JECAM: India-Bulandsahar_Hapur: Status

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\textit{December, 2020}
Site Description

- **Location**: Siyana Tehsil, Part of Bulandsahar and Hapur District (Uttar Pradesh), India
- **Central Lon/Lat of Site**: 78.072 E, 28.615 N
- **Topography**: Slight undulating. Elevation in the study area varies between 109 to 191 m, with elevation gradients running in both North-South and East-West direction
- **Soils**: Young alluvial soils (entisols) with mild textural variations. Nearly 85% of the area has loamy texture
- **Drainage class/irrigation**: Well irrigated (Canals, tanks and bore-wells)
- **Crop calendar**: Kharif: Paddy, sugarcane, maize; Rabi: Wheat, vegetables, sugarcane
- **Field size**: 1-10 Ha.
- **Climate and weather**: Tropics, Hot Sub-humid, Annual precipitation (720 mm approx.)
## Site Description

### Average high °C (°F)

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan  (°F)</th>
<th>Feb (°F)</th>
<th>Mar (°F)</th>
<th>Apr (°F)</th>
<th>May (°F)</th>
<th>Jun (°F)</th>
<th>Jul (°F)</th>
<th>Aug (°F)</th>
<th>Sep (°F)</th>
<th>Oct (°F)</th>
<th>Nov (°F)</th>
<th>Dec (°F)</th>
<th>Year (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17 (63)</td>
<td>20 (68)</td>
<td>25 (77)</td>
<td>32 (90)</td>
<td>31 (88)</td>
<td>31 (88)</td>
<td>29 (84)</td>
<td>29 (84)</td>
<td>29 (84)</td>
<td>27 (81)</td>
<td>24 (75)</td>
<td>20 (68)</td>
<td>26 (79)</td>
</tr>
</tbody>
</table>

### Average low °C (°F)

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan  (°F)</th>
<th>Feb (°F)</th>
<th>Mar (°F)</th>
<th>Apr (°F)</th>
<th>May (°F)</th>
<th>Jun (°F)</th>
<th>Jul (°F)</th>
<th>Aug (°F)</th>
<th>Sep (°F)</th>
<th>Oct (°F)</th>
<th>Nov (°F)</th>
<th>Dec (°F)</th>
<th>Year (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>07 (45)</td>
<td>09 (48)</td>
<td>11 (52)</td>
<td>15 (59)</td>
<td>17 (63)</td>
<td>17 (63)</td>
<td>19 (66)</td>
<td>21 (70)</td>
<td>19 (66)</td>
<td>13 (55)</td>
<td>12 (54)</td>
<td>08 (46)</td>
<td>14 (57)</td>
</tr>
</tbody>
</table>

### Average precipitation mm (inches)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18 (0.7)</td>
<td>24 (0.9)</td>
<td>12 (0.5)</td>
<td>12 (0.5)</td>
<td>21 (0.8)</td>
<td>99 (3.9)</td>
<td>168 (6.6)</td>
<td>207 (8.1)</td>
<td>99 (3.9)</td>
<td>27 (1.1)</td>
<td>6 (0.2)</td>
<td>9 (0.4)</td>
<td>702 (27.6)</td>
</tr>
</tbody>
</table>
Project Objectives

Estimating Crop Area

- Complete mapping of the site (Covering all orchards and vegetable crops)
- Technique development for Area assessment and production forecasting of the various horticulture crops

Monitoring Phenological Events

- Vegetative Growth
- Flowering
- Fruit Development
- Maturity
- Phenology of Fruit Orchards
- Age of Orchard

Assessment of Biophysical Variables

- Vegetation Indices (NDVI, EVI, SAVI, etc.)
- LAI (Leaf Area Index)
- Plant height
- Spectral Signature
- UAV based signature
The study site have wide variety of cropping pattern. The major horticulture crop in the site is mango. About 15% of the total geographical area of the site has been covered by mango orchards.
Mango Orchard Mapping LISS IV (5.8m) data and Object based Classification

LISS-IV data (04-May)  Mango orchard mapped
Mango orchards around Siyana town

Mango orchards overlaid on Sentinel-2 image of 14-Feb-2020
Random Forest Classification for Mango Orchard using GEE

<table>
<thead>
<tr>
<th>Class</th>
<th>Area (000 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mango Orchards</td>
<td>9.0</td>
</tr>
<tr>
<td>Fallow</td>
<td>38.3</td>
</tr>
<tr>
<td>Settlements</td>
<td>9.5</td>
</tr>
<tr>
<td>Water</td>
<td>0.2</td>
</tr>
<tr>
<td>Field Crops</td>
<td>29.5</td>
</tr>
<tr>
<td><strong>Total area</strong></td>
<td><strong>86.4</strong></td>
</tr>
</tbody>
</table>
Soil Indices

**Sentinel 2 MSI based soil indices**

- Generated using composite bands of June month
- Bare soil pixels could be identified in FCC as well as with high values of indices

\[
\text{Brightness index} = \sqrt{\left(\frac{B^2 + G^2 + R^2}{3}\right)}
\]
\[
\text{Colouration Index} = \frac{(R-G)}{(R+G)}
\]
\[
\text{Saturation Index} = \frac{(R-B)}{(R+B)}
\]

- These indices have been identified to show good correlation with SOC content of exposed soil

  Zhuo et al., 2008

- Also aids in studying the measure the thermal alteration of organic matter content of bare soil as well as help to identify the variability in soil-colouring constituents

  Lagacherie et al. 2007

An attempt for spatial mapping of soil quality or properties may be undertaken depending on the availability of ground collected soil samples during fallow period and associated RS data.
Crop and orchard monitoring using RS based indices

Sentinel-2 MS  
Date of Acquisition: 14 Feb 2020
Temporal profile of NDVI and LSWI from Oct, 2019 to Sep, 2020 for Young and Old Orchards
### NDVI multi-year profiles of old and young Mango orchards

<table>
<thead>
<tr>
<th>CLASS</th>
<th>NDVI2016</th>
<th>NDVI2017</th>
<th>NDVI2018</th>
<th>NDVI2019</th>
<th>NDVI2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLD1</td>
<td>0.54</td>
<td>0.39</td>
<td>0.43</td>
<td>0.49</td>
<td>0.54</td>
</tr>
<tr>
<td>OLD2</td>
<td>0.53</td>
<td>0.40</td>
<td>0.44</td>
<td>0.48</td>
<td>0.55</td>
</tr>
<tr>
<td>OLD3</td>
<td>0.55</td>
<td>0.40</td>
<td>0.46</td>
<td>0.48</td>
<td>0.55</td>
</tr>
<tr>
<td>OLD4</td>
<td>0.51</td>
<td>0.39</td>
<td>0.43</td>
<td>0.49</td>
<td>0.56</td>
</tr>
<tr>
<td>OLD5</td>
<td>0.49</td>
<td>0.43</td>
<td>0.42</td>
<td>0.48</td>
<td>0.54</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>NDVI2017</th>
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<th>NDVI2019</th>
<th>NDVI2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>YOUNG1</td>
<td>0.32</td>
<td>0.33</td>
<td>0.40</td>
<td>0.49</td>
<td>0.55</td>
</tr>
<tr>
<td>YOUNG2</td>
<td>0.50</td>
<td>0.56</td>
<td>0.63</td>
<td>0.66</td>
<td>0.65</td>
</tr>
<tr>
<td>YOUNG3</td>
<td>0.53</td>
<td>0.41</td>
<td>0.44</td>
<td>0.49</td>
<td>0.56</td>
</tr>
<tr>
<td>YOUNG4</td>
<td>0.43</td>
<td>0.38</td>
<td>0.36</td>
<td>0.45</td>
<td>0.55</td>
</tr>
<tr>
<td>YOUNG5</td>
<td>0.48</td>
<td>0.37</td>
<td>0.44</td>
<td>0.51</td>
<td>0.56</td>
</tr>
</tbody>
</table>

#### Old Age Mango

#### Young Age Mango
Multi-date SAR VV backscatter

15th July, 2020
12th August, 2020
12th September, 2020

Orchards

Rice
Hierarchical decision tree based classification – Orchard clusters (orange), paddy - green

About 17% is classified as orchard

Classified output based on SAR temporal datasets
Summary of Results

- Orchard mapping using Object based classification and Random Forest on Google Earth Engine
- Soil indices evaluated
- Temporal signatures of Old and Young Orchards studied.
- Preliminary orchard mapping attempted using temporal SAR dataset
Way forward

1) Correlation of Hyperspectral signatures of crops with satellite data and Crop signature library for the horticultural crops grown in the study area.

2) UAV based signature study for the horticultural crops.

3) Horticultural Crop Phenology monitoring.

4) Crop Biophysical parameter retrieval.

5) Technique development for horticulture crop yield assessment.

6) Exploring various types of SAR data for horticultural crop assessment.
Thank You.