CORPUS PUBLISHERS

Current Trends in Engineering Science (CTES)

Volume 1 Issue 1, 2020

Article Information
Received date: June 05, 2020
Published date: July 02, 2020

*Corresponding author
Muhammad Adnan, Department of Agronomy, College of Agriculture, University of Sargodha, Pakistan

Keywords Remote sensing; Innovative way; Agriculture; Crop production

Review Article

Remote Sensing an Innovative Way to Improve Crop Production: A Review

Muhammad Adnan[1]*

Department of Agronomy, College of Agriculture, University of Sargodha, Pakistan

Abstract

Agriculture is providing fuel, fiber and food to humans but productivity of agriculture is affected due to climate change. Remote sensing is science and art in which we gather information without making physical contact with field. In agriculture it plays an important role in crop monitoring, yield assessment and classification. Moreover, it is an innovative way for timely monitoring of crop with accurate picture of agricultural sector with high accuracy and revisit frequency. Furthermore, remote sensing can improve the agricultural crop production by minimizing the input losses. The present review focuses on role of remote sensing in agricultural crop production.

Introduction

Agriculture provides significant contribution in economy of nation. It shows a considerable trading towards industry for making a country strong. In agriculture minimizing production cost is necessary and very most important goal of farmers and government [1]. Old usage of technologies and blind application of inputs negatively affect the crop production. The technology refers as "application of inputs and tools accurately and precisely for achieving maximum economic objectives". In developing countries farmers mostly adopt and perform the traditional practices due to which agriculture production is lower than the developed countries [2]. There are lot of new technologies to reduce the cost of production and maximize the quality production i.e. use of genetic modified crops and remote sensing combined with computer technology. Remote sensing is technique for collecting information regarding field without making physical contact [3]. It is a technique in which earth resources are monitored by space technologies and ground observations for more accuracy and precision. It uses different kinds of devices and tools to make electromagnetic radiation outside this range up to 400-700nm visible to human eye, mainly near, middle, thermal infrared and sometimes microwaves [4]. The major principle behind this is utilization of electromagnetic spectrum (microwaves, infrared and visible) for observing features of earth. It is used for monitoring bare soil, vegetation and water. Moreover, it is used for observing land cover changes, land use pattern, crop growth, monitoring of diseases, water status under field, pest infestation, yield estimation, weather forecasting and precision farming. This data contributes for monitoring features by providing synoptic, timely and repetitive information regarding surface of earth [5].

It plays a significant role by helping farmers to increase in production and reduce the cost of production [6]. Furthermore, by using remote sensing data decision-making ability of farmers improved. Previous studies show that through remote sensing farmers can maintain organic matter content, crop yields, pH, terrain specifics, nutrient levels and moisture [7]. The data collected from the current remote sensing satellites may be utilized to get information regarding two crop production components (GEO, 2013); acreage [8,9] and yield [10-15]. Moreover, it provides information regarding crop phenology [15,16], disturbances [5,17] and stress conditions can be detected [13,18,19]. Keeping in mind regarding remote sensing importance as an innovative way in agriculture. The present review is planned which focuses on role of remote sensing in agricultural crop production.

Remote Sensing

Remote sensing gathers information form the surface by using the reflected and emitted waves coming from the earth. It offers new opportunity to record the data of land and reduces the man efforts. The data collected by remote sensing is mainly soil, geology, vegetation cover, water, nutrients, urban sprawl and terrain [20]. It offers a lot of data like spatial spectral and temporal resolutions and facilitates the planners for mapping and characterization at various scales. It is most effective and less time consuming way of achieving economic potential of crop and soil [21]. The data of remote sensing revolutionized the land applications features [22].

Role of Remote sensing in crop production

During early days the data of remote sensing focuses on land covers and crop types but now its focus is on biophysical characterization of plant [3]. Remote sensing technology has potential to estimate crop productivity on the basis of crop and soil biophysical attributes [23]. The data obtained from remote sensing may be used for estimating crop production [15]. This technique reduces the labor cost and improve precision agriculture [7].

Role of Remote sensing in assessment of field condition

Remote sensing plays a significant role in assessing the plant heath by using bio-physical indicators. Many physiological changes occur in crops due to various stresses can be detected and recorded by remote sensing [24]. Monitoring of drought by using remote sensing is used and accepted. Moreover, VCI (Vegetation Condition Index) and NDVI (Normalized Difference Vegetation Index) is also utilized to identify the drought conditions in field [25-29].

Role of Remote sensing in optimizing Agricultural inputs

The most important role of remote sensing is precision agriculture it helps to optimize the water and nutrient in field. Identifying the need of particular nutrient and need of water at critical crop growth period helps to reduce production cost and improve water and fertilizer use efficiency. In areas where drought occurs drip irrigation along with remote sensing improved the crop production and reduce the inputs [30]. Under wet environment nitrogen fertilizer leaches more due to variation in water content [31]. SOM content [32] and yield [33,34]. These conditions cause TSF (traditional single-rate N fertilization) failures [35]. The nitrogen use efficiency can be improved by remote sensing (7,36].

Role of Remote sensing in pest identification and control

Remote sensing has a great potential to detect the weed infestation in an area and can be used as site specific management of weeds [37-39]. It not only identifies the weed specie but also helps to develop the appropriate amount of herbicide to control. Furthermore, it is also a good approach for assessing and monitoring infected leaves in field by spectral response to yellowing and chlorophyll of leaves [40]. Its application detects the pattern disturbance and help to manage pests in the field [41].

Role of Remote sensing in estimating crop production

Remote sensing is an innovative way to forecast the crop yield by finding a relationship among vegetation indices and yield [42]. Basically the crop yield is dependent on many factors such as variety, soil type, weather, pest and diseases. The spectral response of remote sensing is dependent on all these factors [24].

Conclusion

The present review concludes that remote sensing is an innovative way in agriculture to improve crop production. Moreover, this technique reduces the cost of production and increase the economy of a country [43].

References

1. Gebeyehu MN (2019) Remote Sensing and GIS Application in Agriculture and Natural Resource Management. International Journal of Environmental Sciences & Natural Resources 19(2): 45-49.
2. Insan Akademika, Masood A, Ellahi N, Batool Z (2012) Causes of low agricultural output and impact on socio-economic status of farmers: A case study of rural Potohar in Pakistan. International Journal of basic and applied Science 1(2): 343-351.
3. Shanmugapriya P, Rathika S, Ramesh T, Janaki P (2019) Applications of Remote Sensing in Agriculture-A Review. Int J Curr Microbiol Appl Sci 8(1): 2270-2283.
4. Aggarwal S (2004) Principles of remote sensing. Satellite remote sensing and GIS applications in agricultural meteorology. 23-38.
5. Zhan X, Sohlberg RA, Townshend JRG, Di Miceli C, Carroll ML, et al. (2002) Detection of land cover changes using MODIS 250m data. Remote Sensing of Environment 83(1-2): 336-350.
6. Kumar N, Yamaç SS, Velmurugan A (2015) Applications of remote sensing and GIS in natural resource management. Andaman Science Association 20(1): 1-6.
7. Kingra PK, Majumder D, Singh SP (2016) Application of remote sensing and GIS in agriculture and natural resource management under changing climatic conditions. Agric Res J 53(3): 295-302.
8. Galford GL, Mustard JF, Melillo J, Gendrin A, Cerri CC, et al. (2008) Wavelet analysis of MODIS time series to detect expansion and intensification of row-crop agriculture in Brazil. Remote sensing of environment 112(2): 576-587.
9. Yao F, Feng L, Zhang J (2014) Corn area extraction by the integration of MODIS-EVI time series data and China's environment satellite ($HJ-_1$) data. Journal of the Indian Society of Remote Sensing 42(4): 859-867.
10. Bernardes T, Moreira MA, Adami M, Giarolla A, Rudorff BFT (2012) Monitoring biennial bearing effect on coffee yield using MODIS remote sensing imagery. Remote Sensing 4(9): 2492-2509.
11. Duveiller G, López-Lozano R, Baruth B (2013) Enhanced processing of 1-km spatial resolution fAPAR time series for sugarcane yield forecasting and monitoring. Remote Sensing 5(3): 1091-1116.
12. Mulianga B, Bégué A, Simoes M, Todoroff P (2013) Forecasting regional sugarcane yield based on time integral and spatial aggregation of MODIS NDVI. Remote Sensing 5(5): 2184-2199.
13. Rembold F, Atzberger C, Savin I, Rojas O (2013) Using low resolution satellite imagery for yield prediction and yield anomaly detection. Remote Sensing 5(4): 1704-1733.
14. Meroni M, Marinho E, Sghaier N, Verstrate MM, Leo O (2013) Remote sensing based yield estimation in a stochastic framework-Case study of durum wheat in Tunisia. Remote Sensing 5(2): 539-557.
15. Doraiswamy PC, Sinclair TR, Hollinger S, Akhmedov B, Stern A, et al. (2005) Application of MODIS derived parameters for regional crop yield assessment. Remote sensing of environment 97(2): 192-202.
16. Sakamoto T, Yokozawa M, Toritani H, Shibayama M, Ishitsuka N, et al. (2005) A crop phenology detection method using time-series MODIS data. Remote sensing of environment 96(3-4): 366-374.
17. Verbesselt J, Hyndman R, Newnham G, Culvenor D (2010) Detecting trend and seasonal changes in satellite image time series. Remote sensing of Environment 114(1): 106-115.
18. Mirik M, Ansley RJ, Steddom K, Rush CM, Michels GJ, et al. (2014) High spectral and spatial resolution hyperspectral imagery for quantifying Russian wheat aphid infestation in wheat using the constrained energy minimization classifier. Journal of Applied Remote Sensing 8(1): 083661.
19. Gu Y, Brown JF, Verdin JP, Wardlow B (2007) A five-year analysis of MODIS NDVI and NDWI for grassland drought assessment over the central Great Plains of the United States. Geophysical research letters 34(6): 1-6.
20. Bhagat SV (2012) Use of remote sensing techniques for robust digital change detection of land: a review. Recent Patents on Space Technology 2(2): 123-144.
21. Landgrebe D (1999) Information extraction principles and methods for Multispectral and Hyperspectral Image data. Information processing for remote sensing 82: 3-38.
22. Jin X, Kumar L, Li Z, Feng H, Xu X, et al. (2018) A review of data assimilation of remote sensing and crop models. European Journal of Agronomy 92: 141-152.
23. Liaghat S, Balasundram SK (2010) A review: The role of remote sensing in precision agriculture. American journal of agricultural and biological sciences 5(1): 50-55.
24. Menon ARR (2012) Remote sensing applications in agriculture and forestry. A paper from the proceedings of the Kerala environment congress. pp. 222-235.
25. Kogan F, Yang B, Wei G, Zhiyuan P, Xianfeng J (2005) Modelling corn production in China using AVHRR-based vegetation health indices. International Journal of Remote Sensing 26(11): 2325-2336.
26. Nicholson SE, Farrar TJ (1994) The influence of soil type on the relationships between NDVI, rainfall, and soil moisture in semiarid Botswana. I. NDVI response to rainfall. Remote sensing of environment 50(2): 107-120.
27. Ji L, Peters AJ (2003) Assessing vegetation response to drought in the northern Great Plains using vegetation and drought indices. Remote Sensing of Environment 87(1): 85-98.
28. Anyamba A, Tucker CJ, Eastman JR (2001) NDVI anomaly patterns over Africa during the 1997/98 ENSO warm event. International Journal of Remote Sensing 22(10): 1847-1860.
29. Wang J, Price KP, Rich PM (2001) Spatial patterns of NDVI in response to precipitation and temperature in the central Great Plains. International Journal of Remote Sensing 22(18): 3827-3844.
30. Das DK, Singh G (1989) Estimation of evapotranspiration and scheduling irrigation using remote sensing techniques. Proc. Summer Inst. On agricultural remote sensing in monitoring crop growth and productivity, IARI, New Delhi, 113-17.
31. Delin S, Berglund K (2005) Management zones classified with respect to drought and waterlogging. Precision Agriculture 6(4): 321-340.
32. Casa R, Cavalieri A, Cascio BL (2011) Nitrogen fertilisation management in precision agriculture: a preliminary application example on maize. Italian Journal of Agronomy 6: 23-27.
33. Blackmore S, Godwin RJ, Fountas S (2003) The analysis of spatial and temporal trends in yield map data over six years. Biosystems engineering 84(4): 455-466.
34. Bramley RGV (2009) Lessons from nearly 20 years of Precision Agriculture research, development, and adoption as a guide to its appropriate application. Crop and Pasture Science 60(3): 197-217.
35. Bredemeier C, Schmidhalter U (2005) Laser-induced chlorophyll fluorescence sensing to determine biomass and nitrogen uptake of winter wheat under controlled environment and field conditions. Precision Agriculture 273-280.

36. Li Y, Chen D, Walker CN, Angus JF (2010) Estimating the nitrogen status of crops using a digital camera. Field Crops Research 118(3): 221-227.

37. Moran MS, Inoue Y, Barnes EM (1997) Opportunities and limitations for image-based remote sensing in precision crop management. Remote sensing of Environment 61(3): 319-346.

38. Johnson GA, Cardina J, Mortensen DA (1997) Site-specific weed management: Current and future direction. In The State of Site-Specific Management for Agriculture pp. 131-147.

39. Lamb DW, Weedon MM, Rew LJ (1999) Evaluating the accuracy of mapping weeds in seedling crops using airborne digital imaging: Avena spp. in seedling triticale. Weed research (Print) 39(6): 481-492.

40. Franklin SE (2001) Remote sensing for sustainable forest management. CRC press. Boca Raton, Florida, p.407.

41. Lee WS, Alchanatis V, Yang C, Hirafuji M, Moshou D, et al. (2010) Sensing technologies for precision specialty crop production. Computers and electronics in agriculture 74(1): 2-33.

42. Casa R, Cavalieri A, Cascio BL (2011) Nitrogen fertilisation management in precision agriculture: a preliminary application example on maize. Italian Journal of Agronomy 6: 23-27.

43. 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.