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Estimation of Irrigation Potential Utilization for Kanupur Canal System Using Remote Sensing and GIS

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ABSTRACT

Irrigated agriculture is increasing in India with the high investments in irrigation projects high irrigation potential created. The present study is focussed on investigation on assessment of irrigation potential utilization from public domain satellite datasets to estimate seasonal crop areas for Kanupur Canal System of Nellore District. Spatial, temporal monitoring of the projects during the 2014-15 year for all seasons namely *kharif, rabi*and summer is necessary to monitor the irrigation potential utilization and take the necessary steps for interventions for improvement. Satellite data availability in public domain has provided scope for cost-effective solution for acquiring the temporal satellite data at monthly interval over several irrigation commands. Cost free Landsat 8 OLI sensor which has spatial resolution of 30 m data is found to be very much suitable for the study at regional level as 16 days interval data is available from USGS (United States Geological Service) Earth archives in near real time. The satellite derived crop areas for Kanupur Canal System are *kharif* crop constitutes 65%, *rabi*crop constitutes 50% and summer/annual crops are about 6% of the ayacut designed and irrigation intensity is 121%. Total releases are about 5.467 TMC and irrigation potential utilised was 30913 ha and hence the water productivity is 5654 ha per TMC and delta is 0.49 m.

Key words: *GIS, Irrigation, Public domain, Remote sensing, Satellite* .

India is rich in irrigation infrastructure (irrigation projects) and is increasing gradually to convert majority of rain fed areas into irrigated agriculture to sustain food production and benefit the farmers. Monitoring of irrigation projects for the assessment of irrigation potential utilisation is essential on a regular basis. Conventional methods of eye estimates on crop area estimation at village level needs replacement with suitable technology implementation. Remote sensing based spatial data analysis is the best known practice for improvising these estimates to the reality as the spatial information is captured on a temporal basis and quantification on crop areas at disaggregated level for each project is possible. Andhra Pradesh is one of the state in which massive irrigation infrastructure is existing and huge irrigation potential is created and many more projects are in progress. However, gap exists between irrigation potential creation and utilization which can be estimated with detailed analysis at project/block levels. The gap is because of the non-availability of water on sustained basis and problems of tail ends or insufficiency of water storages in reservoirs due to hydrological drought conditions, etc.

Spatial, temporal monitoring of the projects during the crop seasons namely *kharif, rabi*and summer is necessary to monitor the irrigation potential utilization and take the necessary steps for interventions for improvement. This objective requires spatio-temporal information in synoptic view to know the progressive and problematic pockets in irrigated agricultural lands. Satellite data provides scope for synoptic coverage and multi-temporal datasets. Presently, there are number of satellites providing such datasets and many of them are available in public domains. There are number of Indian, global satellites providing medium resolution data at fortnight / monthly interval which can provide continuity in data acquisition. Landsat and IRS Resourcesat are more popular in this category. Yasir*et al.* (2011) used a public domain satellite data with limited ground measurements to assess the performance of Gezira scheme at two spatial scales: (1) Section level (6,000 to 19,000 ha) and whole Gezira scheme (8,82,000 ha).

Using unsupervised classification of Landsat 7 ETM (Enhanced Thematic Mapper) images (30x30 m resolution) and ground truth information, crop type and cultivated area for 2007/2008 season were estimated. The study demonstrated that remote sensing data supplemental with limited ground data, could be very useful to assess the performance of large irrigation systems and the main areas to improve for higher accuracy should include utilizing higher resolution images, employing interpolation algorithms for cloudy conditions and refining satellite data with additional ground points to improve accuracy of crop classification. The study also confirmed the potentiality of (free) satellite data to assess irrigation performance of large irrigation systems. Despite limitations of public domain optical satellites (coarse resolution, missing data during cloudy conditions), the results were extremely useful for comparative purposes. The study also confirmed that the accuracy future remote sensing studies can be improved by interpreting more ground truth data as well as better interpolation techniques during cloudy conditions. Goswami*et al*. has estimated wheat acreage of Indore district, Madhya Pradesh state, India for the year 2010-11 using single date remote sensing digital data from resource sat P-6 LISS III Sensor was analysed for acreage estimation using maximum likelihood supervised classification and ground truth information. The objective of the present study is to evaluate the irrigation potential utilization of Kanupur canal command of S.P.S.R. Nellore district by using GIS and Remote Sensing.

Kanupur canal system, a medium irrigation project which was started in 1959. This was designed to draw flood water from Pennar river through head sluice located in the right side of Sangam Anicut, to stabilize 7,638 ha in stage 1 and 17,814 ha is stage 2 and total irrigation potential contemplated was 25,452 ha and IP created was 7077 ha. The cropping pattern indicates that there is both *kharif* (Wet), *rabi*(ID) crops in this command. However, there is no break up for the *kharif* and *rabi*crop area in terms of wet and ID crops. This is addressed in this study in terms of existing crop distribution scenario from satellite derived seasonal cropping pattern during 2014-15 crop year.

MATERIAL AND METHODS

There are several satellites which are meant for global data distribution for the public with free of cost such as Landsat missions, NOAA, MODIS, ISRO and sentinel Asia. For the present study requires seasonal data during several months of crop seasons, and hence data available through USGS is fitting well for the study. Landsat 8 OLI (Operational land imager) datasets were selected for the present study as the temporal datasets are available at the frequency of 16 days. The specifications of Landsat 8 OLI are shown in Table 1. The present study utilised the Band 3 to Band 7 as they represent well about the crop features and provide spectral distinction from other features.
Landsat 8 OLI data over Kanupur Canal System available from United States

Table 1. Specifications of Landsat 8 OLI.

Landsat-8	Wavelength (micrometers)	Resolution
Band 1-Coastal aerosol	0.43-0.45	30
Band 2- Blue	0.45-0.51	30
Band 3-Green	0.53-0.59	30
Band 4-Red	0.64-0.67	30
Band 5-Near infrared(NIR)	0.85-0.88	30
Band 6-SWIR 1	1.57-1.65	30
Band 7-SWIR 2	2.11-2.29	30
Band 8-Panchromatic	0.50-0.68	15
Band 9-cirrus	1.36-1.38	30
Band 10-Thermal Infrared (TIRS) 1	10.60-11.9	100* (30)
Band 11- Thermal Infrared(TIRS)2	11.50-12.51	100* (30)

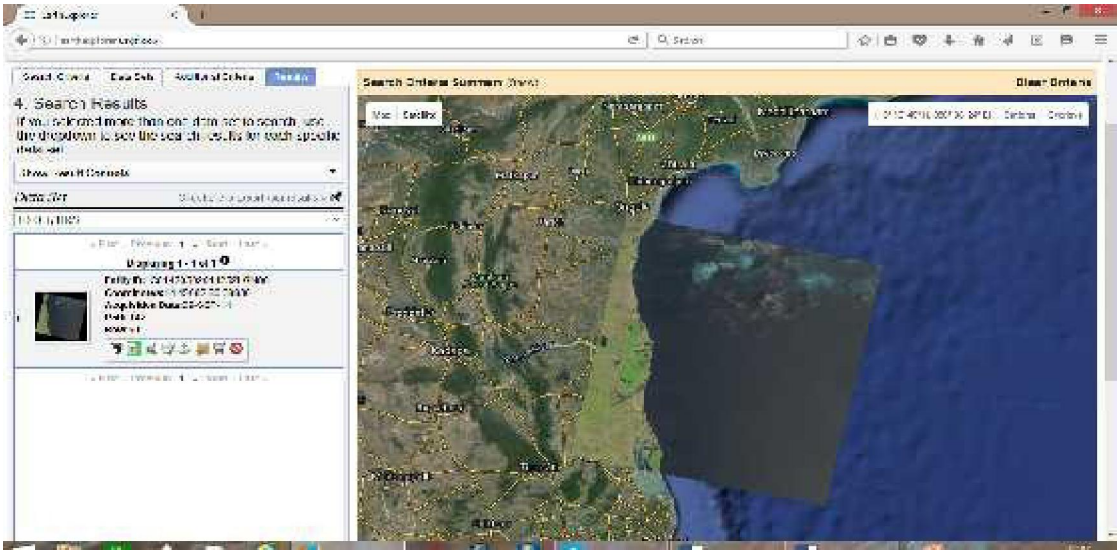

Figure 1a. Landsat 8 image of Kanupur Canal System for *kharif* season (09-09-2014)

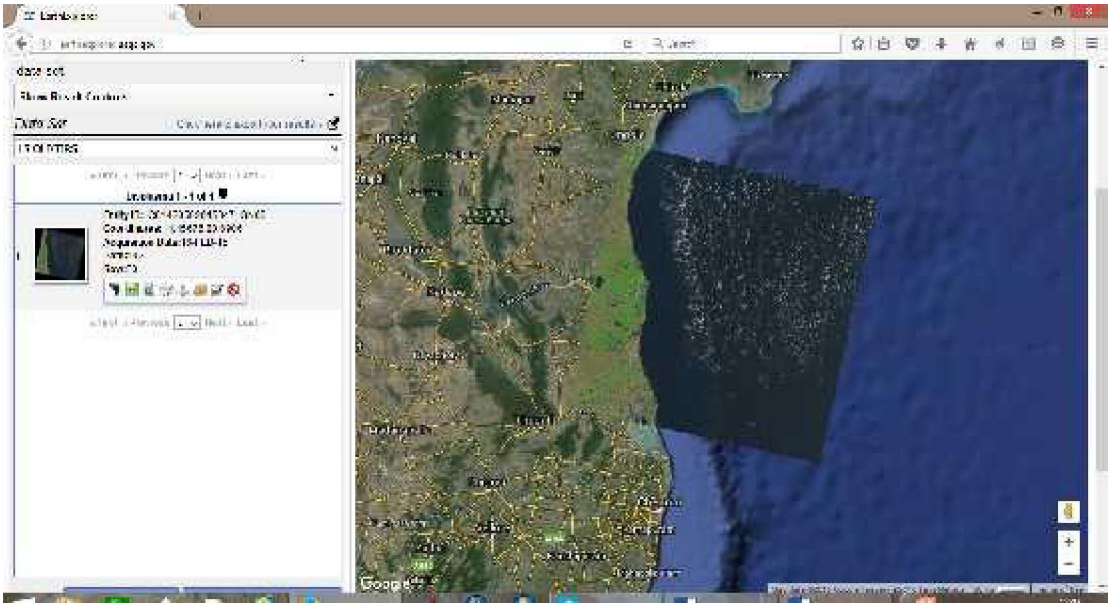

Figure 1b. Landsat 8 image of Kanupur Canal System for rabiseason (16-02-2015)

Figure 1c. Landsat 8 image of Kanupur Canal System for summer season (07-05-2015)

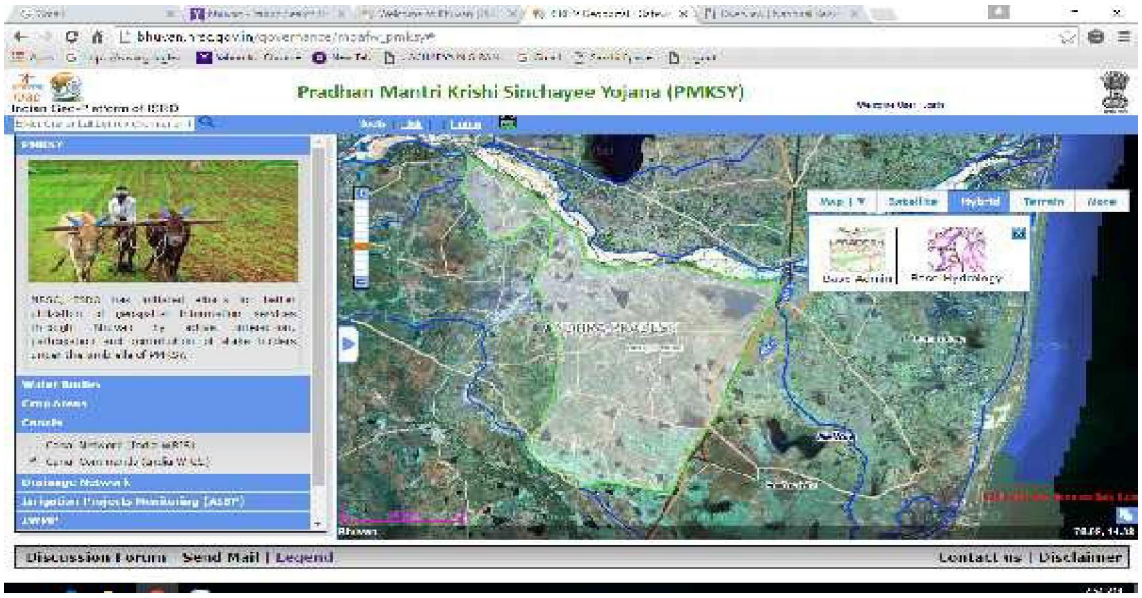

Figure 2. View of Kanupur Canal System command digitized from the ISRO-Bhuvan.

Figure 3. Satellite derived cropping pattern in Kanupur Canal System during 2014-15

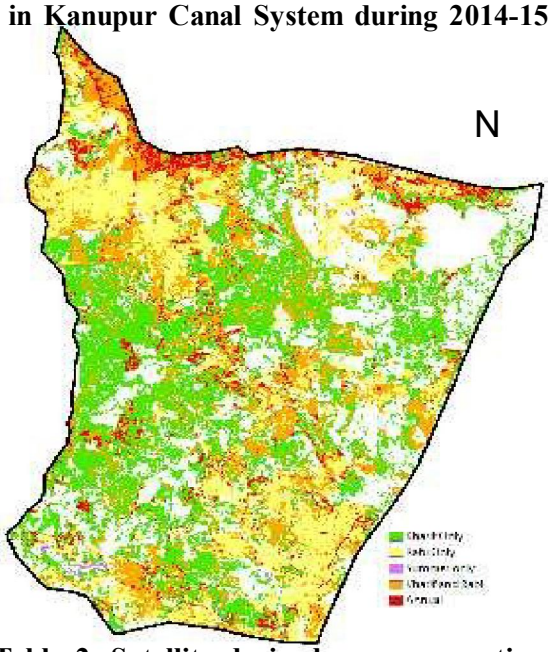

Table 2. Satellite derived crop area estimates in Kanupur Canal System.

Season	Area (ha)
Kharif only	10045
Rabi only	6176
Kharif + *Rabi*	6398
Total *Kharif*	16443
Total *Rabi*	12574
Annual	1743
Summer	153

Geological Service (USGS) web site for three seasons were downloaded as per the reference of Path-142 and Row-50 is shown in Figure 1a to 1c. Kanupur Canal sytem Command boundary was digitized from Indian Space Research Organization (ISRO) web site which was used in the study and is shown in Figure 2.

The downloaded datasets from USGS were in ZIP format and were Unzipped. The softwares were used for satellite data analysis are ERDAS and Arc GIS. The data sets imported into the ERDAS imagine format using layer stack module. Spectral Bands from 3 to 7 were assigned in layer stack software module in sequence for generation of satellite data. The same process was repeated for all other satellite datasets of different seasons for study area. Raster clip module of Arc GIS used for clipping the each satellite image pertaining to each season of the command area boundary. Unsupervised classification was performed for each image in ERDAS imagine unsupervised classification module. This classifier categories various pixels of image into homogeneous areas representing feature/land use classification in irrigation commands areas for different seasons of the year 2014-15.

RESULTS AND DISCUSSION

Satellite derived crop map is shown in Figure 3. Crop area was expressed in terms of

spatial view representing categories viz. *kharif* crop area only, *rabi* crop area only, double crop (crop existing in *kharif* and *rabi*), annual crop (crop existing in all the three seasons), summer crop (crop existing in only April/May).

The seasonal crop area information for Kanupur Canal System is shown in Table .2. Satellite derived seasonal crop area assessment revealed that the total irrigation potential utilisation is 30,913 ha distributed in various cropping seasons. The crops are grown in *kharif* and *rabi*to a major extent. This estimate indicates that the total irrigation potential utilisation is with 121% irrigation intensity (Total crop area in all seasons / ayacut created). *Kharif* crop constitutes 65%, *rabi*crop constitutes 50% and summer/annual crops are about 6% of the ayacut designed. It was observed that *kharif* crop area represented by September month satellite data estimated as 16,443 ha out of which 1,617 ha is wet crop and rest appears to be irrigated dry crops with rainfall / groundwater as source. *Rabi* crop area is represented by February month satellite data and is estimated as 12,574 ha out of which 6,289 ha as wet crop and the rest could be irrigated dry crops. Wet crop area was separated out using higher NDVI of 0.40 and above values in September, February crop mask pixels.

Area under wet crop is obtained by categorising the crop area pixels which are having NDVI (vegetation vigour) greater than 0.4 and also through visual distinction of higher vigour in satellite image. Total releases are about 5.467 TMC and irrigation potential utilised was 30,913 ha and hence the water productivity is 5654 ha per TMC and delta is 0.49 m.

Conclusion

It is concluded from the above study, *kharif* crop constituted 65%, *rabi* crop constituted 50% and summer/annual crops were about 6% of the ayacut designed and irrigation intensity was 121%. Total releases were about 5.467 TMC and irrigation potential utilised was 30,913 ha and hence the water productivity was 5,654 ha per TMC and delta was 0.49 m.

LITERATURE CITED

Goswami S B, ArunaSaxena and G D Bairagi 2012 Remote Sensing and GIS based wheat crop acreage estimation of Indore district, M.P. *International journal of Emerging Technology and Advanced Engineering*. 2(3): 200-203.

Yasir M, Pillai T T, Norlida M, Marloes M and Zaag PVD 2011 Performance assessment of large irrigation systems using Satellite data: The case of the Gezira scheme, Sudan. *ICID 21st International Congress on Irrigation and Drainage*. : 105122.

Jensen J R 1996 *Introductory Digital Image Processing: A Remote Sensing Perspective*, Englewood Cliffs, New Jersey: Prentice-Hall.

Kumar A, Hardeep S S, Yadav M and Hooda R S 2015 Geospatial approach for block wise area estimation of *kharif* season crops in Fatehabad district, Haryana India. *International Journal of Science Engineering and Technology*. 4(1): 148-153.

Menenti M, Visser T N M, Morabito J A and Drovandi A 1989 Appraisal of irrigation performance with satellite data and geo referenced information. (Ed.: Rydzewski, J.R and Ward, C.F) in *Proceeding of the International Conference. Irrigation, Theory and Practice*, 12-15 September 1989, London.785-801.

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