Pakistan Agriculture

• Pakistan is a country of diverse agro-climatic regions. The climate is predominantly arid to semi-arid

• Agriculture occupies pivotal position as it contributes 21% of GDP and provides employment to 45% of labor force

• The main focus of the Government in agriculture has been on addressing the issues of nation’s food security
Pakistan - Agriculture

- Geographic area 79.6 m ha
- Cropped area 23.7 m ha
- Major Crops
  - Wheat 9.1 m ha
  - Cotton 3.1 m ha
  - Rice 2.9 m ha
  - Sugarcane 1.0 m ha
  - Maize 1.1 m ha
- Minor Crops
  - Fruits 0.8 m ha
  - Vegetables 0.4 m ha
  - Pulses 1.5 m ha

Demography 2010 - 11

<table>
<thead>
<tr>
<th>Region</th>
<th>Geographic Area</th>
<th>Cropped Area</th>
<th>Cultivable waste</th>
<th>Forest Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>KHYBER PAKHTUNKHWA (million Hectare)</td>
<td>10.17</td>
<td>1.68</td>
<td>1.93</td>
<td>1.32</td>
</tr>
<tr>
<td>PUNJAB (million Hectare)</td>
<td>20.63</td>
<td>16.96</td>
<td>1.56</td>
<td>0.49</td>
</tr>
<tr>
<td>SINDH (million Hectare)</td>
<td>14.09</td>
<td>3.83</td>
<td>1.38</td>
<td>1.63</td>
</tr>
<tr>
<td>BALOCHISTAN (million Hectare)</td>
<td>34.72</td>
<td>1.30</td>
<td>3.93</td>
<td>1.36</td>
</tr>
</tbody>
</table>

Source: Economic Survey of Pakistan 2012-13
Sectoral Share in GDP (%)

Agriculture: 20.9%
Services: 53.3%
Industries: 25.8%

Source: Economic Survey Of Pakistan

Monitoring of Crops through Satellite Technology

- In 2005 Government decided to invest in advanced technologies for collecting spatial information on agriculture. The purpose was to address short comings of the prevalent system. These included inordinate time lags in provision of estimates and their quality.

- SUPARCO, the National Space Agency, was assigned the responsibility to develop a satellite based system for crop area, yield and production estimation in collaboration with Food & Agriculture Organization of UN.
Pilot Project Coverage

FAO Mission
(09 – 13 MAY 2005)

- Make a pragmatic beginning and expand, after gaining experiences
- Emphasis be made on transfer of technology from expatriate sources and within country
- Cover Khyber Pakhtunkhwa and Balochistan
- Expand coverage in Punjab and Sindh progressively
- Involve stakeholders – PMD, FBS & CRS proactively
Stakeholders

- MINFAL: Crop Wing & Economic Wing
- Federal Bureau of Statistics (FBS)
- Pak Meteorology Department (PMD)
- Punjab: Crop Reporting Service
- Sindh: Crop Reporting Service
- NWFP: Crop Reporting Service
- Balochistan: Crop Reporting Service
- AJK: Agriculture Department

UTF/PAK/101/PAK

- Consultant Services
- Trainings
- Technical Audit of the technology
Crops Coverage (2013)

Wheat  Cotton  Rice  Sugarcane
Maize  Tobacco  Potato

Crop Area Estimation

- Development of Area frame
  - Stratification
  - Probability proportion based
  - Working Raising Factor (RF)
  - Seasonal Ground Truthing
- Image classification
  - Crop calendar
  - Acquisition schedule
  - Processing of Satellite imagery
  - Development of spectral signature
  - Classification (Supervised)
- Field Intelligence
Area Frame Sampling System in Pakistan

• SUPARCO uses satellite based area frame sampling, a fully operational system for the estimation of crop areas, the system is in place since 2007.

• The Satellite Based Area Frame technique use a three stage stratification process to delineate homogenous areas in order to use statistical inference to estimate crop areas.

  • Stratification makes it possible to produce more accurate estimates by reducing variability between samples.
  • These statistical procedures are all part of a scientific probability survey system SUPARCO has implemented.

<table>
<thead>
<tr>
<th>Strata</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Intense Cropland Area (75-100 % Cropland)</td>
</tr>
<tr>
<td>12</td>
<td>Less intense crop land (50-75 % Stratum)</td>
</tr>
<tr>
<td>21</td>
<td>Cropland Pasture Mixed (25-50 %)</td>
</tr>
<tr>
<td>42</td>
<td>Mostly Pasture (25 % cropland)</td>
</tr>
<tr>
<td>13</td>
<td>Un-identified seasonal vegetation</td>
</tr>
<tr>
<td>14</td>
<td>Areas rarely under vegetation</td>
</tr>
<tr>
<td>31</td>
<td>Rural area around11 d city (Less that 50 houses / Km2 )</td>
</tr>
<tr>
<td>32</td>
<td>Inter city</td>
</tr>
<tr>
<td>50</td>
<td>Non farmland (Desert, Forest, Saline, establishments)</td>
</tr>
<tr>
<td>60</td>
<td>Water bodies (Rivers, Canals)</td>
</tr>
</tbody>
</table>

Design & Testing Sampling Strategies

• To substantiate the satellite based image classification system

• The spatial distribution of sampled segments as laid down by standard statistical/remote sensing techniques.
## Crop Calendar

<table>
<thead>
<tr>
<th>Crop</th>
<th>Region Type</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>Central Plain</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Northern Plain</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Punjab</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sindh</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Baluchistan</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
<td>1</td>
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</tr>
<tr>
<td></td>
<td>Gilgit Baltistan</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>FATA</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

## Satellite Imagery Coverage for Rabi 2011-12

### 2nd Acquisition

Date: 08 Mar 2012

### Summary

<table>
<thead>
<tr>
<th>Province</th>
<th>Total</th>
<th>Food</th>
<th>Horticulture</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sindh</td>
<td>39</td>
<td>33</td>
<td>6</td>
<td>8</td>
<td>70</td>
</tr>
<tr>
<td>Punjab</td>
<td>79</td>
<td>61</td>
<td>8</td>
<td>15</td>
<td>163</td>
</tr>
<tr>
<td>KPK</td>
<td>10</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>Baluchistan</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>135</td>
<td>110</td>
<td>25</td>
<td></td>
<td>270</td>
</tr>
</tbody>
</table>

### Legend

- Agriculture Mask
- SPOT Grid
Ground Survey Data Collection System

- Improvement of data transmission of ground truth information through use of smart phones based on Android platform.

**Mobile Application Interface**

**Database management**

Satellite Image Classification
Satellite Image Classification

Purana Dero (Jatoi Farm)

Satellite Image
16-02-2010

Wheat

Classified
Crop Yield Forecasting

Estimation Approach

- Crop yield is a major component for the crop production forecast and estimation in Pakistan.
- Statistical models are being used by SUPARCO for the estimation of the Yield. The following parameters are being incorporated on decadal basis in the model.
  - SUPARCO currently starts with CRS yield estimates and adjusts them based on remote sensing and GIS technologies.
  - Crop yield research at SUPARCO is currently focused on crop yield forecast modeling for early assessments and warning through monitoring of vegetation dynamics, agricultural inputs status.
  - This yield modeling component is based on the modular approach of FAO of the United Nations.

Vegetation Image Behaviour

Incoming light is preferentially absorbed (reflected) depending on plant physiology.

Species Photosynthesis Water Content
Crop Phenology

- Dating of crop stages
  - Starting Dekad
  - Peak Dekad
  - Ending Dekad

- Length of the Season
  - Length of Growth (Peak – Starting Dekad)
  - Sum of NDVI value for different time-periods

Crop Yield Modelling

- Remote Sensing
- Met. Station Data
- Fertilizer Statistics
- Irrigation Statistics
- Crop Statistics
- NDVI Image Processing
- NDVI Image Analysis
- Spatial Interpolation
- Agro-Climatic Analysis
- Monthly
- Districts
- Decadal
- Districts/Provincial
- Area
- Yield
- Production
Crop Conditioning Approach

Major crops are being continuously monitored by the PCI programme across the country for crop forecasting, yield & production estimation to ensure food security.

Activities: Improving Sampling Strategies

Pakistan-Developing Crop Mask proposal
Crop masking is a fundamental requirement in satellite remote sensing to conduct investigative research on crop forecasting /estimation of area distribution among all crops in both Kharif and Rabi seasons.

Conducted study using both coarse and high resolution satellite data during peak crop growth season

This endeavor (by FAO and USDA, executed by SUPARCO) will bring up the specific crop masks per province, designed for varying requirements rather than one crop mask under use for all seasons and crops.

Objectives
- Provide a mask showing distribution of different seasonal crops
- Understand the pattern of different main crops in response to market condition
- Extraction of crop statistics
- Study of floods, developing flood extent maps and damage need assessment.
- Assess the changes in agricultural land use
- Database on spatio-temporal variation of different crops for decision making
Activities: Improving Sampling Strategies

A reliable and up-to-date land cover database has been just completed by SUPARCO for Sindh and Punjab provinces. It provides:

- Description of the environment
- Information on land cover / use
- Baseline data on agricultural land
- Information to support the management of natural resources
- Information on human intervention on the land

The FAO methodologies and tools on land cover mapping were used to conduct the task, including one site trainings and backstopping missions by FAO experts in land cover databases production.

Land Cover of Pakistan

Interpretation keys

- Water bodies
- Dry land
- Wetland
- Forest
- Vegetation
- Agriculture
- Urban areas
- Pastures
- Velds
- Water bodies
Training Workshop on Crop Information Portal and GeoNetwork software. 20-31 Jan 2014.

FAO and SUPARCO organized a two week training workshop in Islamabad:
- Jan 20-23: Administrating the Crop Information Portal
- Jan 24-27: Using the Crop Information Portal
- Jan 28-31: GeoNetwork opensource software

Nineteen experts from Crop Reporting Services of Punjab, Sindh, Khyber Pakhtunkhwa and Baluchistan; from the Agriculture Universities of Tandojam and Faisalabad and from SUPARCO

Activities: Training Programs

Main training topics:
- **Crops Area Estimation**
  - Satellite based Area Frame Technique
  - Satellite Data Image Processing
- **Crop Yield Forecasting and Estimation**
  - Crops/Agri-Land Use Mask Development Techniques
  - Crop Phenology and Growth Stage Monitoring
  - Model Calibration matrices and analysis

Future trainings:
- 04 x Area Frame
- 02 x Yield modeling using Remote Sensing and GIS
- 03 x IT system maintenance/operation
- 01 x Training on Exogenous Shocks
- 01 x Market Outlook Improvement

Distance Learning:
- AF development
- Acreage/yield estimation
- Utilization of auxiliary information on Remote Sensing
Activities: Information dissemination and monitoring

- Project website
- Crop Information Portal
- Pakistan GLAM

http://pekko.geog.umd.edu/glam/pakistan/

Activities: Support to Universities

- University of Agriculture, Faisalabad (UAF)
  The university’s faculty comprises more than 500 teachers and accommodates over 5,000 students. University have a core staff educated in Remote sensing and GIS.

- Sindh Agriculture University, Tandojam
  The university is an academic complex of five faculties, two centers, one constituent college and Directorate of Advanced Studies and Research.

Established activities
- Computer hardware, software and setup
- Development of human resource and technical capacities
- Post set-up consultations
- Establish fully functional units able to provide valuable agricultural crop statistics derived from the integration of ground truth data and earth observation satellite systems
- Specialized short-term United States-based training (4 trainees)
- Technical training
**Activities: Technical Consultations & Reports**

- Pakistan: Advanced Training on Monitoring of Crops through Satellite Technology
- Pakistan: How SUPARCO Makes Crop Forecasts and Estimates based on integral use of RS data
- Punjab CRS: Base Line Survey
- Sindh CRS: Base Line Survey

**Information Sharing**

- Monthly crop bulletin (Pak-SCMS)
- Series of publications about rapid crop damage assessment (floods / droughts)
- Technical reports
Crop Damage Assessment Reports

SUPARCO is publishing reports, beneficial for disaster mitigation
Thank you