SUGARCANE
(Saccharum officinarum)

A species of a tall perennial true grass under the genus Saccharum; main source of sugar in all tropical and subtropical countries of the world.

In the Philippines a significant industry contributing USD1.7 billion annually through raw sugar, molasses & bioethanol production.

providing livelihood to about 58,996 SUGARCANE FARMERS
Can we monitor the growth and health of sugarcane through geospatial products?

Can we help the farmers in obtaining better sugarcane yield?

“YESS”
UP–SRA Yield Estimation System for Sugarcane (YESS)

To generate rapid, realistic and science-based estimate on municipal and farm-level annual cane production

Yield-estimation Products

To generate and automate RS-GIS products for crop growth & health monitoring

Growth Monitoring Products
YESS Growth Monitoring Products

UAV Orthophoto and NDVI Map
Germination  
Tillering  
Grand growth  
Maturity
**Data Source:** Landsat, MODIS

**Application:**

- **Landsat NDVI** - for monitoring the presence and greenness of the sugarcane crop.
- **MODIS NDVI** - to visualize an extended temporal trend of sugarcane cultivation and to detect the start, end, and length of the cropping season.

**Development:**

**Landsat NDVI**
1. Landsat Downloading & Preprocessing
2. Clipping of sugarcane plots
3. NDVI Generated in ERDAS

**MODIS NDVI**
1. MODIS Download (MOD13Q1)
2. Savitsky-Golay Filtering
3. Clipping of sugarcane plots
4. Time-series NDVI

The NDVI formula is given by:

\[ NDVI = \frac{R_{NIR} - R_{Red}}{R_{NIR} + R_{Red}} \]
MODIS NDVI time series (7 years) in Tarlac Mill District
Data Source: MODIS 16 days composite & MODIS 8 days composite

Application:
Useful in determining the crop type (whether a cane is planted or a ratoon) which has an effect on total yield production

Development:
Plant canes have higher standard deviation during the grand growth stage as highlighted
Standard deviation of ratoon crops during the establishment period is more constant

temporal spectral differences

Image classification
Data Source: Landsat

Application:
Can be used to compute the total area of harvestable canes; determining the remaining standing canes when generated during the harvest period.

NDVI: Bands used are B5 and B4 (L8). This index is an indicator of plant health or growth (Rahman et al, 2004).

SWIR BANDS: When combined with B5 (NIR), bands 6 & 7 can provide better estimation of vegetation water content (Ceccato et al, 2002).
Yield-forming to Mature Cane Map

Sample Output: Yield-forming to Mature Cane Map for Tarlac Mill District as of Sep 2016
Sugarcane Area Estimate

**Data Source:** Sentinel 1 (SAR), SRA Sugarcane Shapefile

**Application:**
Can be used in determining the total area planted with sugarcane within a mill district, municipality or a specified farm location.
Sugarcane Area Estimate

Development:

Classification Process

1. Downloaded SAR data - 1 year stack (1 image per month)
2. Buffer and clip
3. Sum data bands - mean, standard deviation
4. Zonal Statistics (maximum of the mean, mean of std dev)
5. Validated shapefile (sugarcane plots)

Post Processing (Data Cleaning)

1. Classified Image
2. Sieve and dump
3. Merge classes
4. Majority/Minority analysis
5. Confusion Matrix
6. Validated shapefile (sugarcane plots)
7. ISODATA
8. Classified Image
9. Optional/If necessary: Accuracy Assessment
Sample Output: Tarlac and Bukidnon Classified Sugarcane Area

Classified Sugarcane in Bukidnon MD
Computed Area: 62,313 Ha
Accuracy: 87%

Classified Sugarcane in Tarlac MD
Computed Area: 10,219.00 Ha
Accuracy: 78%
Cane Canopy Damage Map

**Data Source:** Sentinel 2

**Application:** Detect areas with low, moderate or high canopy damage in terms of crop fractional cover.

**Development:**

- Sentinel 2-A Download
- Extract level 1-C (ToA Ref)
- Computation for Bottom of Atmosphere Ref.
- Derive Fractional Cover
- Resample bands to 10 m resolution

**Steps:**

1. **Sentinel 2-A Download**
2. **Extract level 1-C (ToA Ref)**
3. **Computation for Bottom of Atmosphere Ref.**
4. **Derive Fractional Cover**
5. **Resample bands to 10 m resolution**

**Outputs:**

- Fractional Cover after Typhoon
- Fractional Cover before Typhoon
**Data Source:** Landsat

**Application:**
Burned cane maps highlight the burned area and burn severity of each sugarcane pixels.

Information on burned cane extent is significant in yield estimation models to calculate total sugar lost during harvest.
**Data Source:** Landsat

**Application:**
Burned cane maps highlight the burned area and burn severity of each sugarcane pixels.

Information on burned cane extent is significant in yield estimation models to calculate total sugar lost during harvest.

**Development:**

![Burned Cane Map](image1.png)

**dNBR (FEB-MARCH 2016)**
Data Source: Survey-grade UAV

Application:
- useful for monitoring growth status of canes in smaller plots
- for field validation of other products, e.g. burned cane areas and typhoon-damaged canes
Sample Output:
3D Model, Sugar Mill and Sugarcane Field, Bukidnon
PRODUCT WORKFLOWS

AUTOMATION IN ERDAS IMAGINE
(Ready to use models)

OUTPUT ➔ GEODATABASE

SRA-WEBGIS

Products: From SRA-YESS to SRA-WebGIS
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PRODUCT WORKFLOWS

AUTOMATION IN ERDAS IMAGINE
(Ready to use models)

OUTPUT ➔ GEODATABASE

SRA-WEBSITE

**PRODUCT WORKFLOWS**

**AUTOMATION IN ERDAS IMAGINE**
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**SRA-WEBSITE**
Products: From SRA-YESS to SRA-WebGIS

PRODUCT WORKFLOWS

AUTOMATION IN ERDAS IMAGINE
(Ready to use models)

OUTPUT ➔ GEODATABASE

SRA-WebGIS

SRA-WebGIS Platform
SUMMARY

Aside from the plot-level yield estimate, different growth monitoring geospatial products were developed for the YESS Project through a collaboration between experts, stakeholders and farmers.

Significance of the products:

**FARMERS** can now use the different RS-based products for monitoring their sugarcane plantation. This is vital for making management decisions such as application of fertilizers and determining the right harvest schedule.

**Sugar Regulatory Administration (SRA)** can utilize these products for drawing decisions and for intervention and support to farmers and mill districts with poor sugarcane growth and low estimated production.