



Study of waterlogging and drainage in relation to soil in coastal Odisha using remote sensing and GIS

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Water and soil, the two life sustaining natural resources require due attention in their management. The land availability for agriculture is limited. The limitations of these resources lead people to adopt advanced agricultural research to mitigate waterlogging and irrigation practices in agricultural land to increase productivity level (Vaidya *et al.*, 1995). In coastal areas of Odisha waterlogging is the major land degradation problem. Waterlogging is mainly created by high rainfall and poor surface drainage. The coastal area has been formed by sediments deposited under a variety of environments such as fluvial environment (sand dunes, channel deposits etc.), by natural agencies such as river water, sea wave tides, off shore currents and winds. The coastal area being a flat land with slope less than 0.02 percent, it does not permit easy drainage. Poor drainage conditions thus have developed waterlogging either due to surface ponding or rising of groundwater table owing to excess inflow as compared to outflow. The waterlogging affects the productivity and fertility of land and thus leads to reduction in crop yield in these areas (Anonymous, 2010).

The study area comprises of three Blocks of Odisha namely, Ersama, Kujang and Marsaghai of coastal Odisha (lat. 20°15'-20°26' N, Long. 86°32'-86°40') and lies at the altitude between 5m and 25m above mean sea level. The region mainly covers Luna Chitropala doab area of Mahanadi river systems and lies in the districts of Jagatsinghpur and Kendrapara of Odisha. There are mainly 5 drainage lines namely, Musharhia nala, Barhatubi nala, Cahandapur nala, Tigiria and Patua nala found in the study image which was confirmed by SOI toposheets. Agriculture is the main occupation of the people for the area. In the region where waterlogging prevails, kharif crop (rice) is mainly grown during June to December. In non-waterlogged area, in a small extent rabi crops like Kalai (*Lathyrus*), Moong (*Vigna*) etc. are grown (December - March) after harvest of rice.

The data used for the study were Standard data of IRSP6 LISSIII date: 20th Oct., 2010, path-107, row-058, land use and geomorphology map and survey of India toposheets (1:50,000). In the study, image processing of IRSP6 LISSIII data were carried out to map the waterlogged area. ERDAS IMAGINE 11 software was used for image processing. We also calculated R_{31} ratio i.e., NIR: green ratio for the rectified image. The waterlogged areas obtained by R_{31} method for different coastal Blocks are given in Table 1. Approximately 23341 ha in Ersama, 13243 ha in Kujang and 7066 ha in Marsaghai were found to be waterlogged in the study season. The soils of the study waterlogged area came under 5 different soil series namely, Gopalpur clayey fluventic Haplustepts, Deuli sandy loamy Haplustepts, Kuarpal sandy Haplustepts, Bhutmundai fine sandy Haplustepts and Bagadia sandy loamy Haplustepts (Table 2). The mapping units are also given in the table. The soils of Ersama and Kujang waterlogged sites were mostly finer in texture and deep, where as those of Marsaghai were relatively coarse (Table 2). The hydraulic conductivities of most of the soil samples were less than 0.1 cm hr⁻¹ except few sandy pocket areas of Kuarpal and Bagadia villages (Raut and Pawar, 2011) where conductivities were more than 1 cm hr⁻¹. The severely waterlogged areas (> 50 cm water conjection) (in Gopalpur, Deuli and Bagadia of Ersama Block) should be treated with open drainage where soil texture is fine. The areas where the land slope is more (>0.02%) and waterlogging is slight (<50 cm water conjection) (Bhutmundai and Kuarpal of Marsaghai and pockets of Kujang) sub-surface drainage can be adopted. Through the initiation of new drainage, farmers can take two crops instead of one rice in a year. Thus the farmers of the study area can take paddy-paddy (Kuarpal), paddy-vegetables (Bagadia, Deuli), paddy-legumes like mung and kalai as 2nd crop (Gopalpur, Kuarpal, Bhutmundai) instead of single rice crop.

Table 1. Waterlogged areas in different Blocks of coastal Odisha using R_{s1} index (2010)

Feature	Ersama	Kujang	Marsaghai
Waterlogged area (ha)	23341	13243	7066

Table 2. The description of soil series observed in the study waterlogged sites

Series	Taxonomy	Mapping units
Gopalpur	Clayey fluventic Haplustepts	G4aA1 G5aA1 G4bA1 G4aA1
Deuli	Sandy loamy Haplustepts	D4dB1 D4dA1 D4fA1 D4fA1
Bagadia	Sandy loamy Haplustepts	B3dA2 B3dA1 B4dA1 B5dA2 B4dA1
Kuarpal	Sandy Haplustepts	K5cB1 K4bA1 K4bB1 K5bB1 K5cB2
Bhutmundai	Fine sandy Haplustepts	Bh5cA1 Bh4cB1 Bh4aB1 Bh4aA1 Bh5aA1

G: Series, 3: soil depth (22.5-30 cm), 4:22.5-60 cm, 5: 60-90 cm; a: soil texture, clayey; b: silty clay, c: loamy sand, d: sandy loam, f: silty loam A: slope (0-1%), B: 1-3%; 1: erosion class

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