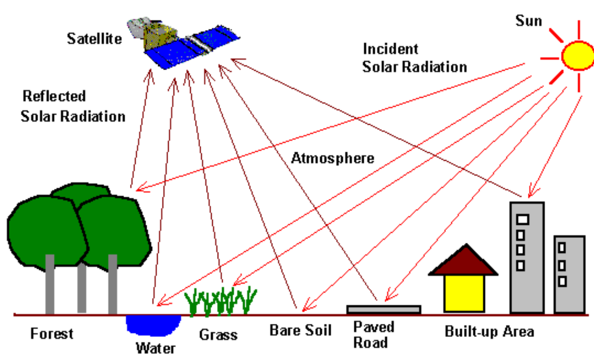

Figure 1 A depiction of processes involves in remote sensing.

MILESTONES IN HISTORY OF REMOTE SENSING

Year	Milestones achieved
1800	Discovery of Infrared by Sir W. Herchel
1839	Beginning of Practice of Photography
1847	Infrared Spectrum Shown by J.B.L. Foucault
1859	Photography from Balloons
1873	Theory of electromagnetic spectrum by J.C. Maxwell
1909	Photography from Airplanes
1916	World War I: Aerial Reconnaissance
1935	Development of Radar in Germany
1940	World War II: Application of Non-Visible parts of Electromagnetic radiation
1950	Military Research and Development
1959	First Space Photograph of the Earth (xplorer-6)
1960	First Meteorological Satellite launched
1970	Skylab Remote Sensing Observations from Space
1972	Launch LANDSAT-I and rapid advancement in digital image processing
982	Launch od LANDSAT-4 with new generation of sensors (TM)
1986	French Commercial Earth Observational Satellite SPOT
1986	Development of hyperspectral sensors
1990	Developing high resolution space borne systems and first commercial developments in remote sensing
1998	Towards cheap one-goal satellite missions
1999	Launch EOS: NASA Earth observing mission
1999	Launch of IKONOS, very high spatial resolution sensor systems

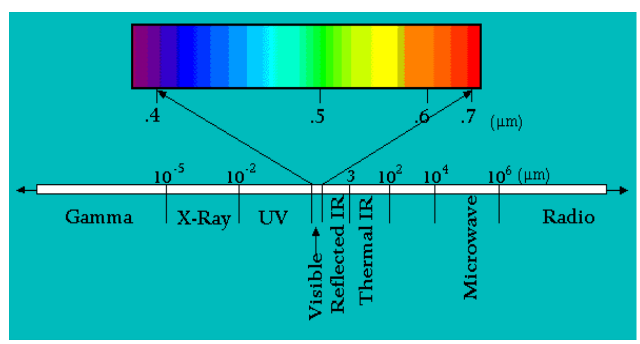

Figure 2 Full range of electromagnetic spectrum.

REMOTE SENSING IN AGRICULTURE

A recent report by the FAO projects that an increase in world population to 9.15 billion by 2050, which may need the current food production to increase by 60%. Many efforts are underway to increase overall production to feed the burgeoning population by increasing efficiency in production such as high intensity agriculture, efficient water use, and high yield varieties. Agricultural production follows strong seasonal patterns related to the biological lifecycle of crops. The production also depends on the physical landscape (e.g., soil type), as well as climatic driving variables and agricultural management practices. All these variables are highly variable in space and time. Moreover, as productivity can change within short time periods, due to unfavourable growing conditions, agricultural monitoring systems need to be real time for higher productivity. Therefore, use of remote sensing is indispensable in monitoring of agricultural field, crop & soil health, water management and its quality, and atmospheric conditions with emphasis to yield.

During the last two decades, remote sensing techniques are applied to explore agricultural applications such as crop discrimination, crop acreage estimation, crop condition assessment, soil moisture estimation, yield estimation, precision agriculture, soil survey, agriculture water management, agro meteorological and agro advisories. The application of remote sensing in agriculture, i.e. in crops and soils is extremely complex because of highly dynamic and inherent complexity of biological materials and soils (Myers, 1983). However, remote-sensing technology provides many advantages over the traditional methods in agricultural resources survey. The advantages include (a) capability of synoptic view, (b) potential for fast survey, (c) capability of repetitive coverage to detect the changes, (d)low cost involvement, (e) higher accuracy, and, (f) use of hyperspectral data for increased information. As mentioned, there are many applications of remote sensing in the agricultural sector. Below is a summary of these applications.

Crop Production Forecasting: Remote sensing is used to forecast the expected crop production and yield over a given area and determine how much of the crop will be harvested under specific conditions. Researchers can be able to predict the quantity of crop in a given farmland over a given period.

Assessment of Crop Damage and Crop Progress: In the event of crop damage or crop progress, remote sensing technology can be used to penetrate the farmland and determine exactly how much of a given crop has been damaged and the progress of the remaining crop in the farm.

Crop Identification: Remote sensing has played an important role in crop identification especially in cases where the crop under observation shows some mysterious characteristics. The crop data collected will be taken to labs where various aspects of crop including the crop culture are studied.

Crop Acreage Estimation: Remote sensing has also played a very important role in the estimation of the farmland on which a crop has been planted. This is usually a cumbersome procedure if it is carriedout manually because of the vast sizes of the lands being estimated.

Crop Yield Modelling and Estimation: Remote sensing also allows farmers and experts to predict the expected crop yield from a given farmland by estimating the quality of the crop and the extent of the farmland. This is then used to determine the overall expected yield of the crop.

Identification of Pests and Disease Infestation: Remote sensing technology aplays a significant role in identification of pests in farmland and gives data on the right pests control mechanism to get rid of the pests and diseases on the farm.

Soil Moisture Estimation: Soil moisture can be difficult to measure without the help of remote sensing technology. Remote sensing gives the soil moisture data and helps in determining the quantity of moisture in the soil and hence the type of crop that can be grown in the soil.

Soil Mapping: Soil mapping is one of the most common yet most important uses of remote sensing. Through soil mapping, farmers are able to tell which soils are ideal for which crops and which soil require irrigation and which ones do not. This information helps in precision agriculture.

Monitoring of Droughts: Remote sensing technology is used tomonitor the weather pattern of a given area. The technology also monitors drought patterns of the area too. The information can be used to predict the rainfall patterns of an area and also tell the time difference between the current rainfall and the next rainfall which helps to keep track of the drought.

Water Resources Mapping: Remote sensing is instrumental in the mapping of water resources that can be used for agriculture over a given farmland. Through remote sensing, farmers can tell where water resources are available for use over a given land and whether the resources are adequate.

FURTHER READING:

https://grindgis.com/remote-sensing/

Atzberger, C. (2013). Advances in remote sensing of agriculture: Context description, existing operational monitoring systems and major information needs. *Remote sensing*, *5*(2), 949-981.

Wójtowicz, M., Wójtowicz, A., & Piekarczyk, J. (2016). Application of remote sensing methods in agriculture. *Communications in Biometry and Crop Science*, *11*, 31-50.

***