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Irrigation performance assessment of Left Bank Canal, Nagarjuna Sagar Project, Andhra Pradesh using remote sensing and GIS

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An investigation on irrigation performance assessment of Left Bank Canal, Nagarjuna Sagar Project (NSP), Andhra Pradesh, India using remote sensing and GIS was carried during *kharif and rabi*, 2010-11. Nagarjuna Sagar Project, a multipurpose project constructed across river Krishna near Nandikonda village of Nalgonda district, Andhra Pradesh, is a storage project to raise irrigated dry crops in *rabi* season and due to availability of water in the reservoir, paddy is grown in most of the command creating water shortage at the tail end along the main canals and down the distributary system. Based on the interaction with the officials of irrigation department and Water Users Association, Mudimanikyam major, Madhira branch canal and Nuzivid branch canals of Left Bank Canal, Nagarjuna Sagar Project were selected for study. Toposheeets pertaining to this study area and Geo-referenced satellite images were procured. Crop cut samples (50 from each major) for ground truth were collected from the study area. Crop cutting experiments were conducted (3 m × 3 m) randomly at selected points in the command area and the corresponding GPS readings were recorded. Irrigation water released from the three majors was collected from authorities of NSP. For each sample point, ground coordinates (longitude and latitude), date of transplanting, date of maturity, variety, yield, moisture percentage in grain were collected. Crop area was estimated using remotely sensed data of IRS P6 LISS III sensor (25th Sept.201 and 14th Oct 2010) for *kharif* 2010 and AWiFs sensor (2nd March 2011) for *rabi* 2010-11. The image was classified using maximum likelihood algorithm as per the training sets defined for various crops and other land use classes based on the ground truth information. Normalized Difference Vegetation Index (NDVI) was used in this study for estimation of crop yield. This study demonstrates how the remote sensing based estimates of crop area and production combined with water release data from project and climatic data can provide better estimates of irrigation performance. The performance indicators namely irrigation intensity, water utilization index (WUI), overall consumption rate (e_p), relative water supply (RWS), output per unit cropped area and water productivity (w_p) were computed based on cropped area, command area, potential evapotranspiration, water diverted from the main canal, rainfall and crop production.

The results of the supervised classification of satellite image of command area with the help of ERDAS imagine 9.3 software showed that rice crop (208653 ha) occupied 72 per cent of the gross command area (GCA) (323070 ha) and 23 per cent are was covered by the other crops (82379 ha) viz., orchards, groundnut, redgram and cotton during *kharif* 2010. During *rabi*, 2010-11, rice crop (173311 ha) occupied 42 per cent of the gross command area (GCA) (408165 ha) and 55 per cent are covered by the other crops (22556 ha) viz., groundnut, redgram, chilies and cotton in addition to orchards occupying 14 per cent (58043ha). The average measured yields from crop cut experiments (CCE) was 2.5 to 5.9 t ha⁻¹ during kharif 2010 and 2.8 to 6.3 t ha⁻¹ during *rabi*, 2010-11 under command area of left bank canal. The Satellite derived yields of the command area using yield model developed based on extrapolation of data from selected study areas, showed that average yields of the of Zone I was 3.92 t ha⁻¹ and zone II was 4.41 t ha⁻¹ . The yields of other crops were converted to equivalent yield of rice and the average rice equivalent yield was 4.33 t ha⁻¹ during *kharif* 2010 under left bank command area. During *rabi*, 2010-11, the average rice equivalent yield was 4.53 t ha⁻¹ under left bank command area. Based on the water discharge data of command areas the performance indicators were worked out. The Water Utilization Index (WUI) computed using the equivalent wet area showed that it was low for zone II (150ha Mm⁻³) as compared to the zone I (188ha Mm-3) during *kharif* 2010 and it was it was high for zone III (198ha Mm⁻³) as compared to the zone I (99 ha Mm⁻³) and zone II (76 ha Mm⁻³) during *rabi* 2010-11. The average project water productivity was 0.99 for zone I and 0.79 for zone II with average of 0.88 for entire command as computed with the volume of water supplied during *kharif* 2010. The average project water productivity was 0.34 for zone I and 0.80 for zone II and was 1.89 for zone with average of 0.61 for entire command as computed with the volume of water supplied during *rabi* 2010-11. In over all zone III used water efficiently followed by zone II compared to Zone I. The advantage of the described approach is that it allows identification of areas where performance is less than potential, thereby providing insights into where and how irrigation systems can be managed to improve overall performance and increase water productivity in a sustainable manner for enhancing food security.

Keywords: Remote sensing, water productivity, irrigation performance, relative water supply, water utilization index, Canal command area.

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