DETECTION OF VEGETATION WATER STRESS ANALYZE FOR IRRIGATION SCHEDULING IN LALITPUR DISTRICT [U.P]

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Abstract : **Detection of vegetation water stress analyse for irrigation scheduling**. Satellite monitoring of vegetation water stress is very important for precision agriculture, which realise on time of irrigation to ensure crops will not suffer from water stress and produce maximum potential yield under limited water condition. Potential of satellite data provide spatial and temporal dynamics of crop growth condition under water stress and analyse for suggestion of irrigation. This study was conducted in Bundhelkhand region of Lalitpur district, temporal **Landsat data OLI+TIRS** was used for detecting water stress using the thermal and optical indices. Land surface temperature, normalized vegetation index and normalized water stress index was used for normalized moisture index to find out water stress condition. The main objective of this study was to detect crop water stress using different optical and thermal based indices to suggest irrigation.

The time series NDVI data was used to extract wheat area of Lalitpur District. Extracted wheat area of the district was 125,296 ha. The comparative analysis of normalize moisture index and land surface temperature was used to determine the thermal water stress index for wheat crop in the study area. The output comes in four group of water stress condition as; Normal – Group 1 or class four (NMI > 1) no water with dense vegetation and low temperature, Low stress – Group 2 or class 3 (1> NMI > 0.8) thermal water stress due higher surface temperature and sparser temperature, Moderate stress – Group 3 and class 2 (0.8 > NMI > 0.5) strong water stress due sparser vegetation and Severe stress – Group 4 and class 1 (0.5 NMI > 0) very high or severe thermal water stress due to high temperature and very low vegetation. Whereas the land surface temperature was negatively correlated with NMI. When NMI is higher the LST was lower and vice versa.

The overall study indicates that, Lalitpur district has a water scarcity region. For better agricultural production there is lack of irrigation facility. Due to this crop are in water stress condition and they do not grow properly. The result was used to suggest better irrigation practices for proper growth of wheat crop in Lalitpur district to improve production. On the basis of this research work the better time for irrigation scheduling was suggest as; first irrigation during 8 December to 25 December and second during irrigation 25 January to 15 February. Other than this when severe water stress is shown in the output the irrigation should be must at that time.

Keywords – Thermal water stress, NDVI, NDWI, Land surface temperature, Scheduling irrigation, Wheat area extraction,

I. INTRODUCTION

1.1BACKGROUND

Biosphere’s continued exposure to abiotic stress viz, extreme temperature chemical toxicity, salinity, drought etc. has led to imbalance in natural status of environment. Any kind of stress can reduce average yield to more than 50% water stress condition arise due to inability to meet human and ecological demand of water whereas water scarcity refers to lack of available water or lack of water supply . An important point is that water scarcity is one of the many aspects that contribute to water stress thus, an area can be highly water stressed but not necessarily water scarce.

Agriculture is the major sector of all economic sectors which has relevance by water scarcity. Currently agriculture accounts 70% of global freshwater withdrawals. Water is a crucial component for food production. Since the biomass production requires huge amount of water to be transpired it won’t be incorrect, if say that agriculture is both cause and victim of water scarcity. Growing demands with population growth has lead to large environmental cost. There is an uncertain impact of climate change on water resources and water demand and similarly impact of bio-energy production on agriculture and climate change alter hydrological regimes and the availability of freshwater with impact on rain fed and irrigated agriculture (UN-WATER, 2009, 2012; FAO,2008; FAO,2011a). Increase in precipitation in temperate zones, reduction in precipitation in semi-arid areas extreme variability in rainfall distribution and overall increase in temperature has been seen. All this has a particular impact on tropical and sub-tropical agriculture (IPCC,2008).The availability of water is also affected by change in runoff in rivers and aquifers recharge which will add to human pressure on water resources .

Even after the utilisation of all our water resources for irrigation, about half of the cultivated area will remain rain fed. It is against this background that dry land agriculture gained importance. Problems of dry land agriculture can be broadly grouped in to two;

1. Vagaries of monsoon – Rainfall variability, intensity and distribution, late onset of monsoon, early withdrawal of monsoon and prolonged dry spells during crop season.
2. Soil constraints – Problem relating to crop production in alfisols are soil crusting, low moisture strong capacity, low soil fertility and soil erosion. Physical constraints such as narrow range of soil water content for tillage, tendency to become water logged and poor traffic ability, low n and t content and land degradation from soil erosion and salt accumulation, especially in low lying area, are the major problems with vertisols. Incept sols and entisols have problem of low water holding and land degradation due to soil erosion. Management of these soils for crop production is relatively easy compare to the other two soil groups.

Bundelhkhand region is a dry area where agricultural condition of Lalitpur is very poor. It is under rain fed condition. Agriculture of Lalitpur is not depend upon rain water. Due to lack of water plants irrigation does not scheduling on time. Due to this plants comes under water stress condition and do not grow properly. Which results the low yield per hectare of crop comparatively other than region which has proper irrigation facility. While seeing the irrigation problem in Lalitpur district this research was conducted to find out the water stress in wheat crop to suggest proper irrigation scheduling.

1.2 DEFINITION OF WATER STRESS

Like all other living organisms, the plants are also frequently subjected to various environmental stresses such as water deficit and drought, cold, heat, salinity and air pollution etc. The study of functioning of plants under these tresses or branch of environmental or ecological physiology. In purely physical sense a stress is any force applies to in object (e.g. an iron rod) which results in change of object's dimensions (e.g. bending). This change in object's dimensions caused by stress is called as strain. With relation to plants, stress is usually defined as an external environmental factor that exerts an adverse influence on the plant'. According to Levitt (1972, 80), stress is any change in environmental conditions that might reduce or adversely change plant's growth and development (i.e. its normal functions, and biological strain is the reduced or changed function of the plant in response to stress'.

1.3 IRRIGATION

Irrigation is defined as artificial application of water for the purpose of supplying moisture, essential, to plant growth. Irrigation also serves the following purposes:

1. It add water to the soil for supplying the moisture essential for plant growth.
2. It provides crop insurance against short duration drought.
3. It cools the soil atmosphere, thereby making more favourable environment for plant growth.
4. It aids in washout or dilution of salts in the soil.
5. It reduces the hazards of soil piping.
6. It softens the tillage pans.

1.4Three major reason for practicing irrigation are:

1. Irrigation only can ensure a stable system of production: Even in areas where the total seasonal precipitation is adequate on the average, it is often unevenly distributed during the year and variable from year to year so that dry land farming is high risk enterprise and only irrigation can ensure a stable system of production.
2. Longer effective crop growing period: Irrigation can prolong the effective crop growing period in area with dry season, thus permitting multiple cropping.
3. Additional input become economically feasible: With the security of cropping under irrigation, additional input become economically feasible. Irrigation reduces the risk of these expensive input being wasted by drought.

1.5 PROBLEM STATEMENT

Each year, in different part of the world stress disrupt agriculture production and food supply resulting to famine conditions 80-90% of biomass of non woody plants comprises of water. When there is a limited water supply to the roots of a plant it directly influence transpiration resulting in water stressed conditions. Availability of less water causes physical limitation in plants. Movement of water, oxygen and carbon dioxide in and out of plant is governed by stomata. During water stress, stomata close to conserve water which result into closing the pathway for the exchange of oxygen, water and carbon dioxide which result into decrease of photosynthesis (porporato et al.2001). Hence growth of leaves is affected by water stress more than root growth because roots can compensate more for moisture stress. Water stress causes reduction in photosynthesis which ultimately leads to reduction in growth and development.

Crop factors influencing crop water stress include soil moisture, leaf water content and leaf water potential.

Detection of water, stress and can help farmers in taking proper measure for reducing negative impacts on irrigation management. Water stress can be detected using remote sensing based techniques.

1.6 PHENOLOGY

With natural as well as anthropogenic stress. "*Healthy plants have generally high chlorophyll content then unhealthy plant"*; reduced chlorophyll is generally associated with stress condition of plant.

Remote sensing studies have become popular for plant and environmental studies during 1980s. Remote sensing helps in providing reliable, quantitative, timely information on latest crop condition in a cost-effective manner instead of cost and time consuming conventional field methods (Bouman, 1995; Letoan et al.1997; Shen et al; 2009). Remote sensing derived information is used to evaluate spatial and temporal variations in crop growth, crop stress, irrigation water management and which relies on timing of irrigation to ensure crop will not suffer from water stress and supports for decision making for agricultural development (Shen et a;2009). The spectral characteristic of vegetation is governed by absorption and scattering characteristic of leaf internal structure and constituents like water, nitrogen, cellulose and lignin. Cellular structure and water content of leaves are detected in near infrared and mid infrared region or wavelength, whereas, leaf pigments are detected by visible band chlorophyll and water content of vegetation are used as major indicator of plant stress. In stressed vegetation, chlorophyll content decreases which results in overall variation in absorption of light by leaf pigments. Consequently it directly affects spectral signature of plant by decreasing reflection in green band and increasing in blue and red band resulting in changing normal spectral signature of plants (Murtha, 1982; Zarco-Tejada et al.; 2000).

Therefore, water stress can be detected using visible, near infrared (NIR), shortwave infrared (SWIR) and thermal infrared (TIR) bands. There are different water stress based indices using Visible, NIR, SWIR, and TIR band viz, vegetation water stress index(VWSI) SWIR and NIR based indices (Ghulam et al 2007) water stress(WSI) are TIR based indices(Jackson et al 1977;Jiang and Islam,2001). During the past decades, significant efforts have been made in the use of satellite data to assess the interactions between land surface and atmospheric processes over a wide range of scales (spatial and temporal). Remote sensing based models are an effective way to detect water stress for a large area. These models are based on land surface temperature it determines water deficit status of the required area ex of such model are LST water stress being the most significant environmental stress, negatively affects crop growth and irrigation management, more than any other environmental factor(Shao et al.,2009). Water stress at flowering stage commonly results in severe ***reduction in irrigation water management satellite monitoring of vegetation water stress is very important for precision agriculture, which relies on timing of irrigation to ensure crops will not suffer from for water stress and produce maximum potential yield under limited water conditions*.** In this study water stress for wheat crop was detected using optical and thermal data in parts of Bundlekhand area for Lalitpur district.

1.7 NEED FOR IRRIGATION

Indian agriculture is under rain fed climatic condition. Where Bundelkhand region is dry zone of the Uttar Pradesh state with water scarcity. Lalitpur is situated in this region where crop irrigation is a tough task due to lack of water. Farmers cannot provide many time irrigation to their crops as in other parts of state. So plants comes in water stress condition and do not grow properly that's why production and yield per hectare is low in this region. By seeing the irrigation problem of Lalitpur we had done the study to find water stress condition of wheat crop for proper scheduling of irrigation to increase the production and reduce the cost. Which will help the farmers.

1.8 RESEARCH OBJECTIVE

To assess performance of different approaches of water stress detection from satellite data. The objective should be to realise highest production per unit of water use then to produce highest yield per unit of water use, especially under the condition of limited irrigation water availability.

1. To find out water stress in wheat crop
2. LST extraction of wheat crop to assess thermal water stress
3. Extraction of NDVI and NDWI to find out NMI of wheat for water stress analysis
4. Suggestion of proper timing for irrigation scheduling

1.9 SCHEDULING IRRIGATION

An ideal irrigation scheduling for optimum yield must indicate correct timing (when to irrigation) and amount of irrigation water at each irrigation. Scheduling irrigation is the process of determining when to irrigation and how much water to apply. Which is irrigation scheduling for NDVI + NDWI = NMI. There are several approaches for determining when to irrigation the crop. The approaches can be broadly classified into three groups.

1. Soil moisture regime approaches
2. Climatological approaches
3. Plant indices

1. SOIL MOISTURE REGIME APPROACHES

In these methods, soil moisture content is estimated to know the deficit in available soil moisture at which it is proposed to irrigation based on predetermined soil moisture content to bring the soil to field capacity. Soil moisture content is estimated either by direct gravimetric method or indirect measurements such as densitometers, resistance blocks, neutron probe etc.

Soil moisture content can be judged by feel and appearance of the soil, with experience, soil samples from root zoon depth are formed into balls, tossed gently into the air and caught in hand. While accuracy of judgement improves with experience, may serve as a guide for estimating the available soil moisture. Based on the allowable depletion in available soil moisture (DASM) irrigation can be scheduling at 25, 50 or 75per cent DASM.

2. CLIMATOLOGICAL APPROACH

An integrate approach to SOAC is essential for an ideal irrigation schedule. Potential rate of water loss from a crop is primarily related to evaporative demand of the atmosphere. Irrigation can be scheduled if allowable depletion of moisture in the root zone and evapotranspiration during the crop period is known.

Pan evaporation (Epan) is used to determine the amount of irrigation water to be applied in the ratio of irrigation water (IW) and cumulative pan evaporation (CPE) from USWB class A pan, usually known as IW / CPE ratio method. IW/CPE ratio of 1.0 indicates scheduling irrigation with quantity of irrigation water equal to that lost in evaporation. If 5cm water is applied when the cumulative pan evaporation is 10cm, the IW/CPE ratio will be 0.5 (5/10cm). The ratio is usually fixed anywhere between 0.5 and 1.0 smaller ratio indicates irrigation at longer intervals and larger ratio indicate frequent irrigations. This method appears to be simple, provided evaporation pan is available. In the absence of any evaporation pan, simple one litre can with a pointer to measure evaporation rate (can evaporimeter) can be used for scheduling irrigation.

3. PLANT INDICES

Any plant character, related directly or indirectly to plant water deficit which responds readily to integrated influence of soil, water, plant and evaporative demand of the atmosphere may serve as a criterion for timing of irrigation to crops.

Visual plant symptoms

Visual signs of plants wilting can be used to schedule crop irrigation. Farmers frequently use dropping, curling and rolling of sensitive plant parts as an indication for plant water deficit. Distinct change in foliage colour is also used to time irrigation, especially to bean. In these methods, the crop has already suffered before exhibiting wilting or change in foliage colour reflecting the influence of water deficits on final yield.

Profile modification

This method also known as soil – cum – sand mini plot technique is used for timing irrigation to crops. The principle involved in this method is to reduce artificially, the available water holding capacity of soil in root zone depth in the mini plot by mixing sand with it. Plants on sand mixed mini plot show moisture stress symptoms earlier than plants in rest of the area. Usually, an area of 1.0m2 is selected in the field and a pit of 1.0m depth is excavated in layers of about 15cm depth. Each layer of soil is mixed with 5 per cent by volume of sand and the pit refilled in the same sequence of layers as excavated by compacting each layer to bring bulk density of soil in the mini plot as that of the surrounding area. Symptoms of plants in the mini plot indicate time for irrigating the crop.

Increased plant stand

An area of about 1.0m2, preferably in a high spot, is snow with the same crop to maintain about four times the plant population compared with that in surrounding area. Crop with high stand establishment wilts earlier than the crop in the rest of the field indicating timing irrigation.

Reduction of growth rate of sensitive plant wheat may indicate irrigation need of crops. In the case of orange plants, irrigation is given when the growth rate of fruit circumference falls below 0.2 to 0.3mm day-1. Since stem elongation of crops like sugarcane, tomato and cotton is highly correlated with water stress, it is possible to use this character as an indication of irrigation needs. Relative leaf water content, plant water potential, stomata resistance and plant temperature which can adequately reflect the internal water balance of the plant may be used as potential indicators for scheduling crop irrigation.

After fixing timing of irrigation, the next step is to determine how much water to apply. Irrigation water applied should bring the soil to field capacity. As such the quantity of irrigation water to be applied to the soil at each irrigation depends on:

1. The amount of available soil moisture (ASM) in the effective root depth at the start of irrigation or the level of available soil moisture (DASM) considered for irrigation.
2. Effective rainfall and/or ground water contribution during the interval between two irrigation.
3. Additional quantity of irrigation water if any, required to leach the soils beyond the root zone depth.
4. The application losses.

The main objective should be to realise highest production per unit of water use than to produce highest yield per unit of water use, especially under the condition of limited irrigation water availability.

II. STUDY AREA

2.1 LOCATION

Lalitpur is one of the districts of Uttar Pradesh state of India. Lalitpur district is a part of Jhansi division and was carved out as a district in the year 1974.Lalitpur is really not only the heartland but also a heart shaped district of Bundelhkand region. It is connected to Jhansi district of Uttar Pradesh by a narrow corridor to the northeast, otherwise almost surrounded Madhya Pradesh state. Lalitpur district lies between latitude2°11’ and 25° 14’(north) and longitude78°10’ and 79° 0’(east) and is bounded by district Jhansi in the north, districts Sagar and Tikamgarh of Madhya Pradesh state in the east and guan district of Madhya Pradesh separated by river Betwa in the west. The geographical area of the district 5,039sq km with a population of 977,447 as per the census of year 2001.

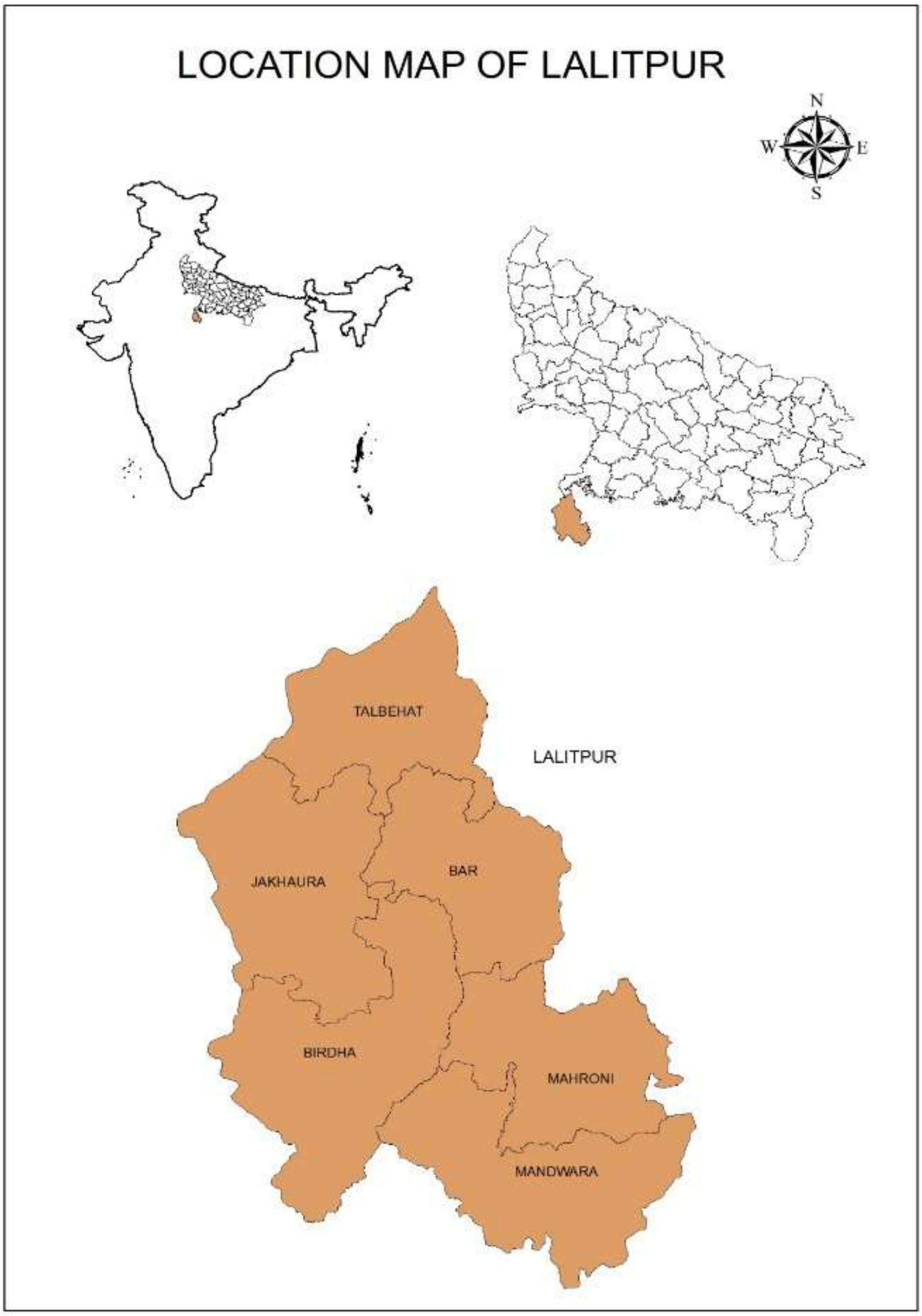


Figure 2-1: Study Area Location Map

III. MATERIALS AND METHODOLOGY

Many studies were carried out in India and abroad to demonstrate usefulness of Remote sensing data to quantify different agricultural parameters and agricultural studies. Looking at potential of remote sensing various methods and techniques. Many studies were carried out in India and abroad to demonstrate usefulness are developed in relating remotely sensed signature from satellite sensor to crop parameters, water stress and final analyse to suggestion of irrigation final discussed in following sections

3.1 DATA USED

To achieve the objective in present study the following satellite products, and software have been used

3.2 REMOTE SENSING DATA

Satellite dataset used for this study was landsat8 details are giving table in fallow;

Table 3.2: details of satellite data products used in this study

S. NO	DATA TYPE	DATA OF ACQUISITION	PATH/ ROW	RESOLUTION
1	Landsat8	October	146/40	30m
	-	-	-	-
2	Landsat8	November	146/40	30
	Landsat8	November	146/40	30
3	Landsat8	December	146/40	30
	Landsat8	December	146/40	30
4	Landsat8	January	146/40	30
	Landsat8	January	146/40	30
5	Landsat8	February	146/40	30
	Landsat8	February	146/40	30
6	Landsat8	March	146/40	30
	Landsat8	March	146/40	30
7	Landsat8	April	146/40	30

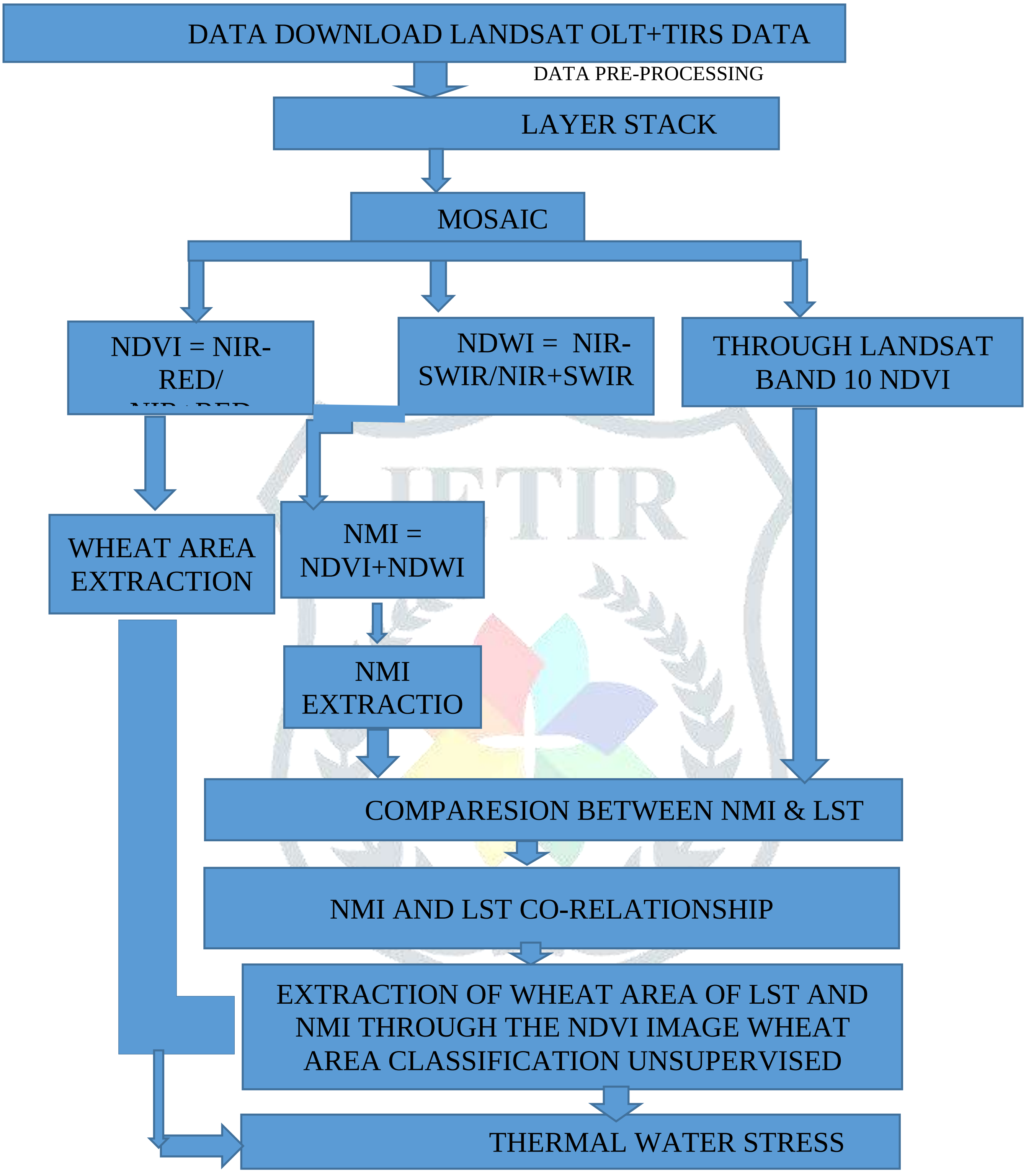
3.3ANCILLARY DATA

- Shapfile of India, uttar pardesh, Lalitpur district and Lalitpur block

3.4 SOFTWARE USED,

- Erdas imagine for image processing.
- Arc GIS for database creation and analysis.
- Microsoft office 2013.

3.5 The methodology adopted for this study can be understood by the following flowchart:



3.6 DERIVINGWATER STRESS INDICES

3.6.1 LAND SURFACE TEMPERTURE (LST)

The land surface temperature (LST) is the radioactive skin temperature of ground. It depends on the albedo. The vegetation cover and the soil moisture in most cases. LST is mixture of vegetation and bare soil temperature. Because both respond rapidly to changes incoming solar radiation due to cloud cover and aerosol load modifications and dermal variation of illumination. The LST displays quick variation too in turn. The LST influence the partition of energy between ground and vegetation and determines the surface air temperature.

There are various methods to calculate LST. I am going to show you the method from the official USGS webpage (HTT; // Landsat USGS GOV/landsat8 – using – product PHPλ) using band 10 and 11 from the thermal infrared sensor (TIRS) of the landsat8 satellite. It is recommended to use band 10 in quantitative analysis because band 11 is significantly more contaminated by stray light than band 10.

LST ALGORITHM

1 STEP – TOA {Top of atmospheric spectral radiance}

$L\lambda = M_L + Qcal + A_L - Oi$

Where,

$L\lambda$ = Spectral radiance

M_L = Band specific (here band 10) multiplicative rescaling factor = 0.000334

Qcal = Band 10 image

A_L = Band specific additive rescaling factor = 0.100000

Oi = Correction for band 10

1 **STEP** – Conversion of digital number nos. into reflection

3 STEP – Conversion of spectral radiance to brightness temperature (BT).

$$BT = \frac{K2}{\ln[(Ki / L\lambda) + 1]} - 274.15$$

K1, & K2 – band specific thermal conversion constant (from metadata)

K1 = 774.890000, K2 = 1321.080000

To have the ans. in °C, radiance temperature is revised by adding the absolute zero (approx. – 273.15°C)

4 STEP – Calculating NDVI,

NIR (BAND 5) – R (BAND 4)/ NIR (BAND 5) – R (BAND 4)

4 STEP – Cal n proportion of vegetation (Pv).

$Pv = (NDVI – NDVIs / NDVIv – NDVIs)2$ {here NDVIv = 0.5, NDVIs = o.2}global
Condect NDVv to Cal Pv.

5 STEP – Caln Land surface emissivity

$\varepsilon\lambda = \varepsilon v\lambda Pv + \varepsilon s\lambda (1 – Pv) + L\lambda$

Where,

C = Surface roughness (C = 0, for homogeneous $_{\varphi}$ flat surface), here taken as constant value of 0.005.

$\varepsilon s\lambda$ = 0.999 (Ref.1480307>paf) for NDVI values b/w 0- 0.2 it is considered that the land is covered with soil emissivity value of 0.996 is assigned.

$\varepsilon v\lambda$ = 0.973 {When NDVI values is greater than 0.5, it is considered to be covered with vegetation value of 0.973 is assigned.

6 STEP – LST

$Ts = BT / \{1 + \{\lambda BT/ P)\ln \varepsilon\lambda]\}$

Where,

λ = wavelength of emitted radiance

$\varepsilon\lambda$ = emissivity calculated

$\lambda = ch / \sigma$ = 1.438×10^2mk {σ = Boltzman constant (1.38×10^{23}J/K)

H = Plank's constant, ($6.626\times10_{34}$J/S)

C = Velocity of light (2.998×10^8m/s)

3.6.2 NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI)

The normalized difference vegetation index (NDVI) is a simple graphical indicator that can be used analyse remote sensing measurements, typically but not necessarily from a space platform and assess whether the target being observed contains live green vegetation or not.

NDVI= NIR (BAND5) – R (BAND4)/ NIR (BAND5) – R (BAND4)

3.6.3 NORMALIZED DIFFERENCE WATER INDEX (NDWI)

Normalized difference water index (NDWI) may refer to one of at least two remote sensing derived indexes related to liquid water. One is used to monitor changes in water content of levees, using near – infrared (NIR) short wave infrared (SWIR) wavelength proposed by Gao in 19996.

NDWI = NIR (BAND5) – SWIR (BAND6) / NIR (BAND5) + SWIR (BAND6)

3.6.4 NORMALIZED MOISTURE INDEX

Normalized moisture index to fined thermal water stress for dry region NDVI + NDWI = NMI. NMI > 1group 1 and class 4 severe condition. No water with dense vegetation and low temperature. 1 > NMI >0.8 – Group 2 and class 3 low stress condition. Thermal water stress due to higher surface temperature and sparser temperature. 0.8 > NMI > 0.5 – Group 3 and class 2 moderate stress condition. Strong water stress due sparser vegetation. 0.5 > NMI > 0 Group 4 and class 1 severe condition. Very high or severe thermal water stress due to high temperature and very low vegetation.

3.6.5 WHEAT AREA EXTRACTION

Since study was focused on wheat crop identification using remote sensing classes was prepared and performed using temporal NDVI images prepared by Landsat the indicates that in Lalitpur district total wheat area extraction is 125,296ha.

IV. RESULTS

The present study attempts to evaluate performance of different water stress indices for analysis of water stress to suggest irrigation. The inputs from remote sensing has been affectively used and integrated with GIS data bases for water stress and growth for wheat keeping in view the usefulness of remotely sensed signatures to quantify crop water stress. The present study was undertaken in wheat area of Lalitpur district in Bundhelkhand region.

The normalized moisture index (NMI) was used to to find thermal water stress index of wheat crop in Lalitpur district. The output was generated in four groups or classes. Which was defined as; (NDVI + NDWI = NMI) NMI >1 Group 1 and class 4 which represent the normal condition. Where no water stress with dense vegetation and low temperature. Group 2 and class 3 when 1 > NMI > 0.8 that is low water stress condition. Thermal water stress due to slightly higher surface temperature and sparser vegetation. Group 3 and class 2 when 0.8 > NMI > 0.5 – which represent the moderate water stress condition due sparser vegetation and high temperature. 0.5 > 0 – Group 4 and class1 severe condition. Very high or severe thermal water stress due to higher surface temperature and very low vegetation.

Fig.4.1:21/10/2016 NMI image

Fig4.2:6 /11/2016 NMI image

Fig.4.3:22 /11/2016 NMI image

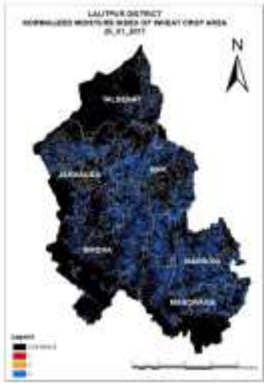
   

Fig.4.4:08/12/2016 NMI image Fig.4.5:24/12/2016 NMI image Fig.4.6:09/01/2017 NMI image Fig.4.7:25/01/2017 NMI image

Fig.4.8:10/02/2017 NMI Fig.4.9:26/02/2017 NMI image Fig.4.10:14/03/2017 NMI image Fig.4.11:30/03/2017 NMI image image

Fig.4.12:15/04/2017 NMI image

By this research result is conclude that most of plant in stress condition. And moisture low and temperature is high. Very high severe thermal water stress due to high temperature and very low vegetation. Due this plant are not growing properly. According to these condition we suggest two irrigation for growing plant properly.

1. We can suggest first irrigation when group 4 and class 1 in severe condition NMI low LST high.
2. We can suggest second irrigation in moderate condition group 3 and class 2. NMI is low and LST high.

4.1 TIMMING OF IRRIGATION:

1. 1st irrigation 15 December to 25 December

2. 2nd irrigation 25 January to 15 February.

4.2 CO – RELATIONSHIP BETWEEN LST & NMI

The highest negative correlation was found between NMI & LST. The two indices also show a low negative correlation for the moisture pattern. However their correlation between the NMI and LST had an of which could be explained by the negative environmental actions promoted in the agriculture areas. The highest negative correlation was between the NMI and LST of water pattern. Analysis showed that the NMI and LST was the of most negatively correlated index in an agriculture land. . Figs 5.13 have been constructed show the typical relationship between two images.

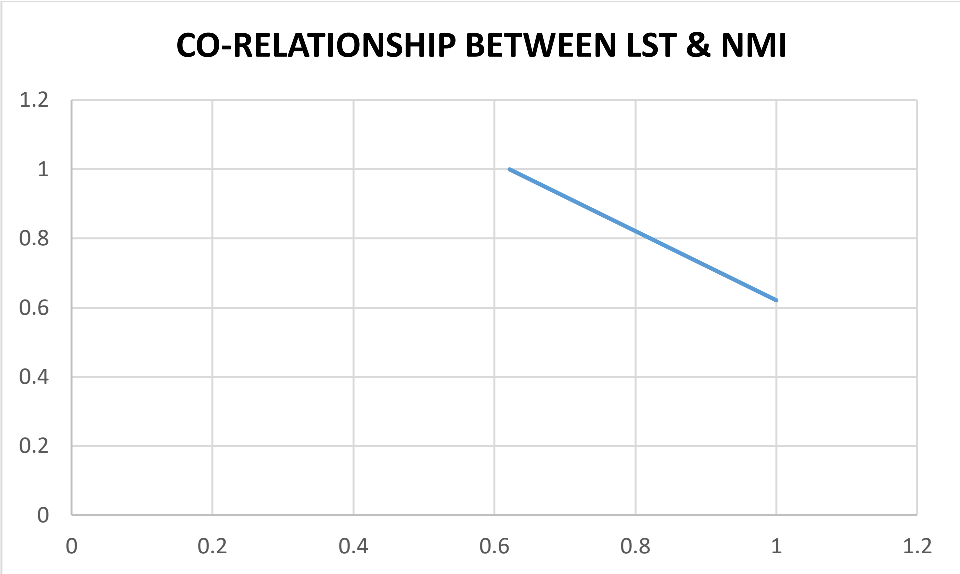


Fig.4. 3: correlation b/w LST and NMI

V. SUMMARY AND CONCLUSION

5.1 SUMMARY

Global water scarcity and unavailability of fresh water including many other biological factors has led to effect crop water stress status influencing its growth. The study focused or detecting crop water stress and observing its analyses to suggest of irrigation. The prime objective of the study was assess performance of different approaches of water stress detection from satellite data and validating with measurements and to analyse the importance of water stress factor in controlling irrigation system. The study was conducted in parts of Lalitpur district latitude 24degri 11’ and 25degri 14(north) and longitude 78degri 10’ and 79degri 0(east).

Wheat crop practiced in the study area during Rabi season. Landsat OLI data for 2016 – 2017 Rabi season was used in this study. Since study was specified for wheat crop discrimination was done using rule based classification technique. Using rule based classification wheat was properly discriminated from other classes showing individual accuracy of wheat .and overall accuracy of. different satellite based indices were derived individually from optical and thermal dataset NDVI, NDWI model was also use for deriving NMI using temporal Landsat data. Predicted water stress for 2016 – 2017were compared LST.

Since study was focused on wheat crop identification using remote sensing classes was prepared and performed using temporal NDVI images prepared by Landsat. The indicates that in lalitpur district total wheat area extraction is 125,296ha.

Normalized moisture index to find thermal water stress NDVI + NDWI = NMI. NMI > 1 – Group 1 and class 4 severe condition. Very high severe thermal water stress due to high temperature and very low vegetation. 1 >/ NMI > 0.8 – Group 2 and class 2 moderate condition. Thermal water stress due higher surface temperature and sparser temperature. 0.8 >/ NMI >0.5 – Group 3 and class 4 low stress condition. Strong water stress due sparser vegetation. 0.5 >NMI >0 – Group 4 and classs1 normal good condition. Now water with dense vegetation and low temperature. When moisture low then temperature is high water stress condition and when moisture high then temperature is low normal condition. Due to this plant are in water stress condition and plant are not growing properly. In conclusion was found useful in detecting water stress and on the basis of suggestion of irrigation showed better results for – first irrigation 8 December to 25 December and second irrigation 25 January to 15 February.

From this study the following conclusion were made:

Different water stress indices were used for quantifying water stress by satellite data.

Compared between to NMI and LST

Total wheat area extraction 125,296ha

Water stress observed was more over Bundhelkhand region in December and January. Water stress observed for November and March was less due to good wheat growth. Which is suggestion of tow irrigation first irrigation 8 December to 25 December and second irrigation 25 January to 8 February.

Which is irrigation scheduling for NDVI + NDWI = NMI

Extraction of wheat area of LST and NMI through the NDVI images classification wheat area.

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