Un-Supervised Classification of Rice Crop using IRS LISS III Satellite Images for Wazirabad Command Area

Ch.Ramesh Naidu, M.V.S.S Giridhar
Professor, Civil Dept, GVPCOE (A), Visakhapatnam, AndhraPradesh.
HOD, Center for Water Resources, JNTUH, Hyderabad, Telangana State

Abstract - In view of the increasing water scarcity and effective water management, it is highly essential for the irrigation engineers to understand the crop acreage in a command area to efficiently utilize the water resources for irrigation. Satellite images provide a useful input for the identification of crops. The objective of the present study is to estimate the Rice crop acreage in Wazirabad command area, Left Bank Canal (LBC), Nagarjuna Sagar Project (NSP), Nalgonda District, Telangana State to understand the crop water requirement of the area. This paper was completely focused on pre processing and digital classification of the satellite imagery to identify the rice crop in the command area in the rabi season for two crop years. Multi date satellite data of IRS P6 LISS III were used to estimate the rice acreage under Water Users Associations (WUAs) within the command area. The study indicated an increase in rice crop area in the year 2009 than in year 2007.

IndexTerms **– Remote Sensing, Digital Image Processing, Geographical Information System (GIS), Water Users Association (WUA)**

I. INTRODUCTION

Agriculture is the largest consumer of water compared to other sectors i.e. domestic, municipal, industrial, and environmental. Effective and efficient water use in agriculture is the key for sustainable Agriculture management (Vimal Garg and Ritu Seth, 2003). However, the water-use efficiency of agriculture in canal command areas is very low and it needs to be improved. In many command areas the water releases are based on the past cropping history and climate and does not consider the present acreage. In order to enhance the irrigation efficiency, estimation of crop acreage is really important in the canal command area before releasing the water to the crops. In the initial years, farmers were encouraged to cultivate crops of their choice in the areas where irrigation water could reach. As a result, the head-reach and middle-reach farmers took cultivation of rice as per official localization scheme. This gave rise to problems of severe shortage of water in general in the tail end reaches. The problem has been further compounded due to traditional way of water releases, inadequate system maintenance and lack of accountability.

II. MATERIALS AND METHODS

The methodology adopted for the study involves the use of satellite imagery in conjunction with field and other collateral data viz. Survey of India topo maps, crop statistics from Department of Agriculture and available block maps from Irrigation Department. The crop information and statistics extracted from satellite imagery were integrated with field data and the results were analyzed on Geographical Information System. The flowcharts depicted in Fig. 1 shows the overall methodology. Since the dominant crop of the study area is rice , multi- date and multi-temporal satellite imagery on the basis of crop calendar for rabi season were procured from National Remote Sensing Centre which were shown in Fig 3. An imagery in the initial crop development stage and the other in the late mid season stage in 2007 and 2009 were selected for the present study. This includes: IRS P6 LISS III of 2007(February and March) and 2009 (February and March). Water Users Association (WUA) maps were collected from the Water and Land Management Training and Research Institute and integrated to command area base map and canal map by setting the common projection and converted to GIS format. The canal block and WUA boundaries under each canal were delineated with reference to canal network Digital Elevation Model, aspect and drainage network extracted from surface hydrology modeling and Survey of India (SOI) topo maps. The satellite imageries (Chari et al. 1994) after being georeferenced w.r.t SOI topo maps were digitally enhanced to extract appropriate information (Navalagund et al. 1991). The rice crop acreage for Wazirabad command area was estimated from the satellite imageries and this was based on the unsupervised classification (Jensen, 1996) using Erdas Imagine software. The Iterative self organizing data clustering algorithm was used to classify the crop and non-crop areas. The classification procedure was shown in Fig. 2. In rabi season, the command area is covered with rice crop and some small patches of non-rice crop. There was difficulty in identifying rice crop and cultivated lands because of the coexistence of early and late stages of crop. However these growth stages were successfully identified or distinguished by taking two multi-date images one in February and the other one in March (Dadhwal, 1999). Differences in the surface reflectance in the near infra red band helped to identify the uncultivated fields/fallow lands and more advanced growth stage fields. To improve accuracy the non-agricultural areas like settlements, water bodies, rocky, scrub and dense forest etc were masked out by using non-agricultural mask. All the features other than rice crop were identified in one class and rice crop fallow land is in different class to facilitate easy calculation of rice acreage.

To evaluate the accuracy and reliability of satellite-derived information, a comparison was made with similar information obtained from the agricultural census abstracts kept by the government departments. The crop acreage reports were then generated for each WUA in order to estimate the water requirements in GIS platform.

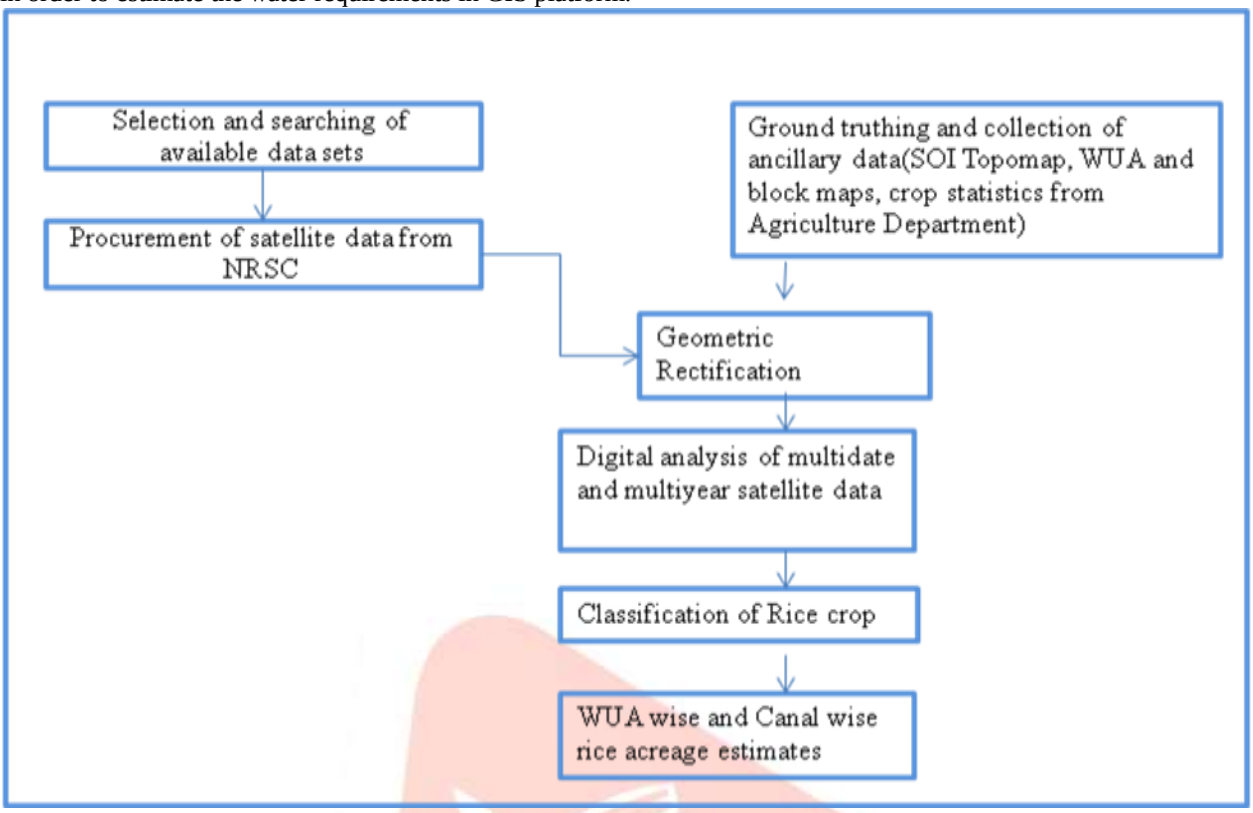


Fig1. Flow chart showing the steps involved in the study

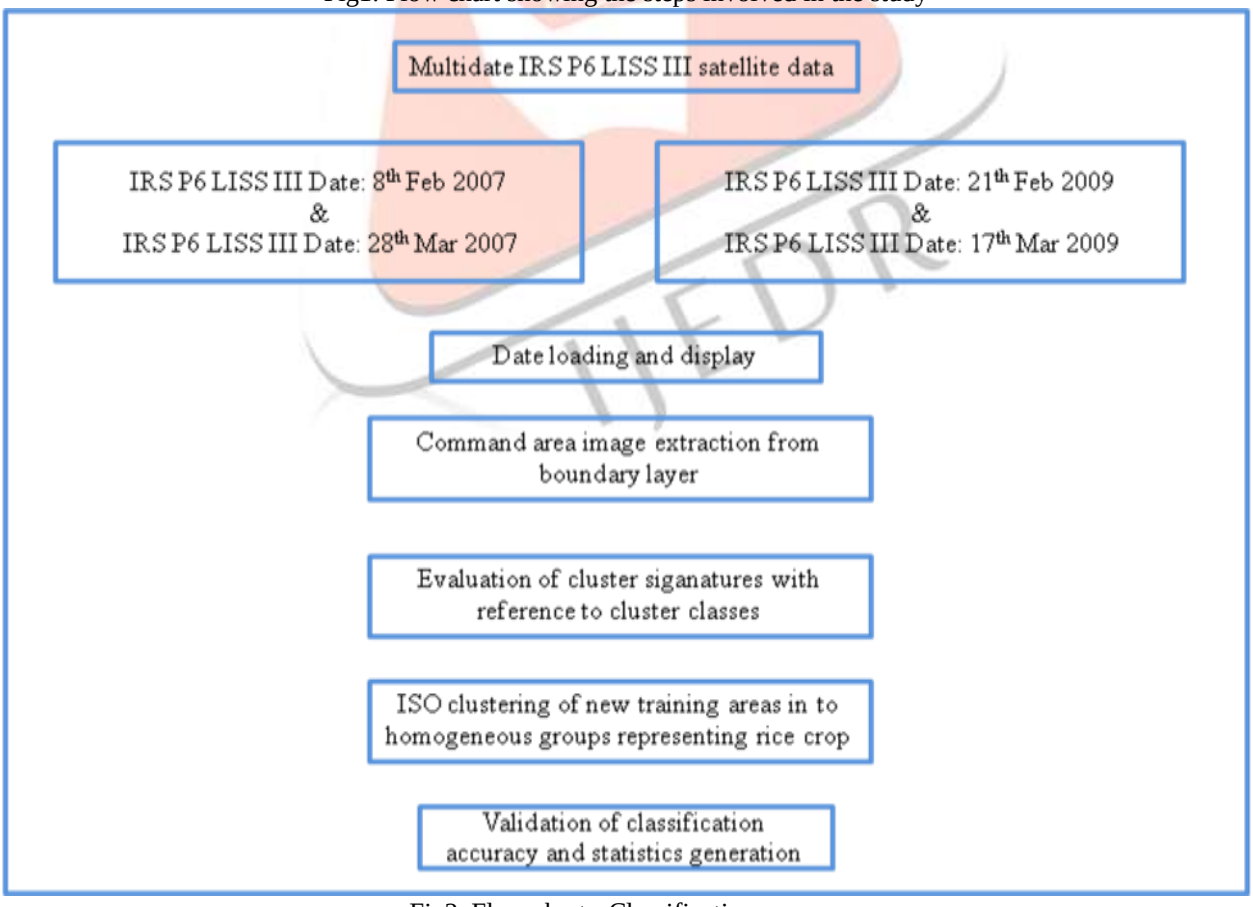
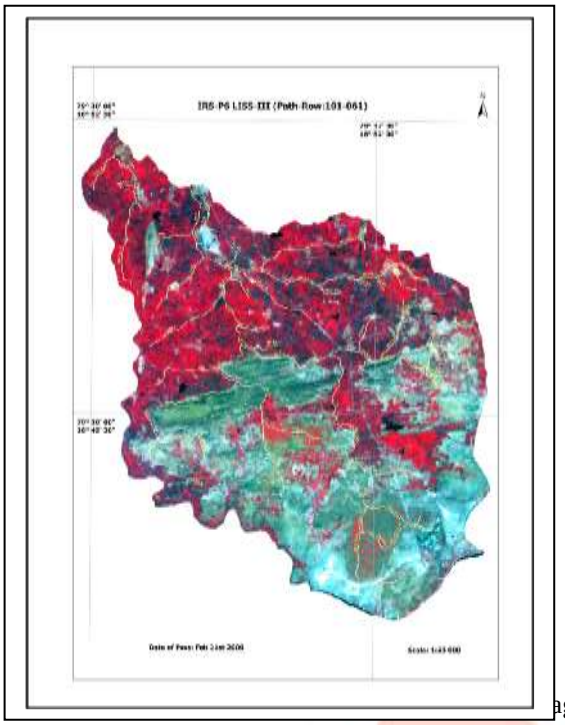
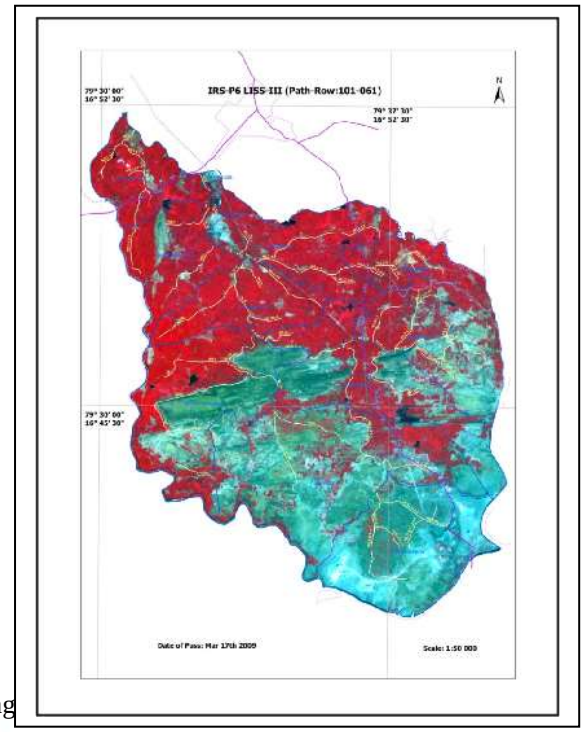


Fig2. Flow chart - Classification process





ag

III. RESULTS AND REPORTS

There are 11 Water User's Associations in the command area. These WUA boundaries were delineated with respect to topography and the canal distributary system. The total area of the command area was calculated from GIS is 26,725 hectares. For Wazirabad command area, the design ayacut of the command area is 13622 hectares. Total rice crop area has been calculated in the GIS platform for the two crop years of rabi season using digital image processing. The classified rice crop images was shown in Fig.4. Rice crop acreage was presented in Table.1. In the year 2007, the total area under rice crop was 9565 hectares and in the year 2009 it is 13322 hectares, which indicates an increase in crop area by 3757 hectares (39%). Also it was observed that there is no reduction of the cropped area is related with population growth and urbanization, etc. The reason behind increase of acreage is the timely water releases from the canals covering both head and tail end reaches.

IV. CONCLUSIONS

The difference between satellite-derived crop acreage and ground information (Government records) is in the range of ±10%. Out of the eleven WUAs under Wazirabad command area, the gross command area was found maximum in Kalleyapalle WUA with 6,482 hectares and minimum area was found in Mirialguda WUA with 279 hectares. Utilizing GIS network model, the total length of the canal system was identified as 155.846 km. The maximum rice crop was identified in Appalammagudem WUA with 1442 hectares in the year 2007 and 1884 hectares in the year 2009 in a gross command area of 3254 hectares. Where as in Dameracherla WUA, the rice acreage was estimated as 20 hectares in the year 2007 and 257 hectares in the year 2009 out of 3324 hectares of gross command area which is situated in tail end of the command area.

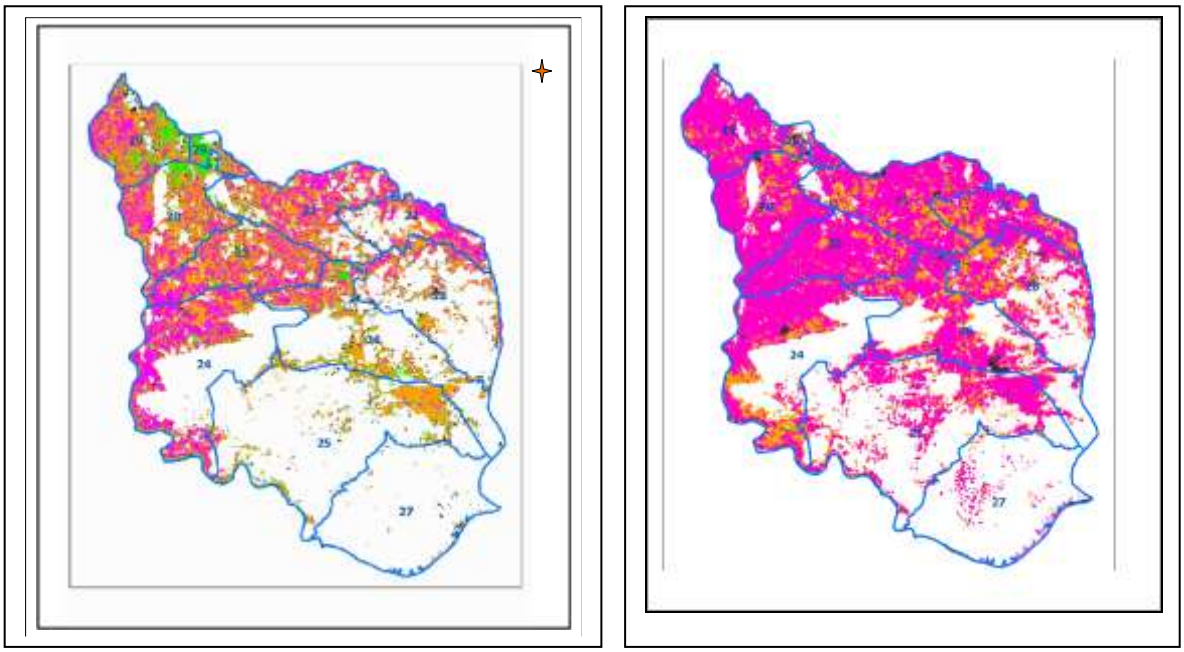


Fig 4. Crop classified images of Wazirabad command area including WUA boundaries in the year 2007 and 2009.

Table1. WUA wise rice crop and fallow land in the year 2007 and 2009

Sno	WUA	Command Area(hectares)	Rice in hectares-2007	Rice in hectares - 2009	Fallow land in hectares-2007	Fallow land in hectares-2009
1	Chillapuram	1340.672	1069.883	1016.084	50.522	7.317
2	Venkatadripalem	1879.674	1310.245	1409.688	52.837	33.423
3	Chinthapalle	2124.498	1354.907	1916.24	64.752	47.283
4	Kothagudem	1179.999	621.495	954.901	29.049	12.06
5	Borrayapalem	1753.079	1389.273	1697.508	38.388	8.605
6	Appalammagudem	3253.912	1479.179	1884.585	51.955	42.687
7	Kalleyapalle	6482.177	786.141	1376.56	154.829	8.163
8	Kondrapole	2740.179	761.249	1191.911	88.059	24.34
9	Dameracherla	3324.884	20.926	257.559	23.717	34.673
10	Kesavapuram	2366.941	591.385	1423.473	87.289	32.321
11	Mirialguda	279.4245	180.311	193.583	10.956	6.986
	Total	26725	9565	13322	652	258

IV. REFERENCES

[1] Chari, S T., Harikishan, J. and Nagesh Kumar D. 1993. Diagnostic analysis of canal system performance in RDS command, Mahaboobnagar, A.P. using satellite techniques. Technical Reporton 1991 & 1992 Kharif seasons.pp. 39-41.

[2] Dadhwal, VK.(1999). Remote Sensing and GIS for Agricultural Crop Acreage and Yield Estimation. Proceedings of WG VII/2 Workshop on Application of RS and GIS for Sustainable Development, International Archives in Photogrammetry and Remote Sensing, Vol. XXXII-7/W9, pp. 58-67.

[3] Jensen, John R. 1996. Introductory Digital Image Processing: A Remote Sensing Perspective. The second revised edition of the title book edition, Upper Saddle River, NJ: Prentice-Hall.

[4] Navalagund, R R., Parihar, J S., Ajai and Nageswar Rao, P P. 1991. Crop inventory using remotely sensed data. Current Science, 61: 162-171.

[5] Vimal Garg., and Ritu Seth. 2003. Designing Decision Support Systems to aid Irrigation Water Planning and Management in command areas. 6th annual international conference, Map India.