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# Landuse Planning Using Remote Sensing Techniques (A case study of Behta Block, District Sitapur, Uttar Pradesh)

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**ABSTRACT**

In landuse planning for Behta block of Sitapur district, UP, all the resource maps were generated at 1:50,000 scale. The theme maps were prepared by visual interpretation of IRS-1B LISS-II geocoded False Colour Composites (FCC) of three season data alongwith Survey of India (SOI) toposheets, as ancillary data. Soils were mapped at the level of series association. Physico-chemical analysis of soils were carried out and their suitability for various landuses were assessed. The resource themes viz. soil, landuse, landform, underground and surface water were integrated, keeping in view the climate and irrigation facilities and socio-economic conditions and a suitable landuse plan was suggested for the block. Double cropping was recommended in single cropped areas to an extent of 84.91% of total geographical area. Agro-horticulture, horticulture, social forestry and agro-forestry were recommended in 1.88%; 4.75%; 1.55%; and 2.36% areas, respectively of the total geographical area of the block.

## Introduction

Optimal landuse planning for sustainable development of an area requires a reliable and timely information on natural resources. Among natural resources soils, landuse pattern and water resources are important. Remote sensing technique has proved as a powerful tool to generate spatial information of natural resources in economic terms with reliability. IRS satellite data are found to be very useful in preparing inventory of these resources (Rao et al., 1996). Satellite data, by virtue of its synoptic viewing, multispectral and multitemporal capability provides vital informations of soils, land and landuse/ land cover inconjunction with ground based survey.

This study was carried out under the aegis of nationwide project, " Integrated Mission for Sustainable Development" where various maps were generated in 1:50,000 scale. These maps were integrated to arrive at composite unit to generate an optimal landuse plan for development of block on a sustainable basis. In addition to these resource maps, institutional infrastructure and socio-economic conditions were also taken into account to make landuse plan more viable.

## Description of Study Area

The study area taken up in Behta Block of Sitapur district of Uttar Pradesh, is identified as floodprone area. The block is situated in the northern part of Sitapur district covering an area of 348.06 sq.km. Geographically, it is located between latitudes 27°39' to 27°55'N and longitudes of 80°54' to 81°14'E. The area consists of younger alluvial plain formed by the action of Dahawar (Sarda) and Chauka rivers which form the northern boundary of the block. The block consists of 136 villages out of which 5 are uninhabited.

The climate of the area is semi-arid which is characterized by severe summer and mild winter. The south-west monsoon prevails over the area from mid June to September. The area is characterized as rainfed farming. The average annual rainfall is 712 mm . The river Dahawar (Sarda) forms the main drainage system and flows from west to east. Chauka river passing through central portion of the area and flowing from north to south is most important drain in the block. Baha nala and Gobaria nadi are other two streams to drain excess water from the area.

## Database and Methodology

IRS-1B LISS-II geo-coded FCC images on 1:50,000 scale, and Survey of India topographical maps of scale 1:50,000, No. 63 E/1,2 and 63 A/ 13,14 were used as primary source of data to prepare thematic maps viz. soil, hydro-geomorphology and landuse/ landcover. Monoscopic visual interpretation techniques using image characteristics were used for mapping

various themes. Final map was generated through four stages viz. prefield interpretation, ground truth of different mapping units with modifications wherever necessary, correlation and finally post field work.

Satellite data of summer season (April,1994) was used to map soils and hydrogeomorphology whereas satellite data of January, October and April were used to map landuse/ landcover. Later, these maps were superimposed one over the other to get the complete resource information of all the themes for the whole area. Interpretation key was established to suggest optimal landuse at a location considering agroclimate, farmer's practice and socio-economic profile of the block.

## Results and Discussion

***Hydrogeomorphology*** : Geologically, the entire block belongs to Quarternary period of alluvium formation. It is characterized as younger alluvium. Older alluvium does not occur in the area. Geomorphologically, the area is a part of very dynamic fluvial regime of Dahawar (Sarda) river. The topography is flat with very minor undulation. The area has been divided into younger alluvial plain and recent flood plain geomorphic units. The groundwater prospects in the entire block is excellent in both geomorphic units (Table 1). Data reveal the existence of clay upto depth of 2 to 7.65 m and rest of the material as medium to coarse sand. The groundwater occurs in both unconfined and semi-confined conditions.

***Soils*** : Soil map was prepared at series/ association of series level using IRS-1B LISS II Geocoded FCC of 1:50,000 scale. For soil mapping, the entire area has been divided into two major landtypes viz. alluvial plains of Dahawar and alluvial plains of Chauka river. These landtypes were further sub divided based on variations in topography, landuse/ landcover, erosion and other image elements such as tone, texture, pattern, size, shape and associations. Typified pedons were selected and classified according to Soil Taxonomy (Soil Survey Staff, 1994) based on morphological and physico-chemical properties. Soil samples collected of each horizons were analysed for physical and chemical properties (Black, 1965). Nine soils series have been identified in the area and the whole study area has been divided into eleven soil mapping units (Table 2). The soils in the area are in general, moderately productive with surface texture ranging from sandy loam to silt loam except in low land of Dahawar alluvial plains having silt loam to clay loam. Predominantly soils are well drained except in low lands of Dahawar which are moderately well drained. Most of the land units are flat to nearly level and have nil to slight erosion. But the soils forming in recent flood plains of Dahawar and point bar complex of Chauka river have gentle slope with slight to moderate erosion and get flooded during rainy season. In general, soils of the block fall under the great group of Ustothents, Ustifluvents and Ustochrepts. The soils have Ustic moisture regime and hyperthermic temperature regime. (Soil Survey Staff, 1974).

Table 1. Hydrogeomorphological status

| S.No. | Geomorphic Unit | Description | Groundwater prospects |
|---|---|---|---|
| Fluvial origin | | | |
| 1. | Alluvial younger | Formed by extensive deposition of Alluvium by Sarda river system. Flat terrain composed of various grades of sand, kankar and some clay. | Excellent. Shallow tubewells upto 100m may give discharge of 150,000 lph. |
| 2. | Flood plain recent | Formed by dynamic fluvial regime of Chauka and Sarda rivers. Lower land than Alluvial plain, mostly sand. | Excellent. Shallow tubewells upto 75m depth may give discharge of 200,000 lph. |

Table 2. Soils and their area under various mapping symbols

| S. No. | Physiography | Soil series/ association | Soil classification | Area (ha) | Area (%) |
|---|---|---|---|---|---|
| Dahawar alluvial plains | | | | | |
| 1 | Uplands | Marsanda<br>Manjhari | Coarse loamy Typic Ustorthents,<br>Coarse loamy Typic Ustifluvents | 6943 | 19.95 |
| 2 | Nearly level | Manjhari<br>Makka Purwa | Coarse loamy Typic Ustifluvents<br>Coarse loamy Typic Ustifluvents | 10641 | 30.57 |
| 3 | Low lands | Jagdishpur<br>Rai Maror | Fine loamy Typic Ustochrepts<br>Fine loamy Fluventic Ustochrepts | 3613 | 10.38 |
| 4. | Old Levee remnents | Makka Purwa | Coarse loamy Typic Ustifluvents | 198 | 0.57 |
| 5. | Recent Flood plains | Khanna Maror<br>Makka Purwa | Coarse loamy Typic Ustifluvents<br>Coarse loamy Typic Ustifluvents | 2033 | 5.84 |
| 6. | | Maror | Coarse loamy Typic Ustorthents | 2326 | 6.68 |
| 7. | Paleochannels | Jagdishpur | Fine loamy Typic Ustochrepts | 73 | 0.21 |
| Chauka alluvial plains | | | | | |
| 8. | Uplands | Rehar | Coarse loamy Typic Ustifluvents | 1911 | 5.49 |
| 9. | Nearly level | Usia | Coarse loamy Typic Ustorthents | 3138 | 9.02 |
| 10. | Low lands | Gandosa<br>Manjhari | Coarse loamy Fluventic Ustochrepts<br>Coarse loamy Typic Ustifluvents | 769 | 2.21 |
| 11. | Point bar complex | Jalhepur | Coarse loamy Typic Ustifluvents | 1029 | 2.95 |
| | Miscellaneous | | | 2132 | 6.13 |
| | Total | | | 34806 | 100.00 |

***Landuse/land cover*** : Satellite images of October, January and April months were used to prepare landuse/ land cover map of the study area on 1:50,000 scale. The classification scheme suggested by NRSA (Anonymous, 1989) has been adopted in the present study. Four major landuse/ landcover types viz. Built up land, Agricultural land, Waste land and Water bodies were identified in the block. Agricultural landuse (crop land) occupies 86.79% of the total geographical area comprising of 74.22% area under double cropping, 10.69% area under *Kharif* cultivation and 1.88 percent under fallow. Wasteland categorized into salt affected land, land with scrub, land without scrub and sandy area accounts for 8.83 percent (Table 3). Other categories such as built up land and water bodies constitute 0.29 and 4.09 per cent, respectively of the total study area.

***Socio-economic status*** : As per 1991 census, the total population of the block is 136584 with population density of 364 persons per Sq. km. The literacy rate of males and females are 27.1% and 7.5% respectively in the block. Scheduled caste population constitutes 35.35% of the total population of the block. Agriculture is the main occupation of the people. About 84% of the population is engaged in agriculture. 67.8% cultivators have land holding size less than one hectare. The area is mostly characterized by rainfed agriculture and only 9.3% of the area is under irrigation. Tubewells,as major source of irrigation, irrigate nearly 97% of irrigated area.

***Landuse plan*** : For efficient utilization of land to meet the requirements of the people of the block, optimal landuse plan has been suggested after

Table 3. Area under various landuse/land cover classes

| S. No. | Landuse/ Land cover Class | | | | | Area | |
|---|---|---|---|---|---|---|---|
| | | | | | | Sq.Km. | % |
| 1. | Built-up Land | 1.1 | Villages | | 0.99 | 0.29 | |
| 2. | Agricultural Land | 2.1 | Crop land | 2.1.1 | Kharif | 37.21 | 10.69 |
| | | | | 2.1.2 | Kharif + Rabi | 258.33 | 74.22 |
| | | 2.2 | Fallow | | 6.56 | 1.88 | |
| 3. | Wastelands | 3.1 | Salt affected land | | | 0.53 | 0.15 |
| | | 3.2 | Land with scrub | | | 15.51 | 4.46 |
| | | 3.3 | Land without scrub | | | 6.46 | 1.86 |
| | | 3.4 | Sandy areas | | 8.22 | 2.36 | |
| 4. | Water Bodies | 4.1 | River/ Stream | | 14.25 | 4.09 | |
| | Total | | | | 348.06 | 100.00 | |

assessing the potential of land resources viz. soils, hydrogeomorphology and terrain conditions. The suitability were dovetailed with agroclimatic and socio-economic data to make them locally acceptable and economically viable.

Major landuses recommended (Table 4) as optimal suitability for sustained production in the block area are discussed as follows

*1. Double cropping with ground water exploitation*
The area under double cropping is 74.22% of total geographical area. Besides this single cropped area (3721 hacteres) were suggested to be brought under double cropping as there is no soil and other constraint except irrigation. Lack of irrigation facilities is the major limitation to manage the area suitably for double cropping. As on 9.3% of the total area is under irrigation. Sprinkler irrigation through borewells can be introduced for irrigation in sandy areas. Major crops suggested are wheat, paddy, sugarcane, lentil, gram, pigeon pea, maize and mustard.

*2. Agro-horticulture* : Fallow lands have been suggesed under Agro-horticulture. This covers an area of 656 hacteres. The soils in these units are well drained, coarse textured and have negligible erosion.

*3. Horticulture* : The area under scurbs were assessed as most suitable for horticulture crops. This has been recommended in 1656 hacteres of the total area. The fruit species suggested are mango, guava, amla, Ber, grape and jackfruit.

Table 4. Area statistics recommended under various land uses

| S.No. | Description | Area | |
|---|---|---|---|
| | | (ha) | (%) |
| 1. | Double cropping | 3721 | 50.08 |
| 2. | Agrohorticulture | 656 | 8.84 |
| 3. | Soil reclamation & kharif cultivation | 53 | 0.71 |
| 4. | Horticulture | 1656 | 22.29 |
| 5. | Social forestry | 541 | 7.01 |
| 6. | Agro-forestry | 822 | 11.07 |
| | Total | 7429 | 100.0 |

*4. Soil reclamation measures & kharif cultivation* : In the block, 53 hactares area were identified for salt reclamation and *kharif* cultivation. Physico-chemical and biological measures are suggested to manage these lands for cultivation. Green manuring crop (Dhaincha, *Sesbania* spp.) is suggested as summer crop. Salt tolerent crops viz. wheat, barley, sorghum, cotton, lentil are recommended in the unit.

*5. Social forestry :* It is suggested in areas of without scrubs along the river courses. The tree species, scrub/ shrub and grasses are suggested to, so as to meet the local demand of people for fuel and fodder as well as to provide protection

against degradation. This covers an area of 541 hacteres.

6. *Agroforestry* : Sandy areas where erosion is major problem are suggested to be brought under agroforestry. The area under this recommendation forms 822 hacteres. It is proposed to raise tree species such as - Arjun (*Terminalia arjuna*) and Mulbery (*Morus alba*), Prospis, Popular, Acacia, Eucalyptus along field boundaries.

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