SUGAR_GIS

From a user perspective

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Cane Development Manager

What is Sugar_GIS?

- A web-based, decision support tool.
- Provides spatial distribution of a wide range of sugarcane production data in an easy to use and sensitive way.
- Based on specific plot recommendations.
- More objective reporting.
- Accuracy of crop estimation.
- Cane variety assessment.
- A one-stop shop for plot information.
- Accuracy and timely assessment of crop and infrastructure.

History of Sugar_GIS

- 2003 - a humble beginning with verification of farm coordinates.
- 2011 - further developed as a project in 2011 with 60/40 co-funding with the EU.
- 2014 – launch of Sugar_WebGIS portal.
- Since then – data cleansing, farm geo-ref, plot ID.

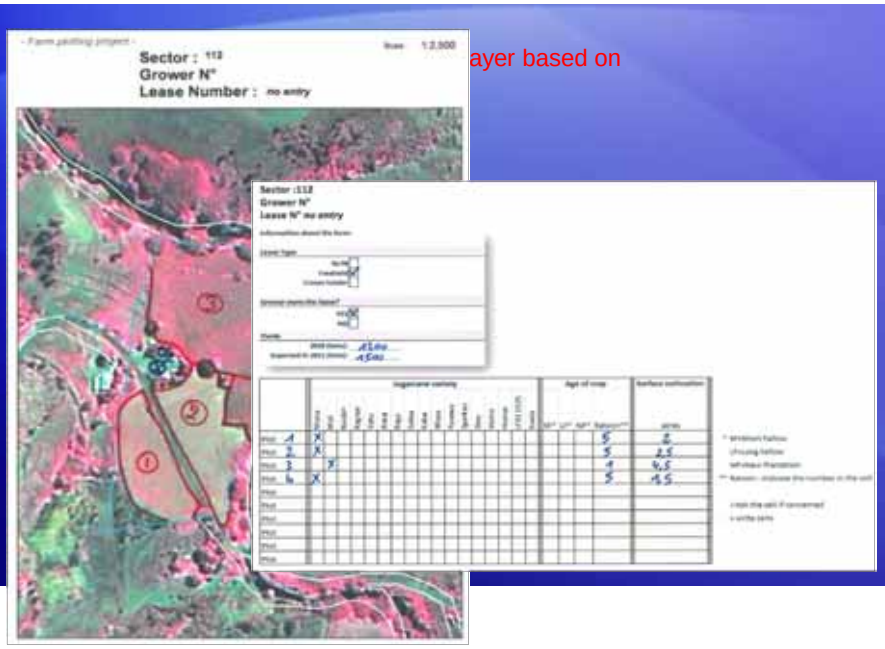
Major Areas Of Intervention

- Cleansing the existing GIS database.
- Developing the use of remote sensing in order to follow and manage field activities and monitor sugar cane growth (in combination with the use of agrometeorological models).
- Developing a web-mapping application to ease decision making processes.

Requirements

- Use of satellite or radar imagery, in order to strengthen these models with a regular vision of what is happening on the ground.
- Based on digitalized maps and the extensive data base built up by FSC over the years.
- Geo-referencing of sugarcane farms.
- Establishing links to other databases.

Initial Field work



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SUGAR_GIS: Support For Decision Making

Crop Production

- Cane estimation
- Distribution of cane lands
- Cost of production
- Agrometeorology

Cane Logistics

- Cane distribution
- Infrastructure
- Cane flow
- Railway operations
- Modeling of various transport scenarios;
- Prospective assessment of the yearly production area;
- 'in real time' monitoring of the harvest;

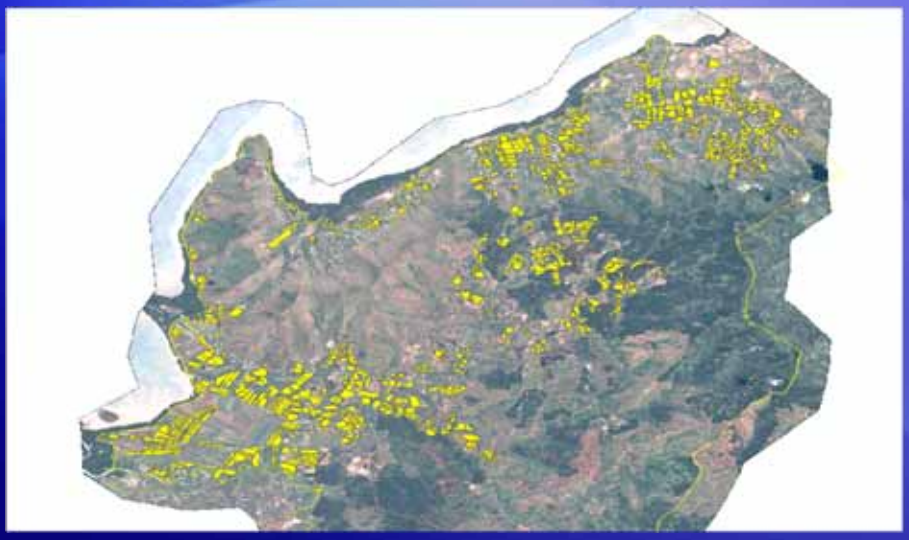
Cane Estimation

- Getting the area right is the key to accurate estimation.
- Initial field work required the identification of farm lease boundaries and registering of manageable plots for individual farms.
- Sugar_GIS is to be developed to evaluate expected production based on other key yield factors such as fertilizers, herbicides and meteorological inputs.

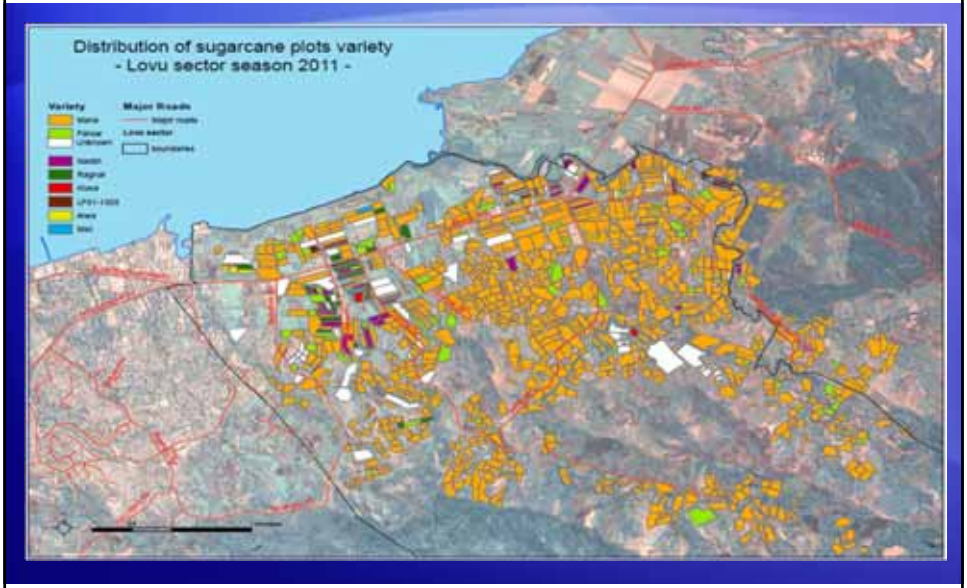
Seeing through new lens

With Sugar_GIS, sugarcane farmers now enjoy a better, informed view of their farm holding.

Distribution Of Cane Lands

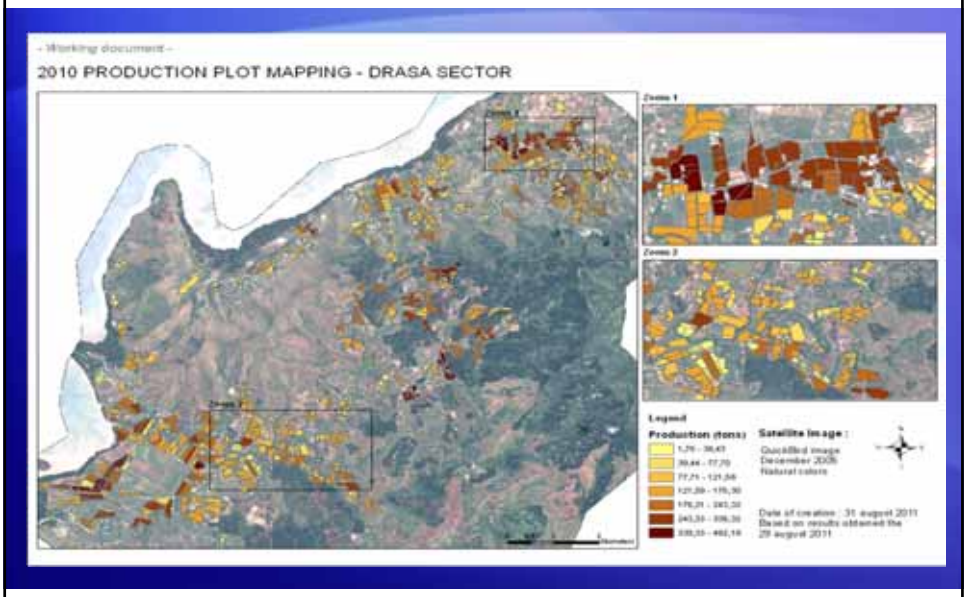


Distribution Of Cane Lands – By Cane Varieties

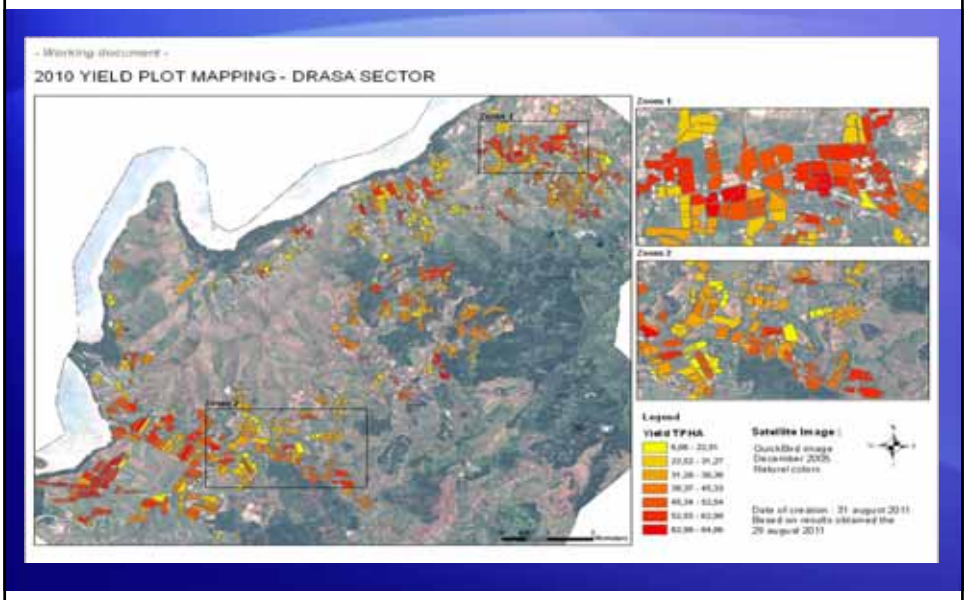


Distribution Of Cane Lands – By Crop Age

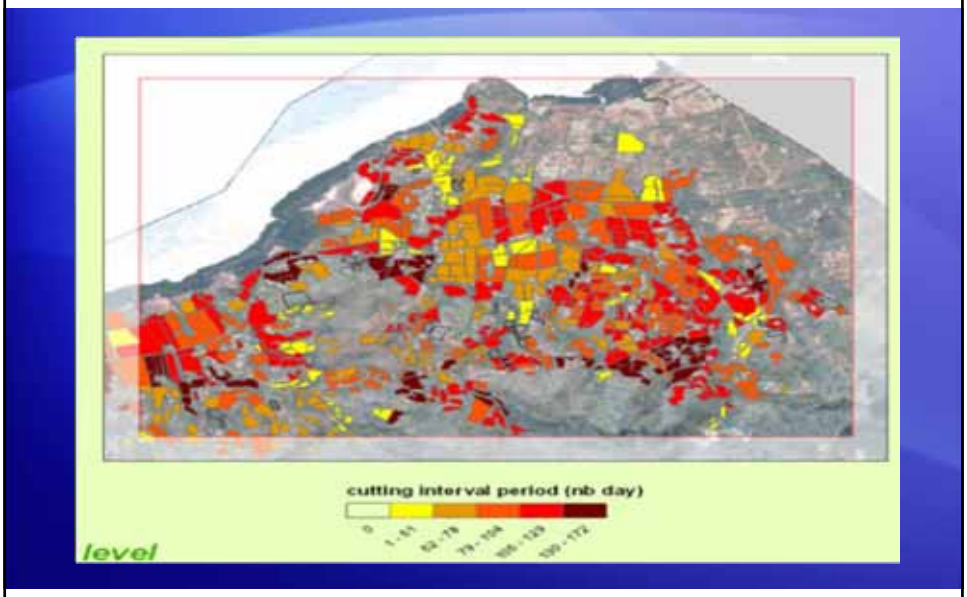
Distribution Of Cane Lands – By Production



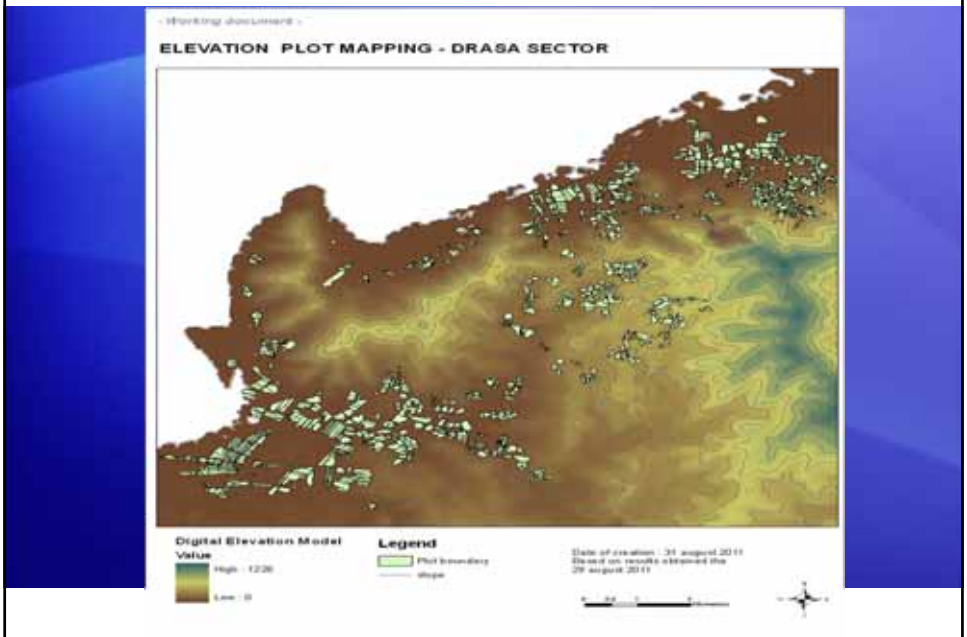
Distribution Of Cane Lands – By Yield



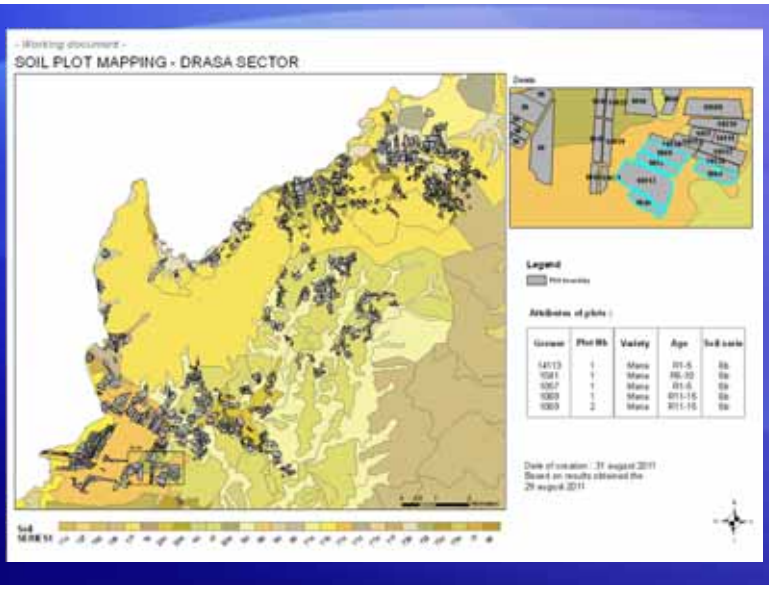
Distribution Of Cane Lands – By Harvest Interval



Distribution Of Cane Lands – By Elevation



Distribution Of Cane Lands – By Soil Series



Assessing Flood Damages

Flood event

Flood event caused by heavy rainfall from tropical depression
Western part of Vitu Levu on 24-25 January 2012

Satellite imagery

The use of SAR imagery (and especially TerraSAR-X) is the only possibility to acquire post-event data through permanent cloud cover.
No recent optical imagery of good quality available

Available radar and historical optical imagery

Radar

- New acquisition of TerraSAR-X StripMap image (2.5 m resolution) on 5/02/2012
- TerraSAR-X StripMap of 1/12/2011

Optical

- KOMPSAT (1m spatial resolution) of 3/09/2008
- SPOT (10m spatial resolution) of 06/02/2009

Assessing Flood Damages

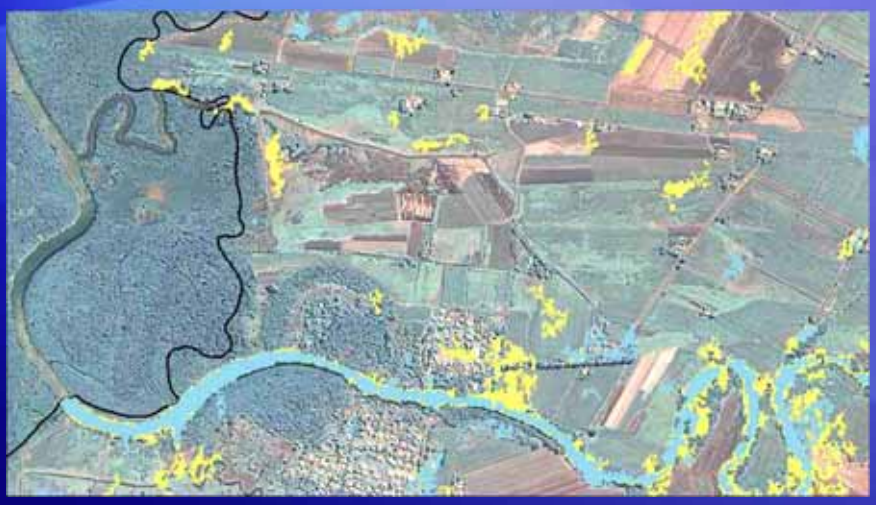
Findings

Standing water has a characteristic spectral signature in TerrraSAR-X images, and appears definitely black on the SAR image.

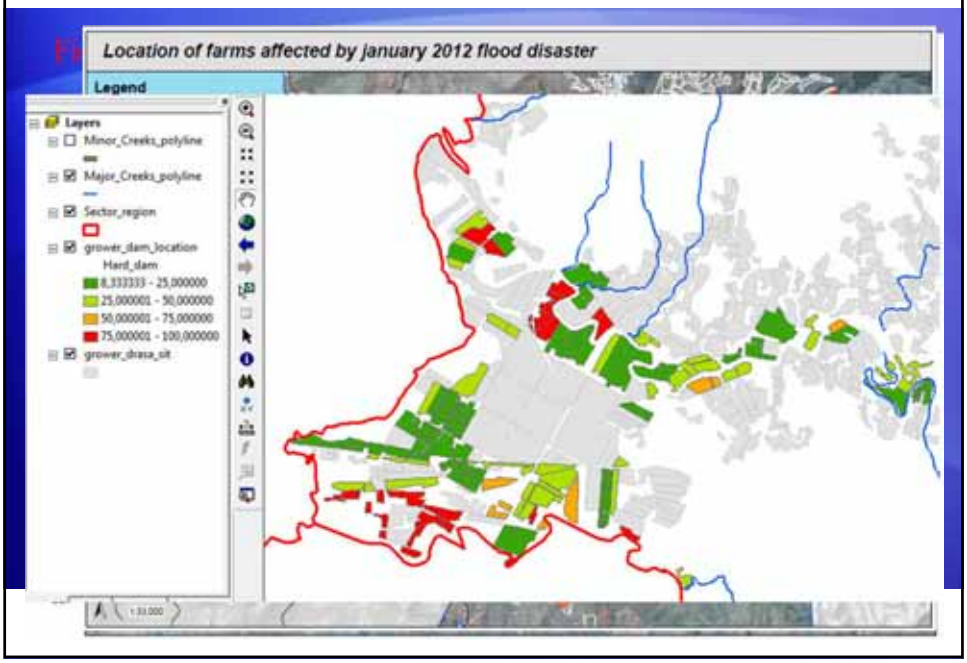
Humid zones could also be detected on SAR imagery, but analyses of temporal series combined with field work would be necessary.

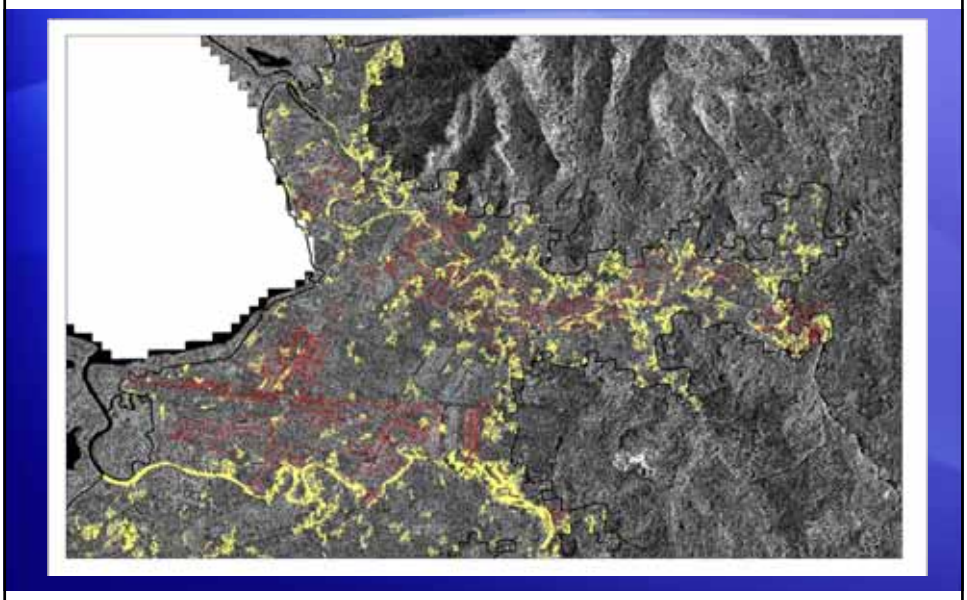
Assessing Flood Damages

Results for the study area



Assessing Flood Damages





Assessing Flood Damages

"Flooded" areas = standing water + probably humid zones (to be confirmed by field work!)

Total "flooded" area in 2011 (pre-event) = 1,896,458 m^2

Total "flooded" area 2012 (post-event) = 3,060,631 m^2

Total "flooded" area = 1,164,173 m^2

Change of total "flooded" area between 2011 and 2012 = 160%

Remarks

The programming of new SAR image (with adapted spatial resolution) should be done immediately after the flood event, or even before in case of heavy rainfall prediction. Delay depends on revisiting time of the satellite.

After the acquisition, rapid data delivery (24h) of the data should be possible on demand.

The necessary image processing for flood mapping (standing water) (pre-processing, segmentation, classification and refinement of pre- and post-event data) can be done semi-automatically in a short time.

The identification of humid zones would require the use of a multi-temporal series of SAR images and specific field work.

Monitoring Sugarcane Growth

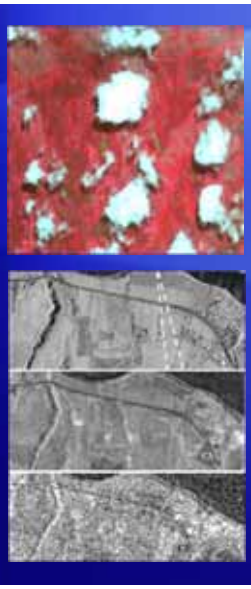
Needs of the sugar industry

To have information on the sugar cane growth throughout the season and to estimate crop development and forecast yields

Objective of the study

To investigate the potential of TerraSAR-X imagery (X-band) in monitoring sugar cane growth

Existing constraints



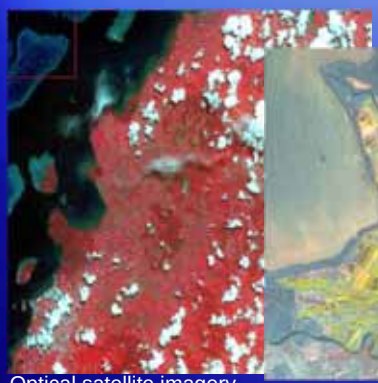
Difficult atmospheric conditions (cloud coverage)

- ✓ Limited use of optical images
- ✓ Solution = Radar/SAR images
  Day and night measurements
  Regardless of atmospheric conditions

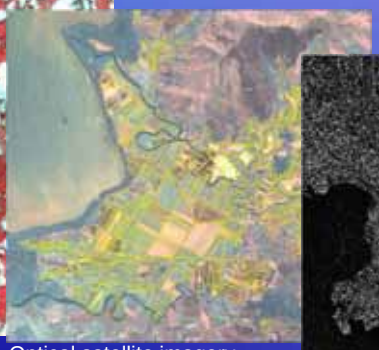
Very small sugar cane plots (avg size of 1 ha)

- ✓ High resolution imagery necessary or
  Spatial resolution around 3m

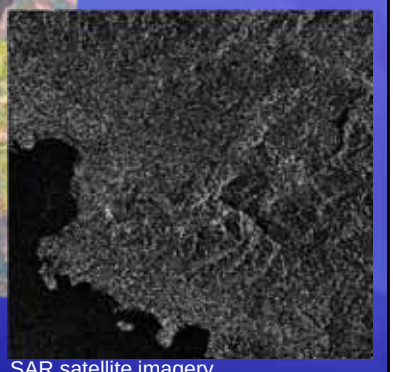
Satellite imagery – Optical and radar



Optical satellite imagery
SPOT

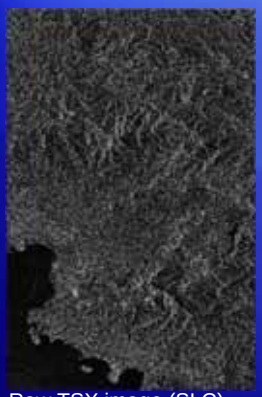


Optical satellite imagery
KOMPSAT + Plot boundaries

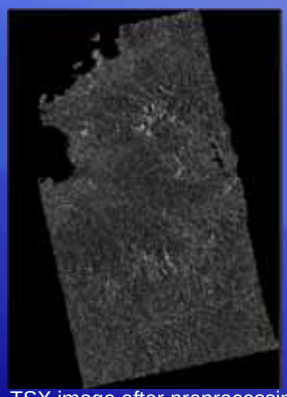


SAR satellite imagery
TerraSAR-X

Satellite imagery – Radar image processing (TerraSAR-X)

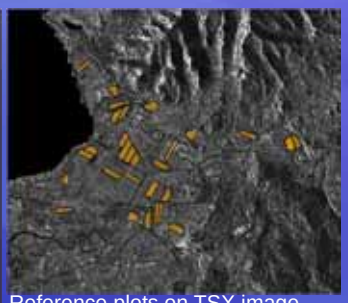


Raw TSX image (SLC)



TSX image after preprocessing

Multilooking–Terrain correction–Radiometric normalization – Speckle filtering



Reference plots on TSX image

Ground measurements and meteorological data

Ground measurements

General parameters
- ✓ Plot boundaries, homogeneity, relief & general characteristics
- ✓ Row direction, distance between rows, plant density
- ✓ Description of sugarcane (plant cane, ratoon, left over cane)
- ✓ Planting and harvesting dates

Vegetation parameters
- ✓ Sugar cane growth stage
- ✓ Crop height measurement
- ✓ Leaf Area Index (LAI)

Soil parameters
- ✓ Soil moisture content measurement
- ✓ Surface roughness

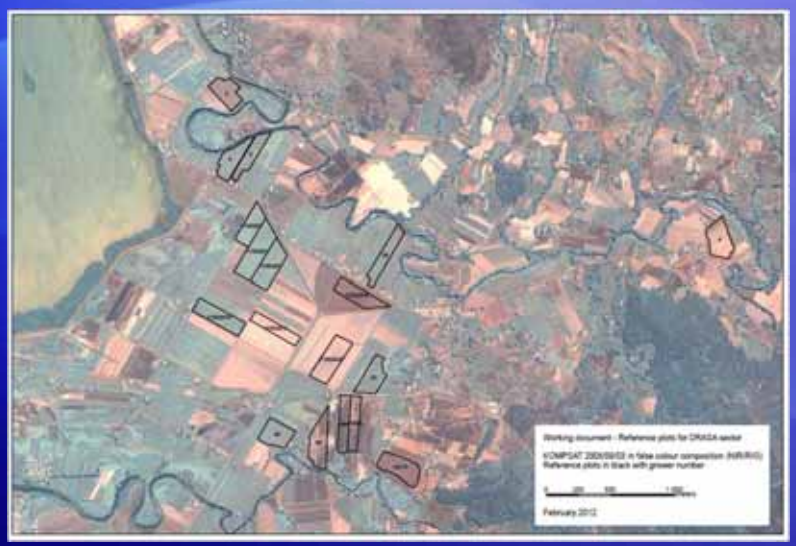
Meteorological data

- ✓ Daily rainfall and temperature data
- ✓ Contacts with Fiji Meteorological Service (FMS)

Field Work

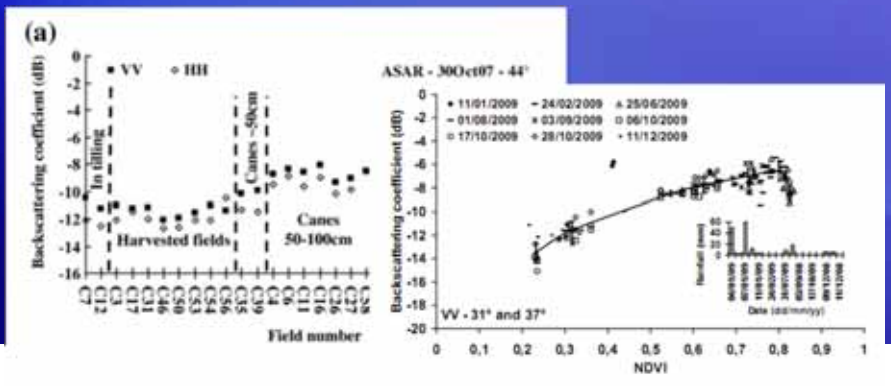
Enumerators conducting growth measurements and observations in the field.

Research Sites



Expected results

- ✓ Sensitivity of TerraSAR-X signal to sugar cane plots' characteristics
- ✓ Relationship between TerraSAR-X signal and sugar cane height
- ✓ Relationship between TerraSAR-X signal and NDVI
- ✓ Relationship between TerraSAR-X signal and LAI
- ✓ Sensitivity of TerraSAR-X signal to soil surface parameters



Outlook

Representative results for Sugarcane Belt

- ✓ Study area = representative situation of Fiji's "Sugar cane Belt"
- ✓ A large number of reference plots will be studied
- ✓ The results should be applicable to the whole Sugar cane Belt area

Cost of SAR imagery

- ✓ Today SAR imagery still expensive to use for operational monitoring
- ✓ Launch of numerous spaceborne SAR sensors (Sentinel1, …)
- ✓ Much more use of spaceborne SAR imagery in the future by a wide spectrum of users, software developments,…
- ✓ SAR imagery & processing promised to become less expensive

Prospects

- Sugar_GIS can be further enhanced to provide more dynamic support for better management of sugarcane production, its harvest and the overall organization of its transport-logistics to the mills.
- Define a series of dynamic real-time performance indicators and develop the necessary web-mapping tools to do so.
- The Sugar_GIS should facilitate direct access (according to access rights and priorities) to the stored data (either to view or generate specific maps/tables/reports) and allow to update specific data fields or layers (if access to do so is granted).

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