Advantages of Estimation of Kharif Crop Using RadarSat ScanSar Data

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Introduction:

The use of space borne remote sensing for agricultural and land use applications has been widely demonstrated as an important tool, particularly for crop monitoring and land cover identification. More importantly, the easy availability of data on a regular basis from operational satellites such as RADARSAT, LANDSAT has created the potential for such an analysis to be implemented as a monitoring tool. This is immensely important in areas where extensive logging activities are prevalent. Optical data like LISS-I, II, III and WiFs are remain the best source of information for crop monitoring and Land use classification with a high resolution and a good discrimination for various land covers. While optical sensors have been successfully exploited for such studies, their use in tropical areas is severely limited by weather conditions. Indeed, cloud cover poses the greatest restriction to the acquisition of data that may be required at different intervals. This limitation has been some what alleviated by the use of Synthetic Aperture Radars (SARs), which are essentially all-weather systems. It has been shown that SAR data allows estimating Kharif rice crop using logical Model based on the backscatter coefficient derived from SAR data.

Objectives:

To develop a methodology for estimating Kharif rice production using SAR data to achieve higher accuracy.

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Study Area:

The state of West Bengal having a geographic area 85752km ^{2} lies in the eastern coast of India between $21^0$45' and $26^0$45'N and $86^0$00' and $90^0$00'E. Rice is the most dominant crop of the state and grown through out the year as Aus, Aman and boro crops. Kharif rice comprising of Aus and Aman rice grown between June-October accounts for 85% of total rice. The state contributes around 12% of total all India rice production. The other major crops of the state are rapeseeds, potatoes, gram and wheat.

Methodology:

1. ***Ground truth data***:
Sites for rice and other crops grown in the district were marked on 1:50000 scale topographic maps of the area. Information on crop stage, percent ground cover, probable harvest date etc. were filled in a GT Performa. GT sites for different rice growing environments has been taken into account.

2. ***Georeferencing:***

- Location of ground control points (GCPs) identifiable in the image and the corresponding topographic map and obtain image co-ordinate.
- Digitizing corresponding GCPs on the map to obtain geographic co-ordinate.
- Feeding this information to lat-long information provided in the header of digital data to obtain a transformation equation between image and map co-ordinates (Sharma, 1992).
- At the time of final image registration we have used UTM 45R E010 projection system.

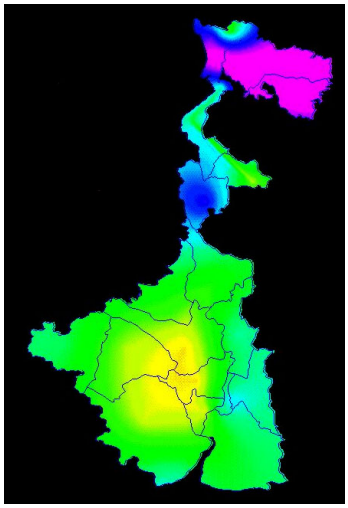
3. ***Backscattering Analysis***:
SAR data analyzed to derive different parameters used to develop the classification method:
    - Backscattering Coefficient ($\mathbf{S^0}$)
    - Texture

First an edge-preserving filter (Gamma) is performed on the image in order to significantly reduce the speckle within the image. It has shown

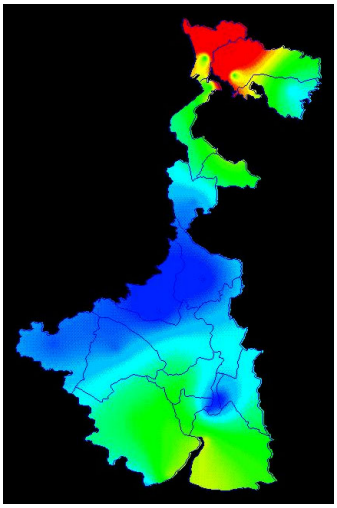
that at flowering stage of crop estimated $\mathbf{s^0}$ showing homogeneous pattern. So flowering stage of rice crop is the suitable stage for this type of analysis. At each known GCP point s^0 has been estimated. We have created different zone on the basis of crop species, rainfall distribution, and temperature distribution. For each zone, we have build up a logical model depend on s0 from known GCP points.
Each model runs using EASI/PACE software for each zone with given particular gray level value for kharif rice crop. Corresponding to each gray level value the number of pixels under the value multiplied with the image resolution is the desired acreage of the crop.

Results and Discussion:

The RADARSAT data has been taken for 1998 kharif rice estimation. It has shown that at flowering stages (July, August, September)SAR data is very much suitable for Backscattering Analysis. Total 120 known GC points has taken and at that point Backscattering coefficient has been estimated.

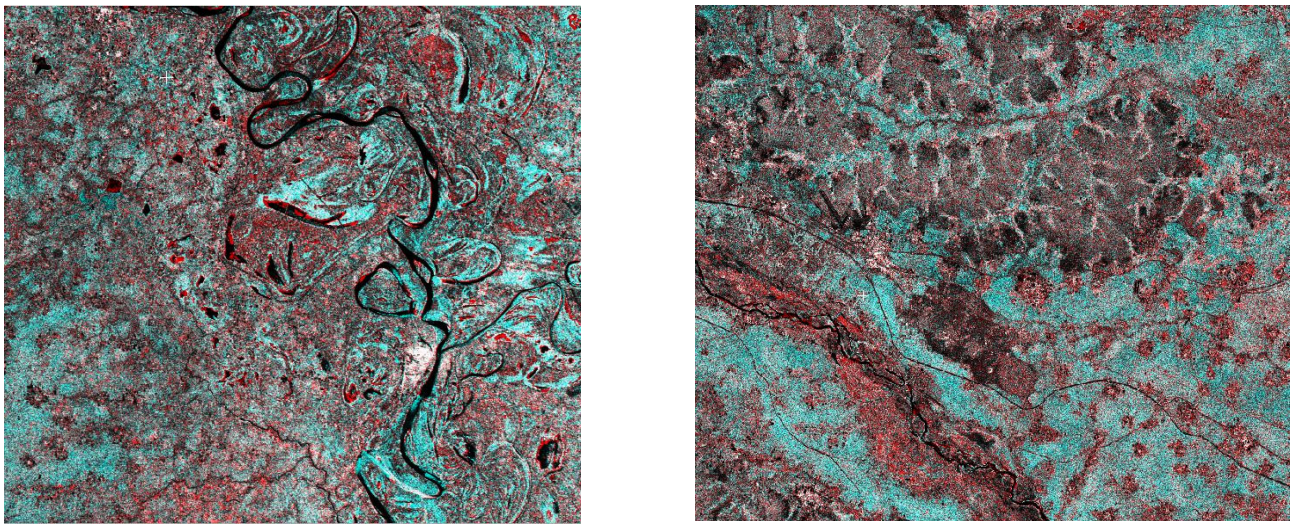


Khariff season Rainfall distribution pattern with district boundary

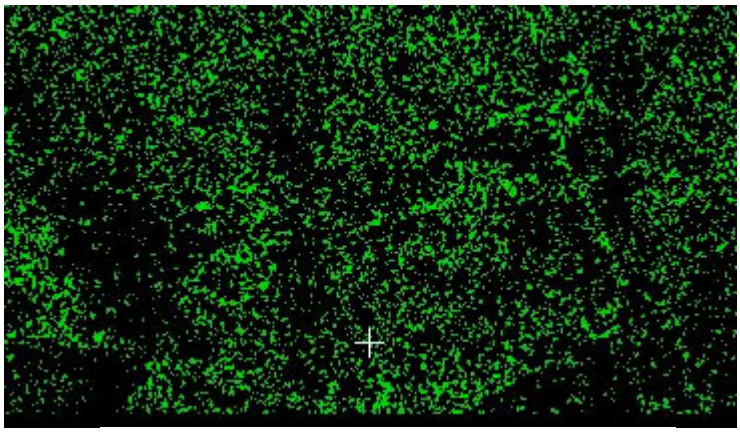


Khariff season mean temperature distribution pattern with district boundary

Zoning the state has been done on the basis of Khariff seasonal temperature and rainfall distribution and also species variety has been taken into consideration. We got 5 zone in the entire state and for each zone different logical model (if-else) has been generated. Zoning analysis has been done using ARC/INFO software and spatial Model run through EASI/PACE software.



RADARSAT Scan SAR Narrow data of
July 1998 part of Bardhaman District



Distributed Kharif rice derived from SAR
data using Logical Model based on
Backscattering coefficent.

WEST BENGAL: KHARIF RICE ACREAGE FORCAST (1998)	
DISTRICT	**ACREAGE('000ha)**
Bankura	**400.21**
Bardhaman	**431.87**
Birbhum	**323.59**
Coochbehar	**238.58**
Darjeeling	**38.91**
E-Midnapur	**307.92**
W-Midnapur	**539.40**
Hooghly	**197.73**
Howrah	**71.60**

Jalpaiguri	**268.42**
Murshidabad	**277.00**
Purulia	**314.57**
W-Dinajpur	**385.81**
Malda	**190.08**
Nadia	**198.54**
24 Parganas	**501.15**
State	**4685.35**

After running the zone wise model we have aggregated the spatially distributed Kharif rice for entire west Bengal State. District wise Kharif rice acreage has estimated by supper imposing the district boundary on model output image. State acreage showed an increase by 3.5% as compared to BES estimate in 1998.

Comparison of results:

The acreage thus obtained were compared with the final estimate figures provided by Bureau of Applied Economics and Statistics (BAES), West Bengal for the year 1998-99. The relative deviation (RD) was calculated as given by (Houston et. Al. 1983).

$$RD\% = (RS- BES) / RS \times 100$$

State acreage showed an increase by 3.5% as compared to BES estimate in 1998

Conclusion:

Rice is the dominant crop in almost all districts during the Kharif seasons and was found in large areas. Hence very good GT sites were obtained in all districts. These sites were used for backscattering Analysis. The over all accuracy of rice crop estimation is 88%.

References:

1.sabins, F.F. 1983. Geologic Interpretation of Space Shuttle Radar Images Of Indonesia. AAPG Bulletin, Vol.67.

2.Tom, C.,L.D. Miller and J.W. Christenson. 1978. Spatial Land-use Inventory, Modelling and Projection: Denver Meropolitan Area with Inputs from Existing Maps, Airphotos and Landsat Imagery. NASA Technical Memorandum 79710. Greenbelt MD: Goddard Soace Flight Center.

3.Roberts, D.A., M.O. Smith and J.B. Adams. 1993. Green Vegetation, Nonphotosynthetic Vegetation and Soils in AVIRIS data. Remote Sensing of Environment, Vol.44
4.Simpson,Robert. B. 1996. Radar, Geographic Tool. Annals, Association of American Geographers. Vol.56.
5.Jensen, H.,L.C. Graham, L.J. Porcello and E.M. Leith. 1977. Side-Looking Airborne Radar. Scientific American, Vol.237.