Wheat Acreage Area of Jalandhar District in Punjab and Health Monitoring of Crop Growing Stage

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Abstract- The real wheat delivering nations on the planet are India, China, USA, France, Russia, Canada and Australia. Worldwide interest for wheat is developing at 1 percent for every year. Yield development and profitability are controlled by countless, for example, hereditary capability of harvest cultivar, soil, climate and administration factors, which differ essentially crosswise over time and space. Early expectation of harvest yield is vital for arranging and taking different strategy choices. Numerous nations utilize the ordinary methods of information accumulation for edit observing and yield estimation in light of ground – based visits and reports. These techniques are subjective, expensive and tedious. Exact models have been created utilizing climate information which is additionally connected with various issues. With the starting of satellites, satellite information are being utilized for edit checking and yield expectation. Most investigations have uncovered a solid connection between remotely detected NDVI and harvest yield. An exertion has been made for near appraisal of these procedures the subtle elements of which are talked about in the paper. The present paper features on utilization of Remote Sensing (RS) and Geographical Information System (GIS) advancements for the wheat land estimation for Jalandhar district, Punjab, India. Wheat real estate estimation is a standout amongst the most essential parameter, if zone has a solid between yearly fluctuations while yield remains generally steady. Single date, cloud free LISS-III computerized information harmonizing with blossoming phase of wheat trim was utilized for land estimation. The regulatory limit of the examination region (Jalandhar District) is overlaid on the picture to remove all pixels having a place with think about locale. ERDAS IMAGINE 9.1 picture examination programming and Arc GIS 9.2 programming were utilized for information preparing and investigation. The refined preparing insights produced utilizing the multi-groups information are utilized for directed order utilizing most extreme probability.

I. INTRODUCTION

Horticulture is one of the most established monetary routine with regards to human progress is in fact experiencing a makeover [1-7]. Farming nation to be a major instrument for reasonable advancement and neediness diminishment, particularly in creating nation as they have a critical agrarian segment in their financial aspects[8-10]. By and by, commitment of agribusiness around 33% of the national GDP and gives work to more than 70% of Indian populace in farming and unified exercises. Along these lines, our nation's advancement generally relies on the improvement of agribusiness. The horticultural generation data is imperative for arranging and allotment of assets to various areas of agribusiness [11-15].

The data on trim land estimation is spine of Agricultural factual framework, if range has a solid between yearly changeability while yield remains moderately steady. Dependable and convenient data on trim zone is of extraordinary significance to organizers and approach creators for proficient and auspicious horticultural improvement and settling on vital choices as for acquisition, stockpiling, open dissemination, fare, import and other related issues [16-20]. India has an amazing managerial setup, which has long standing convention of creating quality data. However with more accentuation on neighborhood, there is further requirement for trim region as for various assortments developed in the region, water system accessibility, the dirt sort and so on which can go far in quick improvement of the district Wheat is a standout amongst the most vital staple sustenance grains of human race [21-26]. India creates around 70 million tons of wheat for each year or around 12 for every penny of world generation. It is currently the second biggest maker of wheat on the planet. Being the second biggest in populace, it is additionally the second biggest in wheat utilization after China, with a tremendous and developing wheat request.

A venture on Crop Acreage and Production Estimation (CAPE) under the Remote Sensing Applications Mission (RSAM) with developed extension and destinations was defined in 1986. A

concentrated exertion has been made under this program to create strategy appropriate over huge zones. Over the previous decade, various product yield determining models utilizing RS information have been created [27-30].

Inthe present study multi-temporal satellite data was analyzed to estimate wheat acreage and extract Wheat phonology during growth period at the tehsil level as well as for health monitoring of various stage of wheat. Thereafter accuracy assessment was performed [31-32].The present paperreflects on the growth of satellite-based methodfor wheat yield estimating, developments in accuracy, appropriateness and knowledge gained in the ground over the yearsby means ofrecurrently the data from a series of Indian Remote Sensing(IRS) series of satellites.

II. STUDY AREA

Study area Jalandhar district boundary lies between 30^0- 34' to 31^0–01' North and 75^0 – 18' to76^0 – 20' East .The total geographical area of the district is 3,401 sq. km that occupying 5.3%of the total geographical area of the state of Punjab. It is located Ludhiana district in East, Kapurthala in West, Hosiharpur in North and Ferozepur in South. The District lies in the heart of the State and is situated between the River Sutlej and Beas. The average annual rainfall in the district is 703.0 mm.The locale is a piece of Bist Doab Tract, which is bury alluvial plain amongst Beas and Satluj River. Physiographically, the area is described by two unique highlights i.e. immense upland plain and Satluj surge plain. Jalandhar area is possessed by two sorts of soils a) tropical bone-dry dark colored and b) dry darker soils. The Bist Doab Canal System is the real wellspring of trench water system. The system of Jalandhar branch (inundate northern and focal parts) and Phillaur distributary of Nawashahar branch (flood southern parts of the area). The region is underlain by Sub-later to Quaternary alluvium containing sand, rock, stones, Kankar and dirt. More seasoned alluvium possesses the uplands everywhere throughout the area aside from along the waterway Sutlej (figure. 1).

Introduce work has been done utilizing following datasets. It incorporates editing design, water system, field measure, trim developing period and their term, likely dates of sowing, distinctive land cover classes and so on. Harvest logbooks for developing periods of different products in the investigation range are utilized. Information For the exploration work completed Single date, cloud free satellite picture advanced information concurring with blooming phase of wheat trim utilized. Satellite information furnish determination with the return to time of 24 days is useful for depiction of little rural fields. Introduce work has been done utilizing the field astute ground truth gathered with GPS, countless and other land utilize classes were set apart in satellite picture obtained and, it could be anything but difficult to recognize wheat preparing sets in perspective of huge coterminous ranges and best reasonable satellite information for wheat trim. Satellite picture informational collection utilized as a part of this examination was georeferenced by picture to-picture enrollment with existing expert pictures .The range under various element classes was computed by utilizing measurements choice in the Arc Map programming. The managerial limit of the investigation zone (area/taluka/tehsil and so forth.) is overlaid on the picture to extricate the whole pixel having a place with contemplate locale/taluka. The arrangement of all pixels (finish list) or a piece of it through deliberate examining is done to acquire the region of the coveted products. In this method, region/taluka trim guide demonstrating spatial dispersion of various products waterways be created. The refined preparing insights created utilizing the multi-groups information are utilized for administered order utilizing most extreme probability/other parametric classifiers. The carefully grouped pixels of study yield and aggregate pixels in the region cover picture are utilized for evaluating crop extent in the region (figure.2).

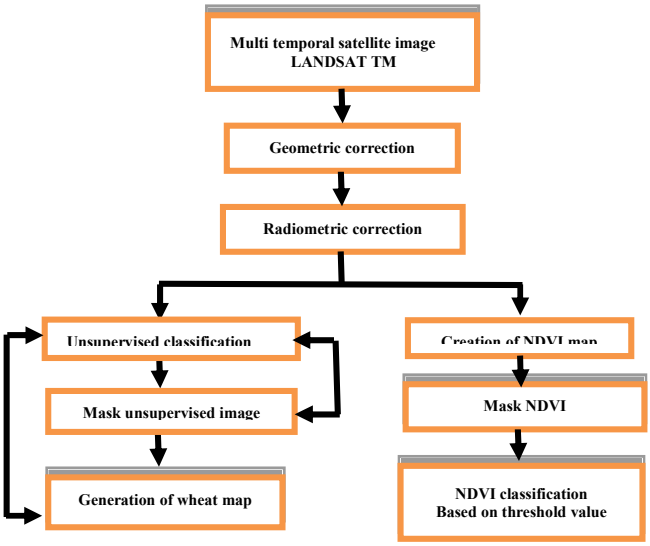

Figure. 2 Methodology adopted

III. RESULTS AND DISCUSSION

A. Wheat Area Estimation Using RS and GIS Technique

This paper has been carried out using the field wise ground truth data collected with GPS, a large number of field's verification and wheat area were marked in LANDSAT TM imagewith maximum accuracy. It could be easy to identify wheat contiguous areas and best suitable satellite data acquisition date (12-January,2016) for wheat crop.The administrative boundary of the study area (district/taluka) is overlaid on the image to extract the entire pixel belonging to study area. The classification of all pixel picking from the classify image and also mask of the desired crops.

B. Temporal Variation of NDVI in Wheat Crop Area

LANDSAT TM imagery was geometrically corrected and radio metrically rectified. The Normalized Difference Vegetation Index (NDVI) is generated for each image. NDVI represents the greenness of the vegetation. All the images have positive values, there is no negative value. The NDVI images have been stacked. From this stacked NDVI images classification has been done. In post classification with the ground truth the classes are assigned. The value of NDVI varies in different date it indicates the change of greenness in crop area. The minimum and maximum value gradually increases from earlier date. The temporal variation of NDVI shown in Fig. 3, table 1.

C. Crop Growing Stage Monitoring

The known crop growth period from December to mid-May an attempt was made to establish crop phonological relationship between multi-temporal images. During the crop growing period, wheat has increasing greenness up to flowering stage. From grain filling stage onwards there is a decline in the greenness.Based on this the crop growth stages were derived with the help of NDVI. As the wheat map of the study area has been generated from the stacked NDVI images. In our study area NDVI of the beginning date 12january -2016 covered the range from 0.05-0.3 and maximum area (59230.71) covered on 0.25. It has been increased 0.15 to 0.4 on 13 February and the large area (62965) covered by 0.35 NDVI value. Within 16 days it's touch the pick point of NDVI and it's between 0.6 to 0.85, maximum area (64429.56) covered by 0.8.Describe below in table format (figure.4) .

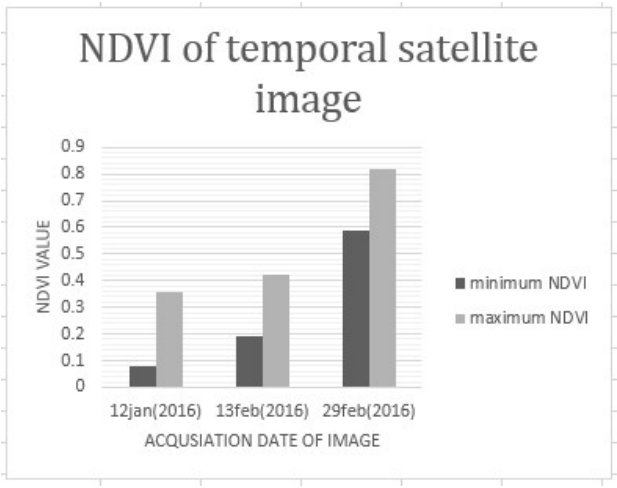

Figure. 3 Temporal Variation of NDVI in Wheat Crop Area

NDVI of temporal satellite image		
Image ecquisition date	**Minimum NDVI**	**Maximum NDVI**
12jan(2016)	0.08	0.36
13feb(2016)	0.19	0.42
29feb(2016)	0.59	0.82

Table.1 Temporal Variation of NDVI in Wheat Crop Area

12jan(2016)		13feb(2016)		29feb(2016)	
NDVI Value	Area in ha.	NDVI Value	Area in ha.	NDVI Value	Area in ha.
0	0	0	0	0	0
0.05	1600.83	0.05	0	0.05	0
0.1	8537.76	0.1	0	0.1	0
0.15	13873.86	0.15	533.61	0.15	0
0.2	49625.73	0.2	2668.05	0.2	0
0.25	59230.71	0.25	14407.47	0.25	0
0.3	10138.59	0.3	60297.93	0.3	0
0.35	533.61	0.35	62965.98	0.35	0
0.4	0	0.4	2668.05	0.4	0
0.45	0	0.45	0	0.45	0
0.5	0	0.5	0	0.5	0
0.55	0	0.55	0	0.55	0
0.6	0	0.6	0	0.6	425.88
0.65	0	0.65	0	0.65	2190.24
0.7	0	0.7	0	0.7	15696.72
0.75	0	0.75	0	0.75	47029.32
0.8	0	0.8	0	0.8	64429.56
0.85	0	0.85	0	0.85	10951.2
0.9	0	0.9	0	0.9	0
1	0	1	0	1	0

Figure. 4 Area covered by different NDVI in various growing stage

d. ***Trend of NDVI for different crop stages***

On 12th of January, the early wheat has reached its peak NDVI about 0.35. On 13th February, the range of NDVI has increase due to further crop growth. On 29th February the peak NDVI area has increased. From the NDVI trend curve it is seen that peak NDVI has shifted from 12 January to 13february and to 29 February. From the above graph clearly identify that the NDVI value gradually increase day by day, it indicates health growth of wheat (figure. 5 and 6).

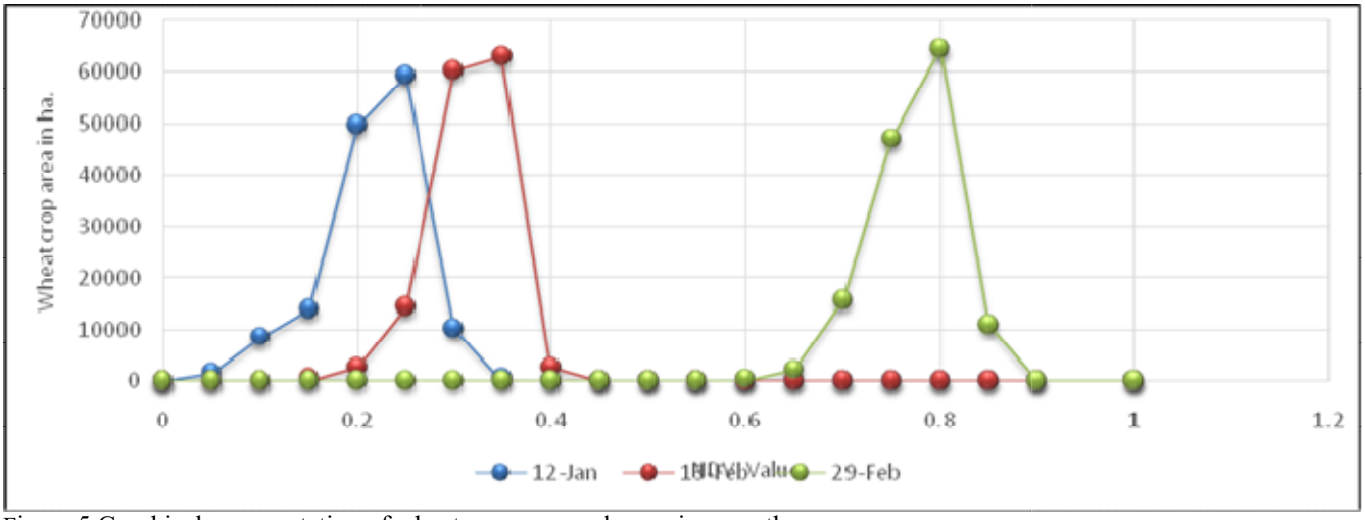

Figure.5 Graphical representation of wheat crop area and cropping months

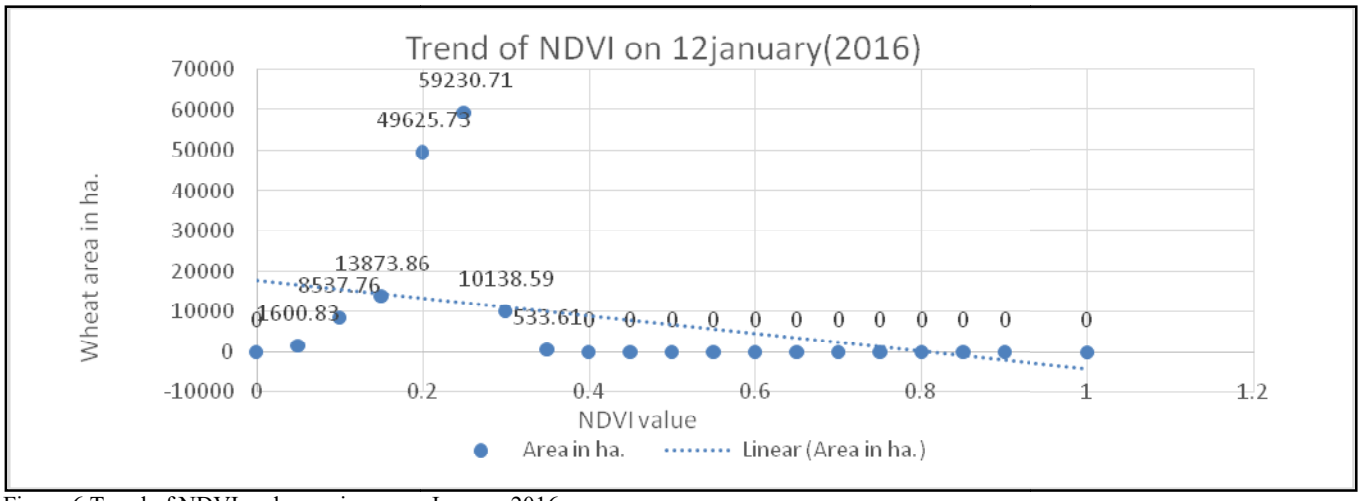

Figure.6 Trend of NDVI and cropping year, January 2016.

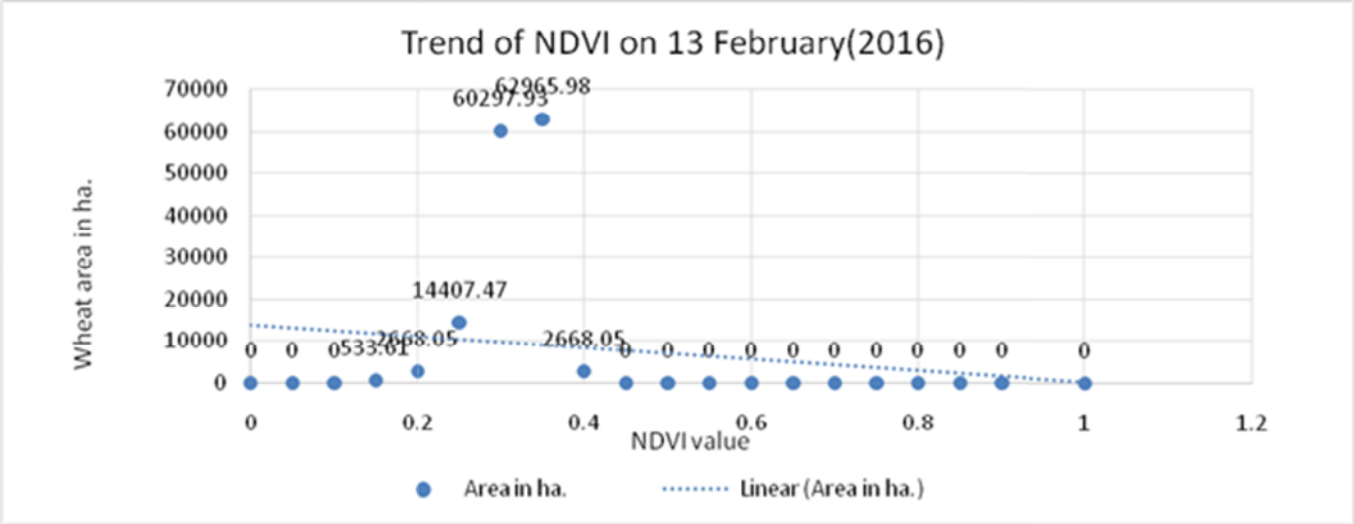

Figure.7 Trend of NDVI and cropping year, February 2016.

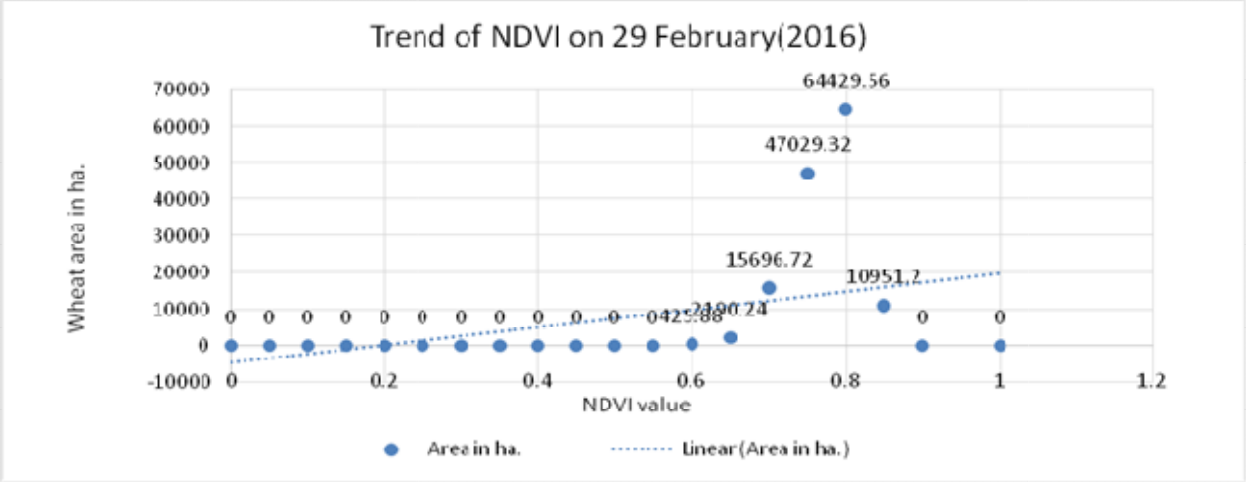

Figure.8 Trend of NDVI and cropping year, February 2016.

The spectral reflectance of wheat was slightly higher in green region, low in red region and high in Near - Infrared region at the most of the GT point site .The NDVI values were lower in GT sites where the crop coverage was poor.This was further supported by lower reflectance in NIR region and comparatively higher reflectance in green region, due to lower absorption of NIR and higher reflection of green radiation by soil surface. Vegetative index basedon spectral reflectance values of crop gave a goodindication of biomass production of wheat crop. The classified image obtained after unsupervised classification is shown in Fig 7 and 8.

The images showing only wheat crops (recoded images)the total pixel of the district of wheat crop was obtained.The area under the wheat crop in each district was obtained by multiplying these number of pixels by resolution of the data (total number of pixel *30m). It is observed that many linear features like canals and roads were correctly classified as non-crop class in the present analysis.

The total area of Jalandhar district is 263200 ha. Within which 137444 ha. Area covered by wheat crop. It cover the 52% of the total area of Jalandhar district. It's maybe some overestimate due to some other crop reflectance like potato etc.There are three taluk/block inside the Jalandhar district (Jalandhar, Nakodar and Phillaur). After the classification or extraction of wheat area, mask three taluk boundary and subset the classify image then calculate the wheat area of these tehsil (figure. 9-12).

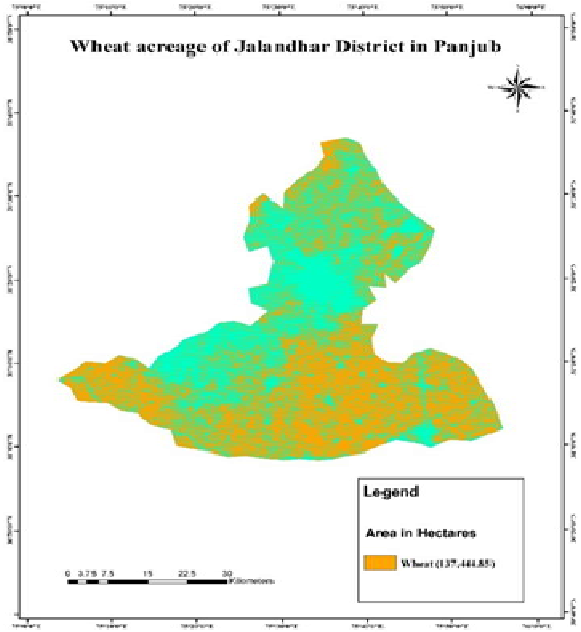

Figure. 9 wheat acreage of Jalandhar district

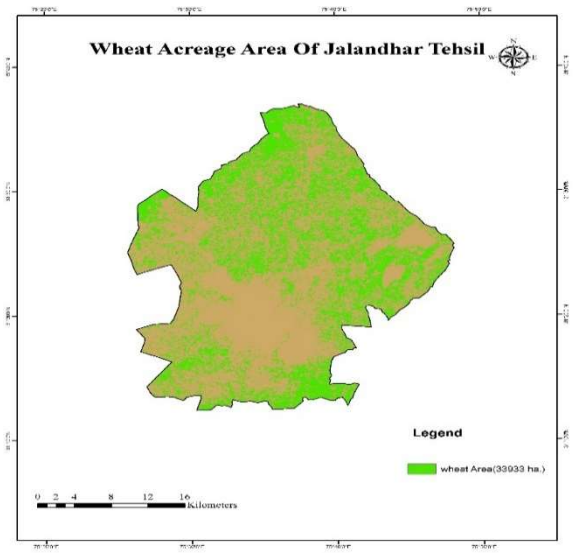

Figure. 10 Wheat acreage a of Jalandhar tehsil

If we compare the wheat acreage area between tehsil so we can see the highest wheat acreage area occupied by the phillaur tehsil, lowest area covered in Jalandhar tehsil and the rest tehsil belong to the middle position. Jalandhar district which reduced the agriculture area. The total wheat acreage area of Jalandhar tehsil is 33933ha and Nakodar tehsil covered 47636.3ha. Area covered by Phillaur tehsil 55875.7ha.

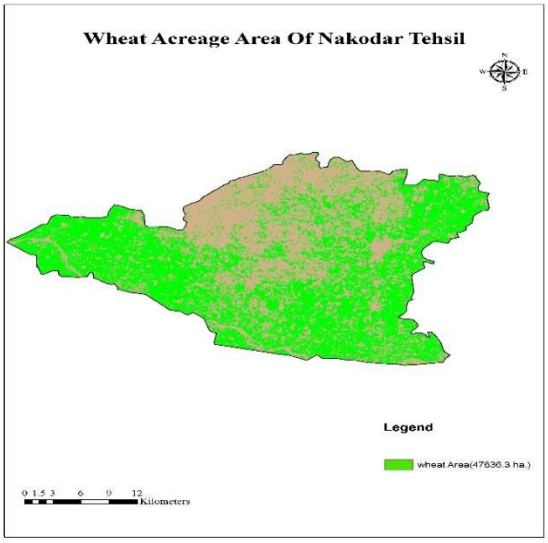

Figure. 11 Wheat acreage of Nakodar tehsil

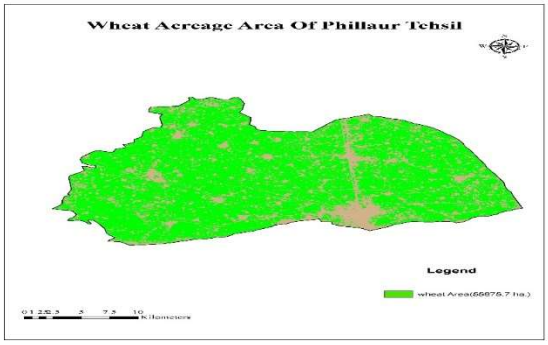

Figure. 12 Wheat acreage of Phillaur tehsil

Temporal satellite image are used for health condition of wheat. NDVI is generated for each satellite image. NDVI represents the greenness of the vegetation. The weighted NDVI of 12january (2016) is 0.22, 13february (2016) -0.305 and on 29february (2016)-0.70. All the image have positive value. The NDVI value of the temporal image gradually increase from 12 Jan to 29 February it indicates the growth of wheat crop.

IV. CONCLUSION

Remote sensing based agriculture monitoring is an important component of food security Information system which provides reliable and timely crop area estimates and crop production forecasts at national, regional and global scale. This paper reveals the result of one year (2016) remote sensing based district and tehsil/block level wheat acreage estimates. The conclusion derive from the above discussion are based on multi temporal satellite data. There is a noteworthy positive connection between

remotely detected NDVI and field level yield. This obviously demonstrates the capability of utilizing NDVI for wheat trim yield expectation. To gauge generation before collect encourage the definition of workable showcasing methodologies prompting better fare/import of yield in the state, which will lead better financial state of the state. Yield estimation would help farming office in appraisal of profitability of land for particular harvest. Pre-reap wheat real estate/creation estimation, is valuable to encourage the solid and convenient gauges and empower the managers and organizers to take key choices on import-send out approach matters and exchange arrangements. Remote detecting and GIS advancements have come a long route in trim inventories the world over. The coarse determination single date satellite information were utilized as a part of the underlying years. Such inventories served the reason for enhancing the unwavering quality and exactness of estimations that aided extensively in arranging store network administration procedures. Be that as it may, throughout the years, arranging and administration exercises have downscaled from local scale to singular handle scale. All the while, high determination satellite symbolism at substantially less expensive and moderate cost are getting to be plainly accessible for regular citizen utilize. These progressions combined with propels in methods of remote sensing and GIS have empowered researchers to create cultivate level harvest inventories that would prompt a circumstance where exactness trim administration turns into a reasonable alternative sooner rather than later.

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REFERENCES

[1] Bairagi, GD, Zia-ul Hassan, “Wheat Crop Production Estimation Using Satellite Data,” Journal of the Indian Society of Remote Sensing, Vol. 30, No.4, 213-219, 2002.

[2] Campbell, NA, De Boer, ES andHick, PT,“Some observations on crop profile modeling,” International Journal of Remote Sensing, 8, 193-201, 1987.

[3] Hayes, MJ, Decker, WL, “Using NOAA AVHRR data to estimate maize production in the United States Corn Belt,” Int. J. Remote Sens, 17, 3189–3200, 1996.

[5] Prasad, AK, Chai, L, Singh, RP, et al., “Crop yield estimation model for Iowa using remote sensing and surface parameters,” International Journal of Applied Earth Observation and Geoinformation, 8(1), 26-33,2006.

[6] Oza, M.P.,Bhagia, N.L., Rajak,D.R. and Dadhwal, V.K.2002. All India wheat inventory using multi date IRS WiFS and weatherdata, the international Archives of the Photogrammetry, Remote Sensing and Spatial information Sciences, Vol.34, Part XXX.

[7] Dadhawal, VK, and Parihar, JS, 1985. Estimationof 1983-84 wheat acreage of Karnal district (Haryana) using Landsat MSS digital data. Scientific Note: IRS-UP/SAC/ CPF/SN/09/85. Space Applications Centre, Ahmedabad.

[8] Dadhawal, VK, “Remote Sensing applications for agriculture – Retrospective and Perspective,” Proc. ISRS National Symp., Remote Sensing applications for Natural Resources: Retrospective and Perspective, Bangalore, 11 – 22. 1999.

[9] Dadhwal, VK, Singh RP, Dutta, S and Parihar, JS, “Remote sensing based crop inventory: A review of Indian experience. Trop. Ecol, 43(1), 107-122,2002.

[10] Kumar, V, “Forecasting Spring wheat yield using time series analysis: A case study for the Canadian prairies,” Agron. J., 92, 1047-1053, 2000.

[11] MacDonald, RB and Hall, FG, “Global crop forecasting,” Science, 208, 670-679, 1980.

[12] Nain, AS, Dadhwal, VK and Singh, TP, “Real time wheat yield assessment using technology trend and crop simulation model with minimal data set,”Curr. Sci., 82(10), 1255-1258, 2002.

[13] Oza, MP, Bhagia, N, Dutta, S, Patel, JH and Dadhwal, VK, “National wheat acreage estimation for 1995-96 using multidateIRS-1C WiFS data,”J. Indian Soc. Remote Sens., 24, 243-254, 1996.

[14] Salazar, L, Kogan, F and Roytman, L, “Use of remote sensing data for estimation of winter wheat yield in the United States,” Int. J. Remote Sens., 28 (17), 3795-3811, 2007.

[15] Singh, SK and Kanga, S, “Role of Geoinformatics in Site Suitability Analysis of Infrastructures using PRA Approach,” American International Journal of Research in Science, Technology, Engineering & Mathematics, 1(18):81-85, 2017.

[16] Kanga, S, Sharma, LK, Nathawat, MS and Sharma, SK, “Geospatial approach for forest fire risk modeling: a case study of Taradevi Range of Shimla forest division in Himachal Pradesh (India),” Indian Forester, 137 (3), 296-303, 2011.

[17] Kanga, S, Sharma LK, Pandey, PC and Nathawat MS, “GIS Modelling Approach for Forest Fire Risk Assessment and Management,” International Journal of Advancement in Remote Sensing, GIS and Geography,Vol 2. 30-44, 2014.

[18] Pandey, AC, Singh, SK, Nathawat, MS and Saha, D, “Assessment of surface and subsurface waterlogging, water level fluctuations and lithological variations for evaluating ground water prospects in Ganga Plains,” International Journal of Digital Earth. Vol. 6, No. 3, pp. 276 – 296, 2013.

[19] Kanga S and Singh SK and Sudhanshu, “Role of GIS in Creation of Spatial Socio Economic Indicators of Bilaspur District, H.P. (India),” Journal of Arts, Science and Commerce International Refereed Research Journal, 2(10): 48-55, 2017.

[20] Singh, S. K. “Geospatial Technique for Land use/Land cover mapping using Multi-Temporal Satellite Images: A case study of Samastipur District (India),” Environment & We An International Journal of Science & Technology, Vol.11, Issue 2-4, 2016, pp. 75-85, 2016.

[21] Singh, SK, Saklani, B, Prakash, S, Chauhan, R and Gupta H, “Geospatial Approach for Decentralised Planning at Rajhana Panchayat, Himachal Pradesh,” International Journal of Advancement in Remote Sensing, GIS and Geography, Vol. 2, No. 2, pp. 27- 43, 2014.

[22] Singh SK, Kumar V and Kanga S, “Land use/land cover change dynamics and river water quality assessment using geospatial technique: a case study of Harmu river, Ranchi (India),” International Journal of Computer Sciences and Engineering, Vol.5, Issue.3, pp.17-24, 2017.

[23] Singh, SK and Pandey, AC, “Geomorphology and the controls of geohydrology on waterlogging in Gangetic Plains, North Bihar, India,” Environmental Earth Sciences. Vol. 71, Issue. 4, pp. 1561-1579, 2014.

[24] Singh, SK, Pandey, AC, Rathore, VS and Nathawat, MS, “Evaluating factors responsible for contrastic signature of wasteland development in northern & southern Ganga plains (Bihar State, India) with focus on waterlogging,” Arabian Journal of Geosciences. Vol. 7, Issue 10, pp. 4175-4190, 2014.

[25] Singh, SK, Chandel, V, Kumar, H and Gupta H, "RS & GIS based urban land use change and site suitability analysis for future urban expansion of Parwanoo Planning area, Solan, Himachal Pradesh (India). International Journal of Development Research, Vol. 4, Issue 8, pp. 1491-1503, 2014.
[26] Kanga, S, Sharma, LK, Pandey, PC, Nathawat, MS and Sharma, SK, "Forest fire modeling to evaluate potential hazard to tourism sites using geospatial approach," Journal of Geomatics, Vol., 7, 93-99, 2013.
[27] Kanga S, "Geospatial techniques for Land use Land cover mapping using satellite data: A case study of Bilaspur District (Himachal Pradesh)". In Avishek K., et al., (Eds.) Construction management, Mechanization and Environmental sustainability. White Falcon Publishing, pp. pp. 251-258, 2017, 2017.
[28] Singh, SK, Kumar, S and Kanga S, "Land use/land cover change dynamics and river water quality assessment using geospatial technique: a case study of Harmu river, Ranchi (India)". International Journal of Scientific Research in Computer Science and Engineering, Vol.5, Issue.3, pp.17-24, 2017.
[29] Kanga S, "Forest cover and land use mapping using remote sensing and GIS Technology".Suresh Gyan Vihar University Journal of Climate Change and Water, Vol. 1 (2) Feb 2017 pp. 13-17, 2017.
[30] Sinha, S, Nathawat, MS, Sharma, LK, Kumar, P, Kanga, S and Pandey, PC, "Remote estimation of land surface temperature for different LULC features of a moist deciduous tropical forest region. In: Mukherjee, S., Gupta, M. & Srivastava, P.K. (Eds.). Remote Sensing Techniques in Earth Sciences, Springer Springer International Publishing, pp. 57-68.
[31] Kanga S, Tripathy G, Singh.SK, "Forest Fire Hazards Vulnerability and Risk Assessment in Bhajji Forest Range of Himachal Pradesh (India): A Geospatial Approach," Journal of Remote Sensing & GIS, Vol. 8, Issue.1, 1-16, 2017.
[32]Singh, SK,"Evaluation of flood and waterlogging dynamics in indo-gangetic plain using geospatial technique: a review," Open Access International Journal of Science and Engineering, 2(3), 1-7, 2017.