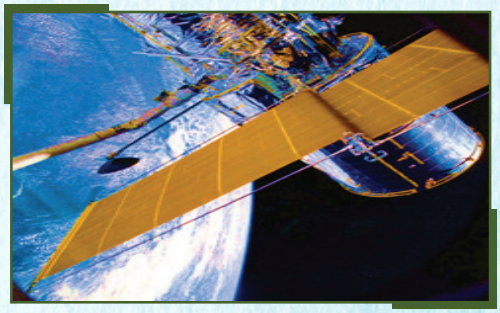
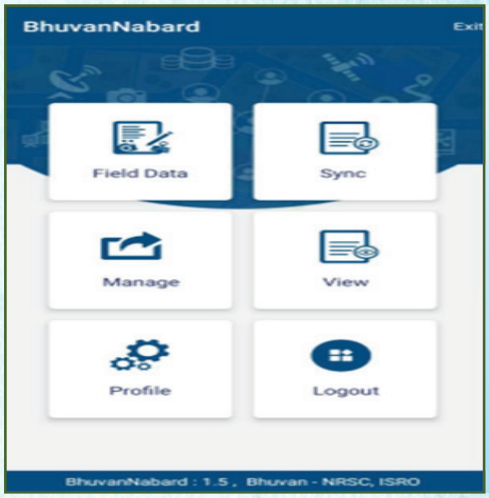
NABARD

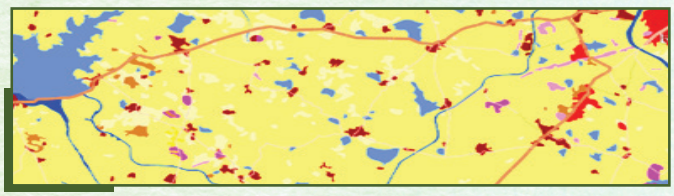
WATERSHED DEVELOPMENT PROJECTS

An Initiative by Nabard

Monitoring and Evaluation of Watershed Projects using Remote Sensing and GIS or Geo Spatial Techniques







Background

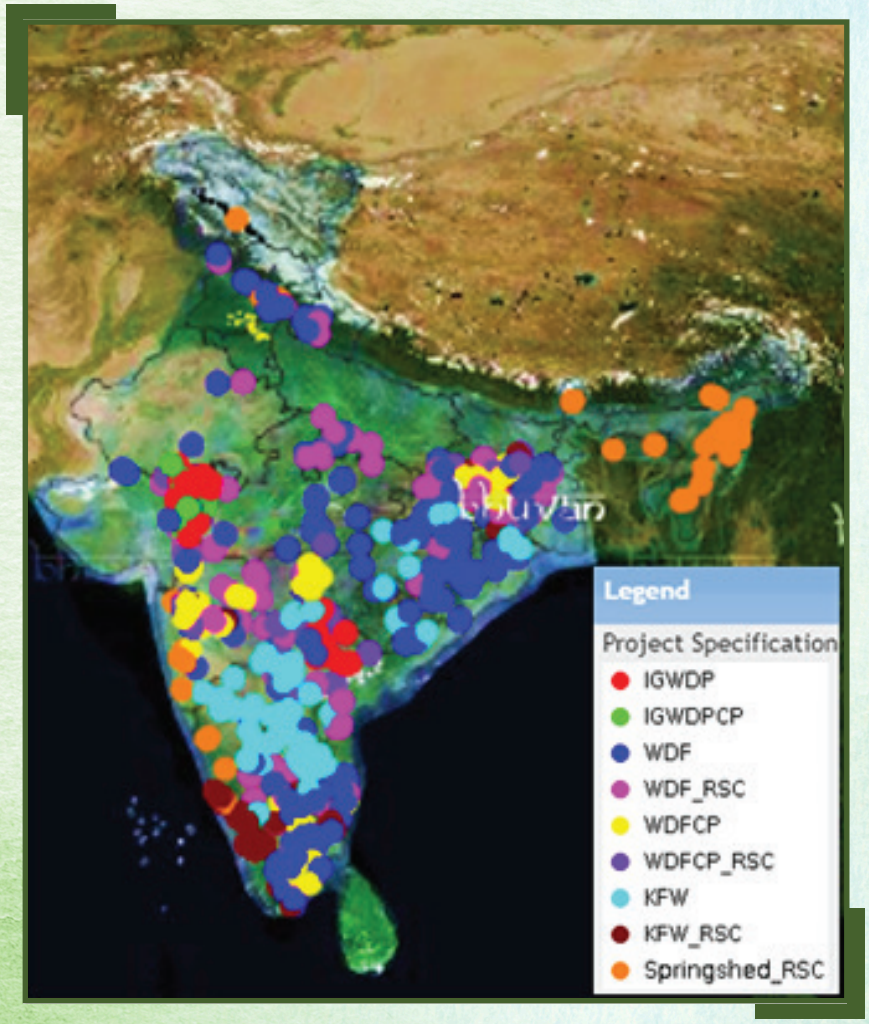
NABARD has been implementing participatory watershed projects as a part of Natural Resource management since last three decades with an aim to reduce risk associated with rainfed farming systems and ensure livelihood security through holistic development involving soil and moisture conservation, productivity enhancement measures, climate proofing interventions and alternative livelihood interventions, etc. Cumulatively, as on 31st March 2022, 3557 projects covering 2.6 million hectare area are sanctioned by NABARD with financial assistance of Rs. 2589.26 crore.

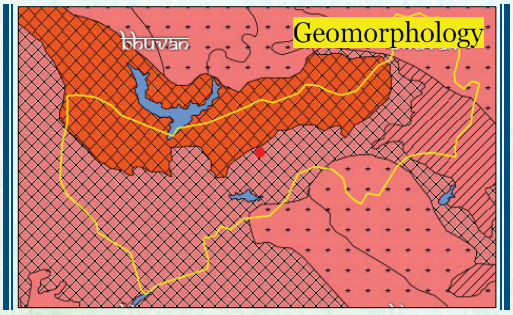
With the increase in the number of projects and need for digitization of NABARD's interventions in NRM sector, web-based monitoring of on-going projects and evaluation of completed projects is being done using NABARD Bhuvan Portal. While remote sensing provides high spatial, spectral and temporal data, GIS connects data to a map, integrating location data with all types of descriptive information and helps users understand patterns, relationships, and geographic context.

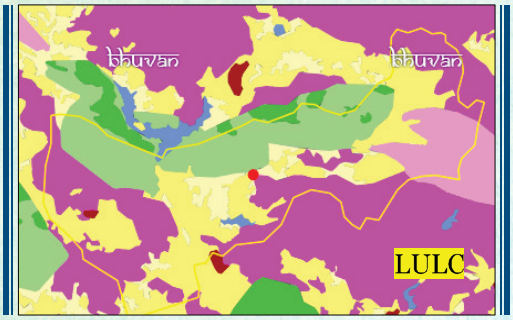
NABARD Bhuvan Portal and Mobile Application

NABARD Bhuvan Portal is a Web-based monitoring geospatial platform which is being used for monitoring of the physical and financial progress for each activity/sub-activity being implemented under watershed development programme. The Portal enables access via three categories of users, viz., Citizen Level, Administrator level (NABARD RO/HO) and Data Provider level (PFA/DDM). The Verified watershed boundary shapefiles are hosted on the portal after which implementing agencies can geotag the interventions using the NABARD Bhuvan Mobile Application in the project areas along with photographs and other details. This helps to ensure that watershed project area is maintained as well as conservational activities take place within the watershed boundary to achieve the maximum benefits.

Portal hosts geospatial database including administrative boundaries like state boundaries, district boundaries, village boundaries and data like roads, settlements, waterbodies etc. In addition, portal has multi-temporal satellite images with capabilities to overlay and derive thematic information viz. LULC, geomorphology, drainage, slope, soil etc.





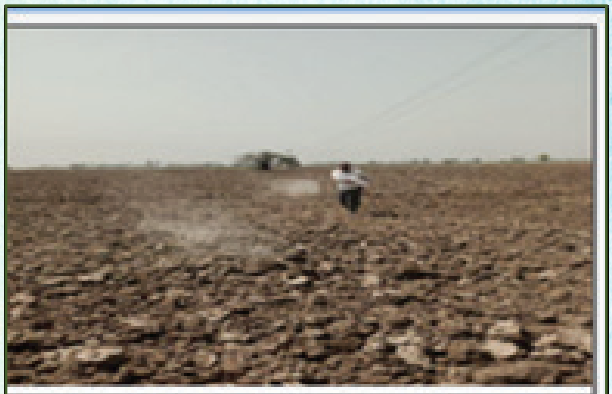


Present Status

As on 30 June 2022, 928 watershed projects are hosted on the portal with more than 63,000 geo-tagged assets.

A. KfW Soil Projects : The portal also on-boarded all the KfW Soil Projects in which sustainable soil health management and climate change adaptation measures are integrated.

B. Reclamation of Alkaline Soils- Geotagging: Apart from watershed and springshed projects, under the Pilot project Reclamation of Alkaline soil, all the beneficiary farm lands from the states of Haryana (629) and Punjab (517) were geotagged at the time of gypsum application. All the non-spatial information including quantity of gypsum applied, soil pH, ESP and crop yield (pre-application), etc were captured while geotagging.



1 2

Farmer Name	Mahavir Singh
Land Type	Private
Physical Details Unit	Ha
Physical Unit Value	2.8
Details	Paddy
Block/Taluka	Moonak
Qty of Gypsum/Lime(MT)	14.90
pH Value	9.4
ESP Value	26.39
Crop Type	Kharif
Crop Yield	3.2

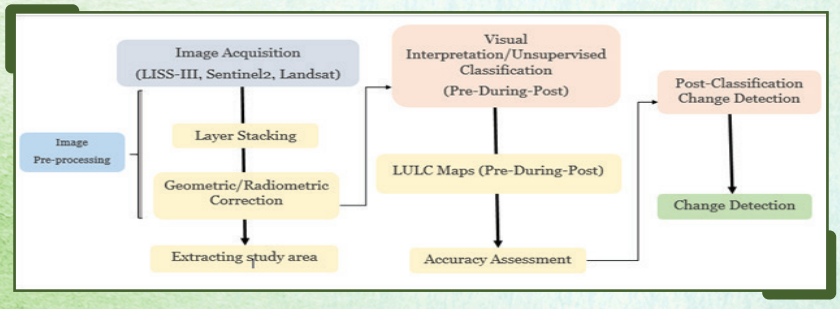
Evaluation of Impact of Interventions

With a view to holistically assess and evaluate the long-term effects and the impact of the activities through satellite imageries, land use and land cover changes are analyzed through a comparison of satellite images acquired for the same area at different time periods. High spatial resolution, and the repetitive coverage of the satellite provides an excellent opportunity to evaluate the same.

S. No.	Satellite/Sensor	Spectral (µm)	Resolution Spatial (m)	Temporal (days)
1	Sentinel 2 (Source: ESA)	Band 3: 0.56 Band 4: 0.66 Band 8: 0.84	10	5
2	IRS P6 LISS-III (Source: ISRO)	Band 2: 0.52-059 Band 3: 0.62-0.68 Band 4: 0.77-0.86 Band 5: 1.55-1.75	23.5	24
3	IRS P6 LISS-IV (Source: ISRO)	Band 2: 0.52 - 0.59 Band 3: 0.62 - 0.68 Band 4: 0.77 - 0.86	5.8	5

The satellite data used for impact evaluation of watershed projects are LISS III, LISS IV multispectral images obtained from National Remote Sensing Centre, Indian Space Research Organization (ISRO), and Sentinel 2 images sourced from European Space Agency (ESA). The satellite imagery as selected considering cloud coverage less than 10% and availability of the satellite imagery for the three years (Pre-during-Post) for same season. Monthly rainfall data obtained from India Meteorology Department (IMD) was used to understand the rainfall pattern in watershed project areas. Before undertaking change detection analysis, the following conditions are ensured: (1) precise registration of multi-temporal images; (2) precise radiometric and atmospheric calibration or normalization between multi-temporal images; (3) similar phenological states between multi-temporal images; and (4) selection of the same spatial and spectral resolution images if possible. Changes on the landscape are detected as changes in the 'spectral space' occupied by an image pixel.

General Specifications of satellite data



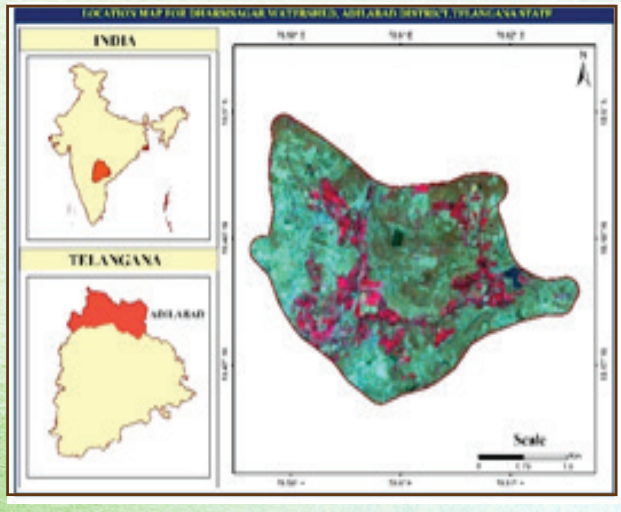
Flow diagram of Methodology of LULC Change Detection

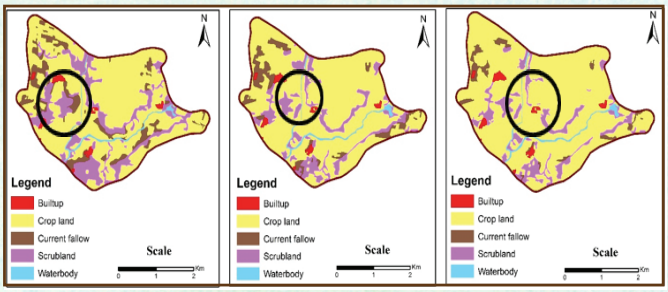
POST Classification change detection technique is used which requires rectification and classification of each remotely sensed image. The maps are then compared on a pixel-by-pixel basis using a change detection matrix specifying the 'from-to' change information. Classification of image is carried out using Unsupervised Image Classification algorithms such as ISODATA clustering as well as through visual interpretation based on any, or all, of the visual elements of tone, shape, size, pattern, texture, shadow, and association.

Up to 9 classes are identified viz., crop land, fallow land, waterbody, plantation, barren land, scrubland, mining and wasteland. The LULC maps are generated for three different time periods viz. pre, during and post project implementation stages to map three scenarios of the watershed for the same cropping season. The spatial variations occurred in LULC of watershed over the period of project implementation are estimated. Validation of LULC maps is done by correlating the maps with high resolution (sub-centimetres) Google Earth imagery. The results are also correlated with the photographs of geotagged assets.

Land Use Land Cover Change Detection in Dharmasagar Watershed using Remote Sensing and Geographic Information System - Case study I

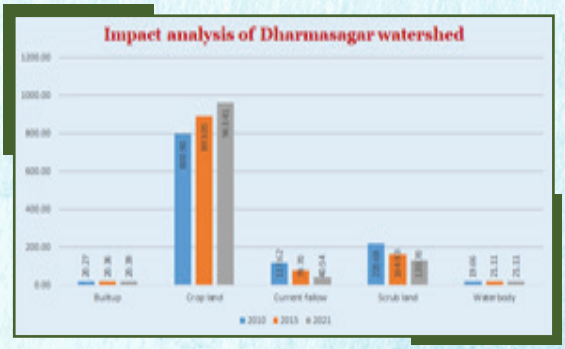
Dharmasagar Watershed, Adilabad District of Telangana was supported under the Watershed Development Fund from 2008 to 2016. Satellite images for the years 2010, 2015, and 2021 were analyzed to study the impact of watershed interventions on land use/land cover changes in the watershed. The changes are depicted in the images below:





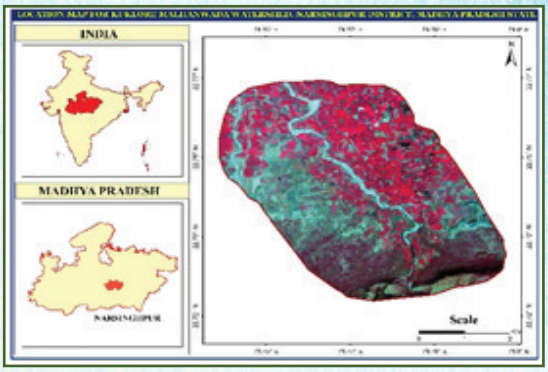
Impact analysis of Dharmasagar Watershed (area in hectare)

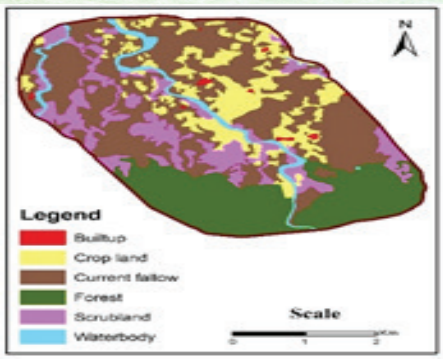
The analysis of satellite data shows that implementation of various watershed interventions under the project led to significant conversion of current fallow land and scrubland (indicated by decrease in area) to crop land (indicated by increase in area). As a result, there is an increment of 163 ha in crop land by 2021.

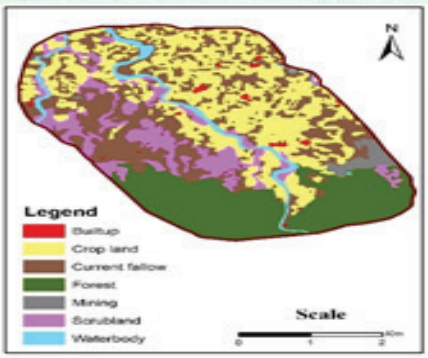


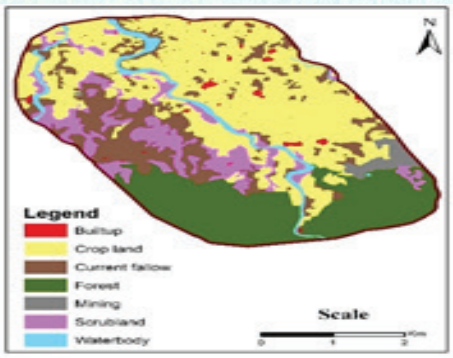
Land Use Land Cover Change Detection in Kuklor-Malhanwada Watershed using Remote Sensing and Geographic Information System - Case study II

Kuklor-Malhanwada Watershed, Narsingpur District of Madhya Pradesh was supported under the Watershed Development Fund from 2008 to 2019. Satellite images for the years 2009, 2016, and 2021 were analyzed to study the impact of watershed interventions on land use/land cover changes in the watershed. The changes are depicted in the images below:



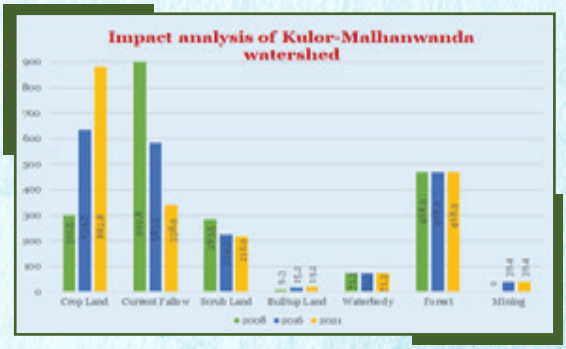




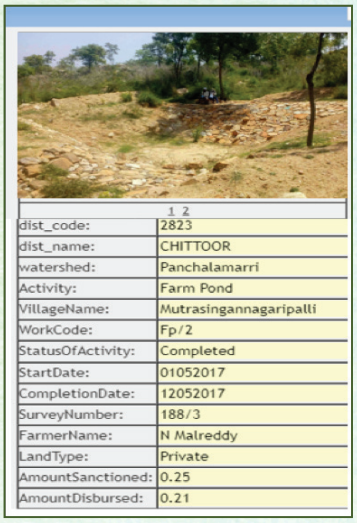


Impact analysis of Kuklor-Malhanwada Watershed (area in hectare)

The analysis of satellite data shows that implementation of various watershed interventions under the project led to significant conversion of current fallow land scrubland and (indicated by decrease in area) to crop land (indicated by increase in area). As a result, There is an increment of 581 ha in cropland by 2021.



Overview of a Geotagged Asset Farm Pond under KfW Soil Project (SEWOH-Phase I) in Panchalamarri watershed, Chittoor, Andhra Pradesh



dist_code:	2823
dist_name:	CHITTOOR
watershed:	Panchalamarri
Activity:	Farm Pond
VillageName:	Mutrasingannagaripalli
WorkCode:	Fp/2
StatusOfActivity:	Completed
StartDate:	01052017
CompletionDate:	12052017
SurveyNumber:	188/3
FarmerName:	N Malreddy
LandType:	Private
AmountSanctioned:	0.25
AmountDisbursed:	0.21

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Farm Sector Development Department
Nabard Head Office Bandra (E), BKC, Mumbai 400001