Monitoring agricultural land usage and tree crop plantation on the riverside using remote sensing for

Narmada river conservation in central India

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Challenges for water conservation projects

1. River Restoration at a scale can be complex and expensive
2. Impact Measurement Metrics difficult to measure manually
3. Regulatory Policy making and Collective Participatory approach
Study Area

- Only three major rivers in peninsular India that run from east to west
- 1,312 km approx
- Crossing 19 districts in MP
- Analysed 12 districts
- 30 major dams including Sardar Sarovar (21 irrigation, 5 hydropower, and 4 multipurpose)

Narmada basin in State of Madhya Pradesh, India
Framework for river conservation monitoring

- River Basin Boundary
- Plantation Plan
- Geospatial AI/ML Engine
- Sentinel Imagery

- Water
- Tree density
- Drought
- Precipitation

- NDWI
- NDVI / SAVI
- NDDI
- Precipitation

FOR GOVERNMENT
- Policy Making
- Impact Analysis
- Monitoring
- Prioritising
Water Detection

Using water capacity alone for measuring impact can be misleading.

Weather conditions and drought index play a major role for the impact.
Water Detection

District wise water capacity

Water Capacity (%)
Tree Density Change Estimation Model

Sentinel-2 Images

Mean NDVI Image for 2018 rabi season

Mean NDVI Image for 2017 rabi season

ML Model Tuning

High Resolution Validation
Validation using High Resolution Imagery

- Location information collected from social media campaign
- High resolution data analysed over the span of 3 years for validation
- Validation data used for fine tuning and retraining the model
Model for Impact analysis

1. Variable selection

2. Variable Estimation

3. Tree Density Estimation

4. Change Detection

Dependent variable

Water

Tree density

Drought

Precipitation

\[ NDWI_1 = \frac{(G - NIR)}{(G + NIR)} \]

\[ \delta_{water, diff} = \frac{\sum_{Oct, Nov, Dec} water - \sum_{Oct, Nov, Dec} water}{18} \]

\[ NDVI = \frac{(NIR - R)}{(NIR + R)} \]

\[ \delta_{trees, diff} = \frac{\sum_{Oct-Dec} trees - \sum_{Oct-Dec} trees}{18} \]

\[ NDDI = \frac{(NDVI - NDWI_2)}{(NDVI + NDWI_2)} \]

\[ NDWI_2 = \frac{(NIR - SWIR)}{(NIR + SWIR)} \]

\[ \delta_{drought, diff} = \frac{\sum_{Oct-Dec} drought - \sum_{Oct-Dec} drought}{18} \]

\[ \delta_{precipitation, diff} = \frac{\sum_{July-Dec} precipitation - \sum_{July-Dec} precipitation}{18} \]
Delta change in tree density brings a 3-4 % change in water body area, which can be considered as significant considering the number of variables that can affect the water body surface area.
## Potential Success & Failures

### Part A: Failure District

<table>
<thead>
<tr>
<th>District Name</th>
<th>Trees Planted</th>
<th>Estimated Density</th>
<th>Estimated and Prediction deviation</th>
<th>Additional plantations cultivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Mawra</td>
<td>5089129</td>
<td>51700000</td>
<td>207.0482263</td>
<td></td>
</tr>
<tr>
<td>1 Narsinhapur</td>
<td>5042319</td>
<td>38500000</td>
<td>96.61948524</td>
<td>Additional plantations cultivated</td>
</tr>
<tr>
<td>2 Seoni</td>
<td>3270605</td>
<td>17300000</td>
<td>43.28239802</td>
<td></td>
</tr>
<tr>
<td>3 Jabalpur</td>
<td>4500167</td>
<td>20600000</td>
<td>23.99746242</td>
<td>Potential success</td>
</tr>
<tr>
<td>4 Dindori</td>
<td>3367201</td>
<td>8774495.512</td>
<td>-28.31318017</td>
<td>Potential success</td>
</tr>
<tr>
<td>5 Raipura</td>
<td>3510000</td>
<td>9188888.28</td>
<td>-31.16986027</td>
<td>Potential success</td>
</tr>
<tr>
<td>6 Barwani</td>
<td>2667815</td>
<td>6431014.09</td>
<td>-33.41602183</td>
<td>Potential success</td>
</tr>
<tr>
<td>7 Dhari</td>
<td>3881795</td>
<td>9153474.461</td>
<td>-35.89650897</td>
<td>Potential success</td>
</tr>
<tr>
<td>8 Sehore</td>
<td>2773155</td>
<td>3703323.22</td>
<td>-63.92676359</td>
<td>Potential failure</td>
</tr>
<tr>
<td>9 Hoshangabad</td>
<td>6200777</td>
<td>6909001.056</td>
<td>-71.18729568</td>
<td>Potential failure</td>
</tr>
<tr>
<td>10 Hens</td>
<td>3307201</td>
<td>1120261.765</td>
<td>-90.65441496</td>
<td>Potential failure</td>
</tr>
<tr>
<td>11 Dewas</td>
<td>4929985</td>
<td>492951.2722</td>
<td>-96.11700005</td>
<td>Potential failure</td>
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<tr>
<td>12 Ankapur</td>
<td>3389558</td>
<td>204964.7095</td>
<td>-98.38210361</td>
<td>Potential failure</td>
</tr>
</tbody>
</table>

### Part B: Success district in-depth analysis

<table>
<thead>
<tr>
<th>District Name</th>
<th>delta water</th>
<th>delta rain</th>
<th>delta drought</th>
<th>Estimated DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhar</td>
<td>27.463333</td>
<td>0.758196</td>
<td>0.000900</td>
<td>0.052195</td>
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<tr>
<td>Rasen</td>
<td>26.563333</td>
<td>0.365780</td>
<td>0.000900</td>
<td>0.083100</td>
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<tr>
<td>Barwani</td>
<td>24.253333</td>
<td>0.000000</td>
<td>0.425157</td>
<td>0.000000</td>
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<tr>
<td>Narsinhapur</td>
<td>17.543333</td>
<td>0.639485</td>
<td>0.759773</td>
<td>1.000000</td>
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<tr>
<td>Jabalpur</td>
<td>4.946667</td>
<td>1.000000</td>
<td>1.000000</td>
<td>0.470021</td>
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<tr>
<td>Dindori</td>
<td>2.330000</td>
<td>0.679972</td>
<td>0.905116</td>
<td>0.078317</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Categorization logic</th>
<th>Precipitation</th>
<th>Trees</th>
<th>Drought</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant</td>
<td>&gt; 0.3</td>
<td>&gt; 0.4</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>Not significant</td>
<td>&lt; 0.3</td>
<td>&lt; 0.4</td>
<td>&gt; 0.5</td>
</tr>
</tbody>
</table>

### Actual Trees Planted

- **Model coefficient**: 3.6916
- **Adjusted R2**: 0.4734
For districts Devas, Sehore, Harda and Hoshangabad, on the bank of the river farmers grow majorly rice, wheat and soybean. Because of this reason plantation was executed quite far from the river bank which is very evident from our analysis that impact was less.

- Change in tree density has a positive change in water body area in Jabalpur, Seoni, Narsinghpur and Mandla.
What do we do at CropIn using AI & ML
CropIn Technology Solutions is a leading "Full-Stack AgTech" organization that provides SaaS solutions to agribusinesses globally. CropIn enables its clients to analyze and interpret data to derive real-time actionable insights on standing crop, thus enabling businesses to utilize technology to effectively drive their initiatives around **Digitization, Compliance, Sustainability, Predictability and Traceability**.

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**FARM MANAGEMENT SOLUTION**

An award winning, robust and flexible farm management solution which empowers data-driven decision-making, and provides complete visibility of resources, processes and performance on the field

**smartrisk**

**AGRI BUSINESS INTELLIGENCE SOLUTION**

A **market intelligence** solution that leverages agri-alternate data and **satellite image analytics** for effective production monitoring and risk forecast

**mwarehouse**

**PACKHOUSE SOLUTION & TRACEABILITY**

A packhouse solution to monitor post-harvest processes and trace the journey of crop from farm to shelf

**smartsales**

**INPUT CHANNEL MANAGEMENT SOLUTION**

CRM and input channel management solution to forecast and improve sales

**acresquare**

**POWER OF TECHNOLOGY FOR YOUR FARMERS**

Interact with the farmer even when you are not there at his farm
THANK YOU

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