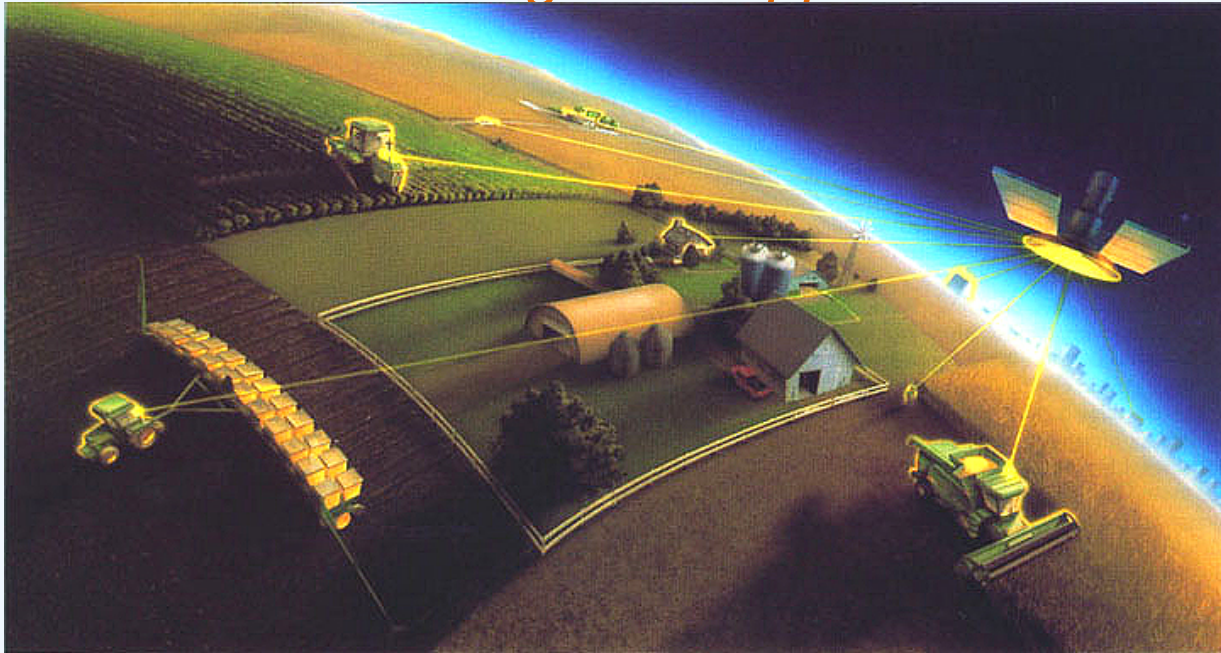


Synergy between GNSS and GIS Application for Monitoring Land use Production

An Integrated Approach



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Space Technology Applications Directorate
Pakistan Space and Upper Atmosphere Research Commission
(SUPARCO)

Outlines

- Rationale
- Introduction
- Integrated Approach
- Geospatial Technologies
- Application of GNSS
- Architecture and Design
- Sneak peak of Application
- Conclusion

Rationale

- Land development in countries with diverse physiography need technological interventions
- Pakistan's territorial landscape comprises, deserts, snow packed and dry mountainous ranges, arid and dry plateau, fertile agriculture lands and extensive man made irrigation system

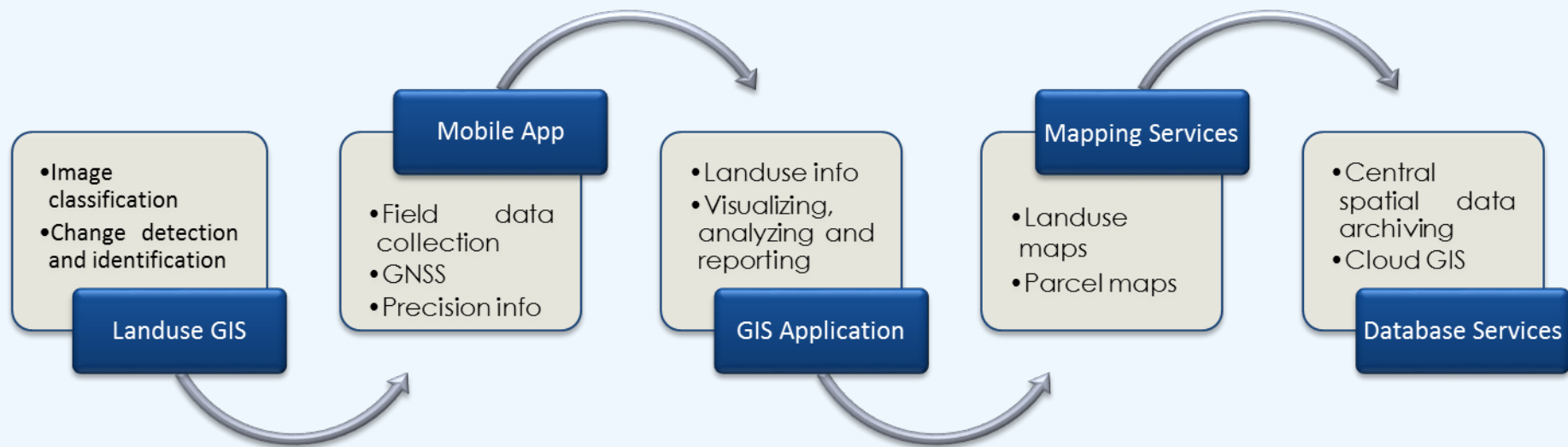
Introduction

- Geospatial technology is operational at macro and micro scales for land use planning and management in Pakistan
- Country level land use is being developed using remote sensing, GIS and GNSS technologies
- Technology is also in use at farm level for monitoring of agriculture land, crops and crop production

Integrated Approach

- Geospatial technologies for baseline mapping of land use and temporal changes
- Precision mapping through GNSS
- Location based real time dissemination of micro level (Farms) information
i.e. soil fertility, crop sown, crop production etc

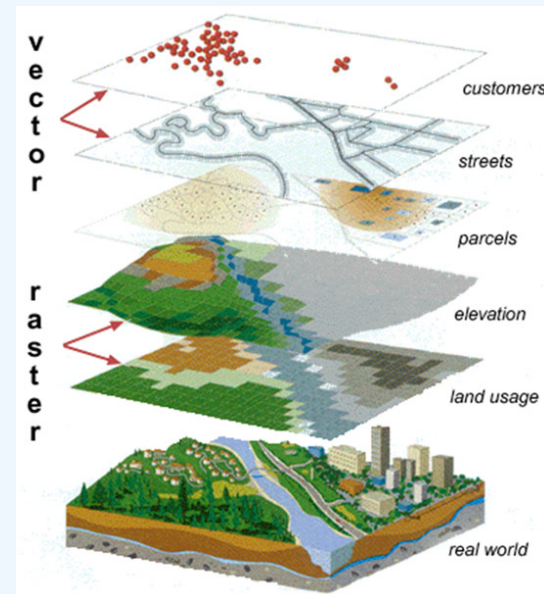
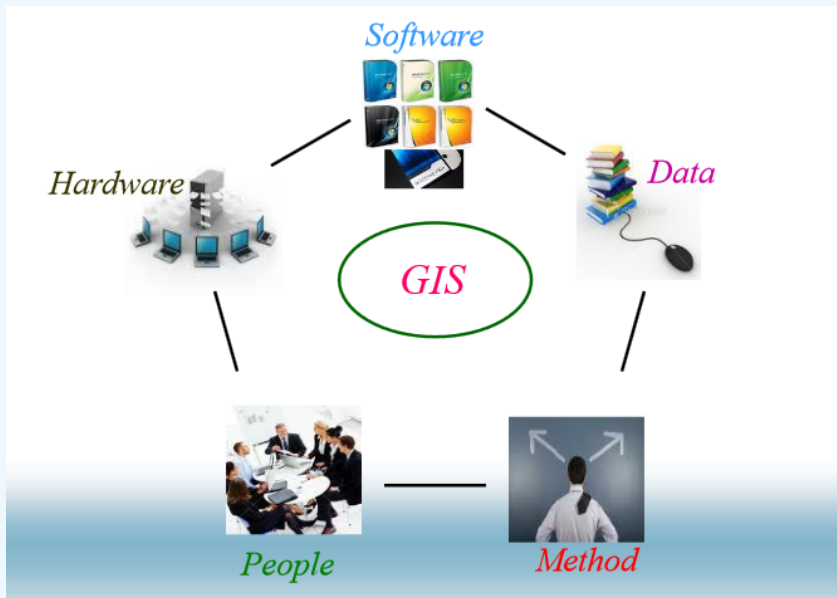
Integrated Approach



Geospatial Technologies

Geographic Information System (GIS)

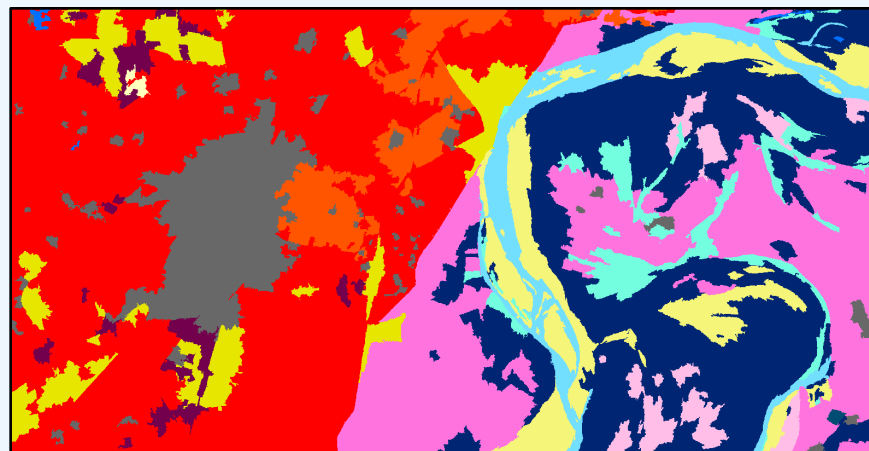
- To address 'which', 'what' and 'where', relationships and store auxiliary information on landuse for analysis





GIS Land use

"Land use is characterised by the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it" (FAO/UNEP, 1999)

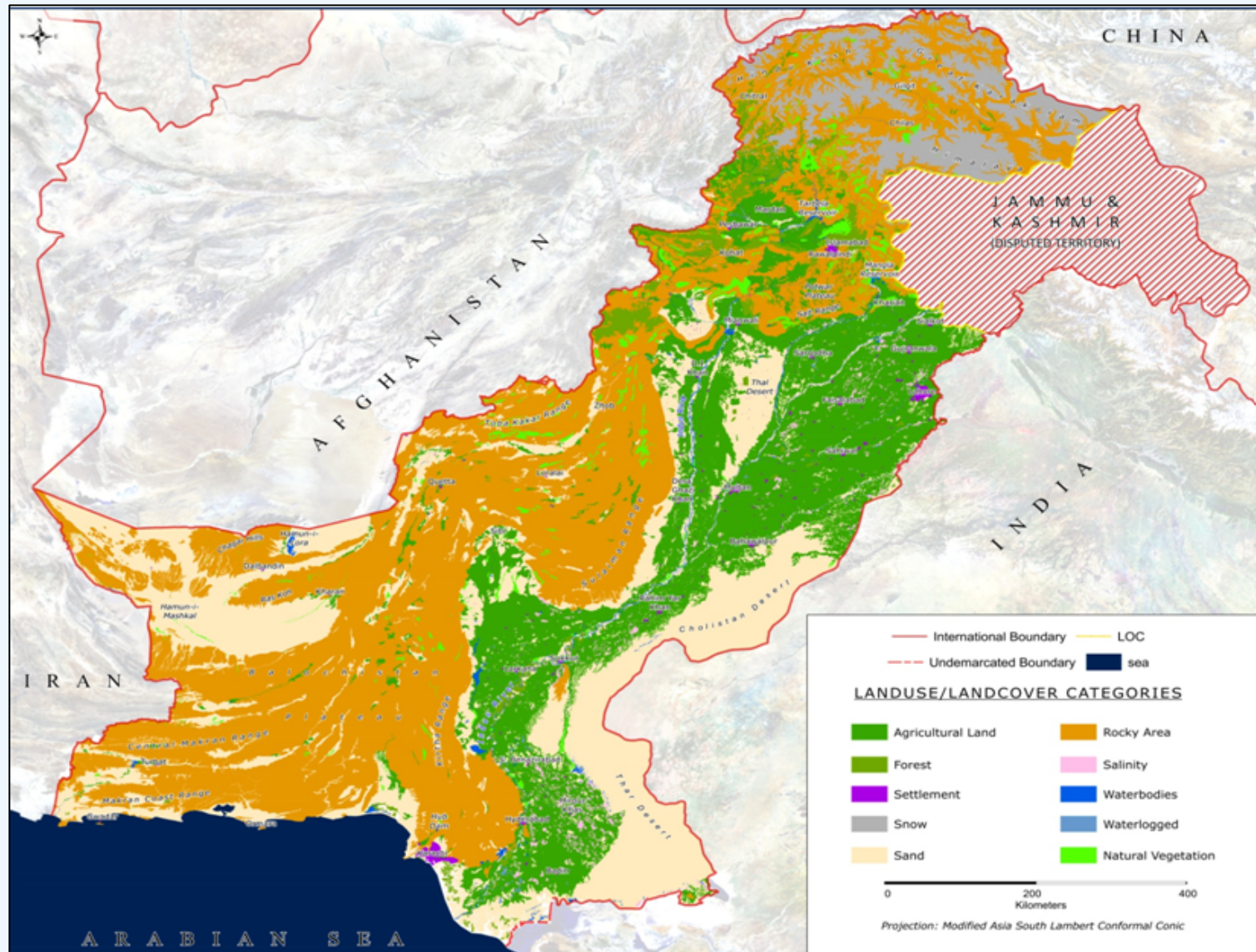


Legend

LCS3code	HCir	HCSL	Rp	SNcoW	SaW	TNo
BL	HCirFP	HCpf	SA	SNo	TCir	TNoW
BRSV	HCirS	HNco	SCir	SaD	TFP	WB
BU	HCRf	MN	SL	SaDNV	TNc	WLBA
GFNW	HCRfD	RB	SNc	SaFP	TNcW	

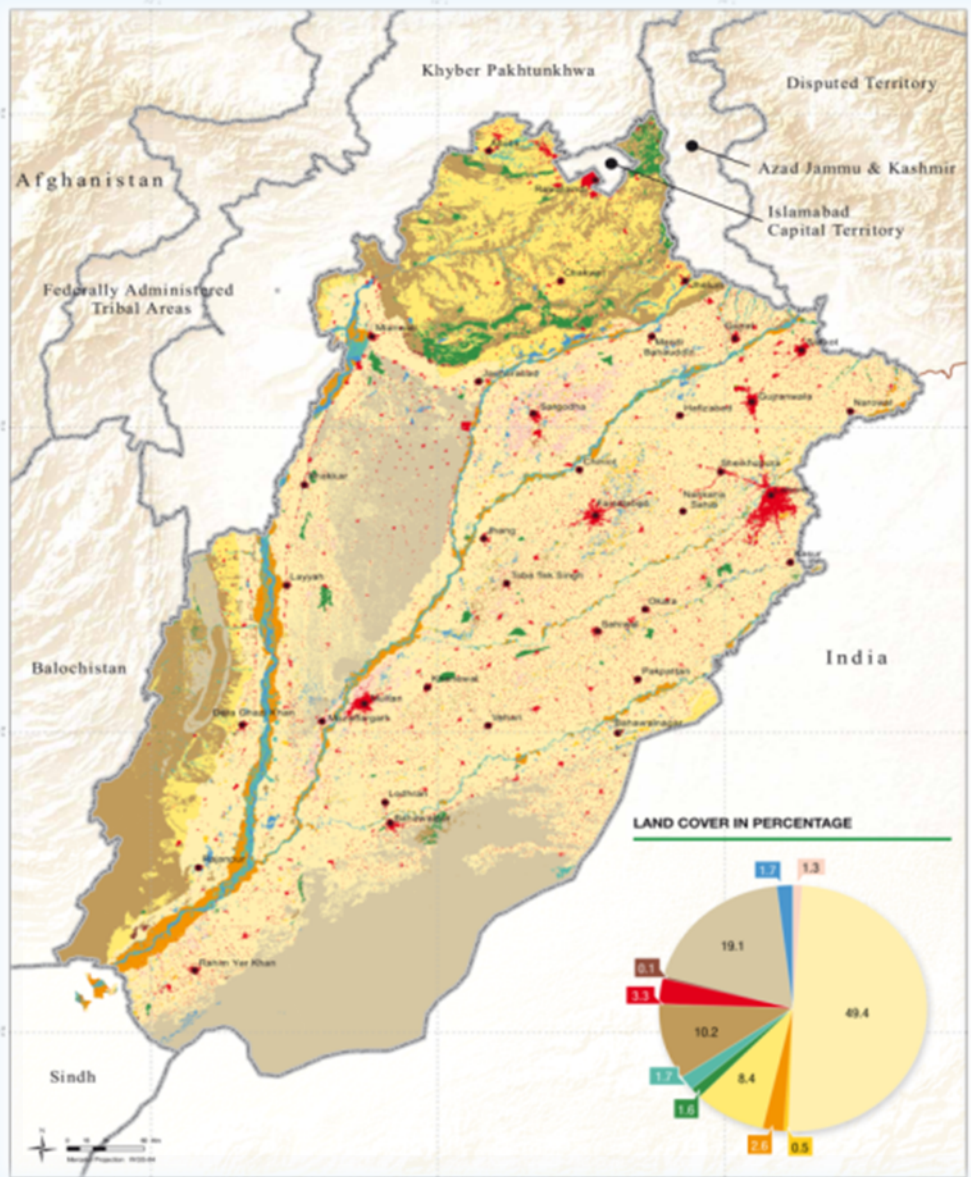
GIS

Land use Map of Pakistan



GIS

Land use Map of Punjab Province

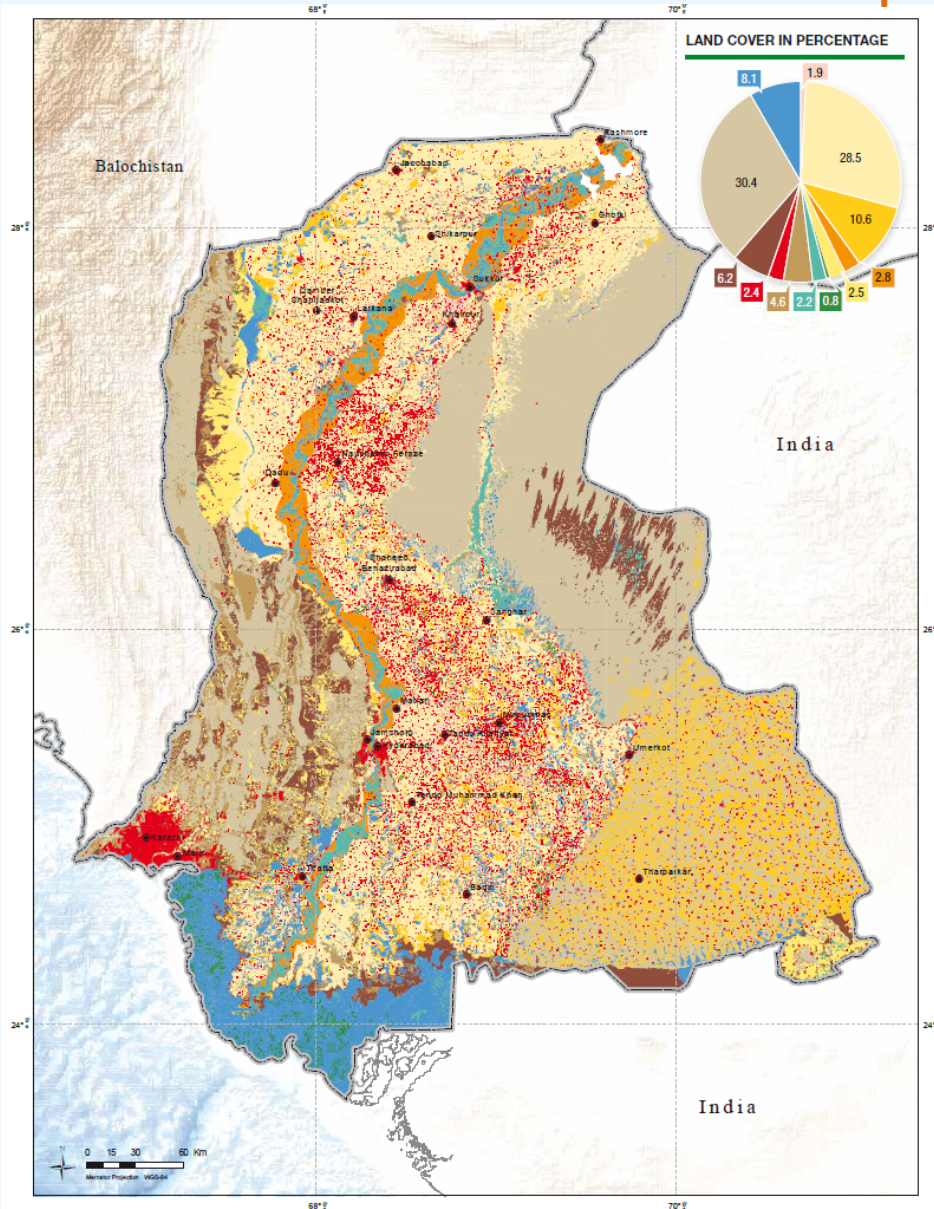


Legend




	Orchards
	Crop Irrigated
	Crop Marginal and Irrigated Saline
	Crop in Flood Plain
	Crop Rainfed
	Forest - Natural Trees and Mangroves
	Natural Vegetation in Wet Areas
	Range Lands - Natural Shrubs and Herbs
	Built-up
	Bare Areas
	Bare Areas with Sparse Natural Vegetation
	Wet Areas
	Snow and Glaciers

GIS

Land use Map of Sindh Province

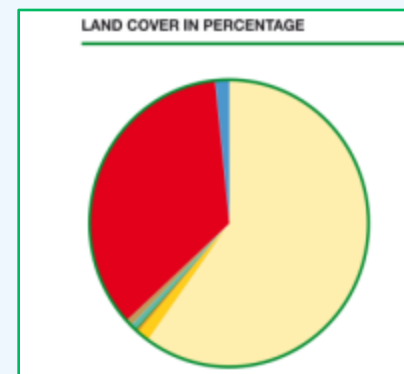
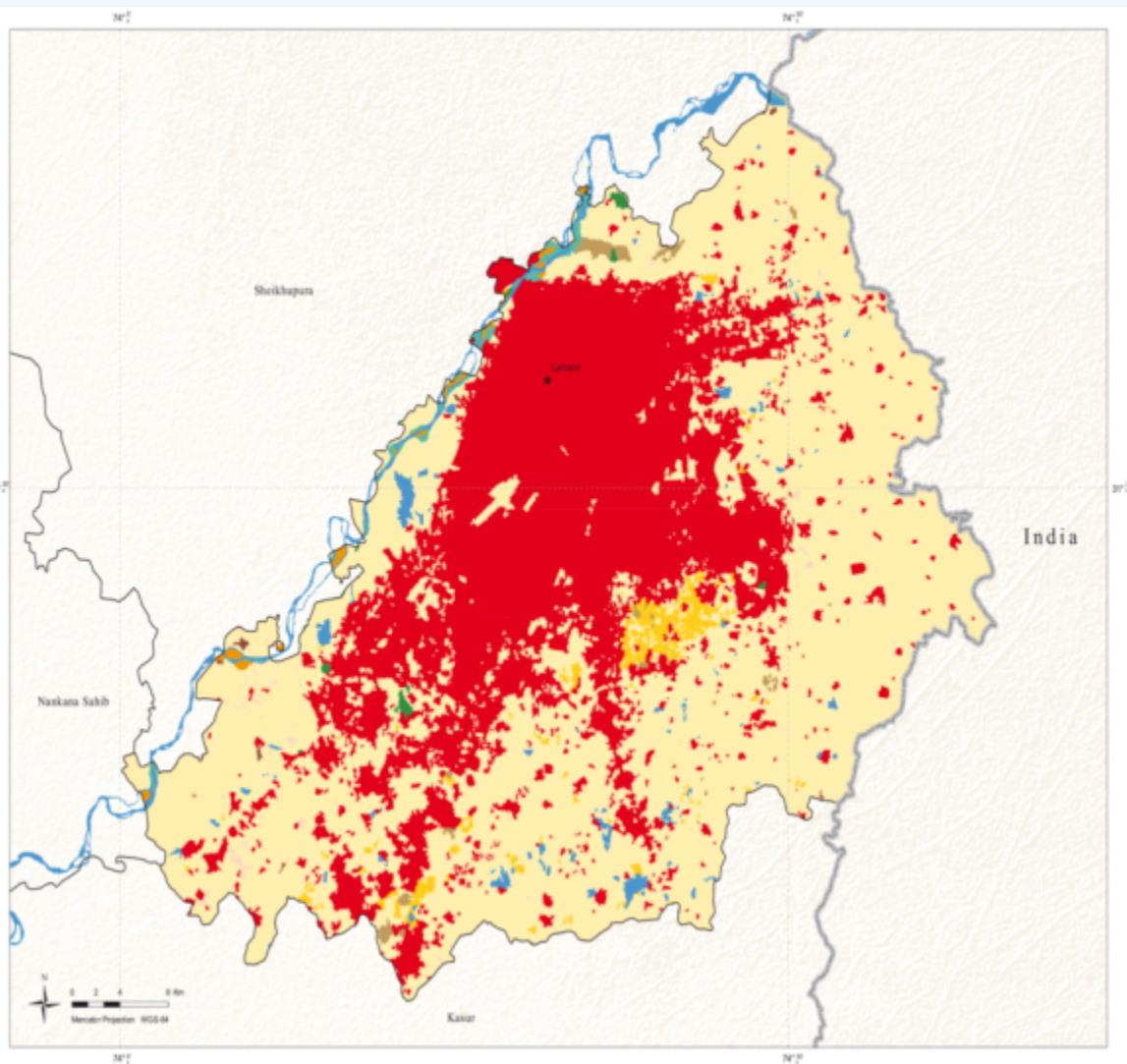


Legend

-  Orchards
-  Crop Irrigated
-  Crop Marginal and Irrigated Saline
-  Crop in Flood Plain
-  Crop Rainfed
-  Forest - Natural Trees and Mangroves
-  Natural Vegetation in Wet Areas
-  Range Lands - Natural Shrubs and Herbs
-  Built-up
-  Bare Areas
-  Bare Areas with Sparse Natural Vegetation
-  Wet Areas
-  Snow and Glaciers

GIS

Land use Map of Lahore City



DISTRIBUTION OF LAND COVER IN THE DISTRICT

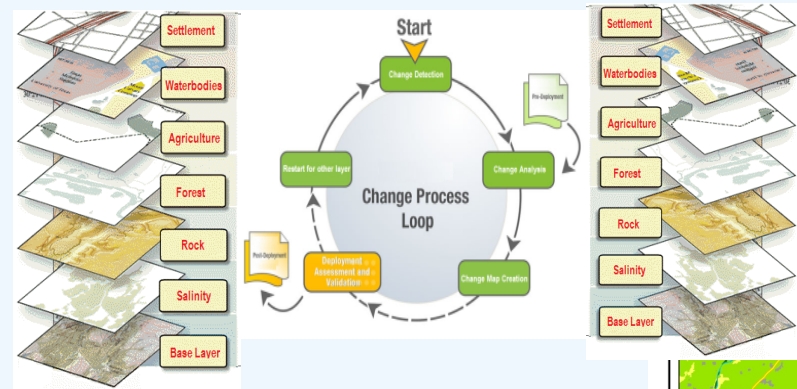
Legend	km ²	%
Orchards	4.02	0.2
Crop Irrigated	1,048.33	59.9
Crop Marginal and Irrigated Saline	28.16	1.6
Crop in Flood Plain	4.70	0.3
Crop Rainfed	0.00	0.0
Forest - Natural Trees and Mangroves	3.35	0.2
Natural Vegetation in Wet Areas	7.49	0.4
Range Lands - Natural Shrubs and Herbs	8.50	0.5
Built-up	621.06	35.5
Bare Areas	1.36	0.1
Bare Areas with Sparse Natural Vegetation	0.00	0.0
Wet Areas	23.79	1.4
Snow and Glaciers	0.00	0.0
Grand Total	1,750.77	

GIS

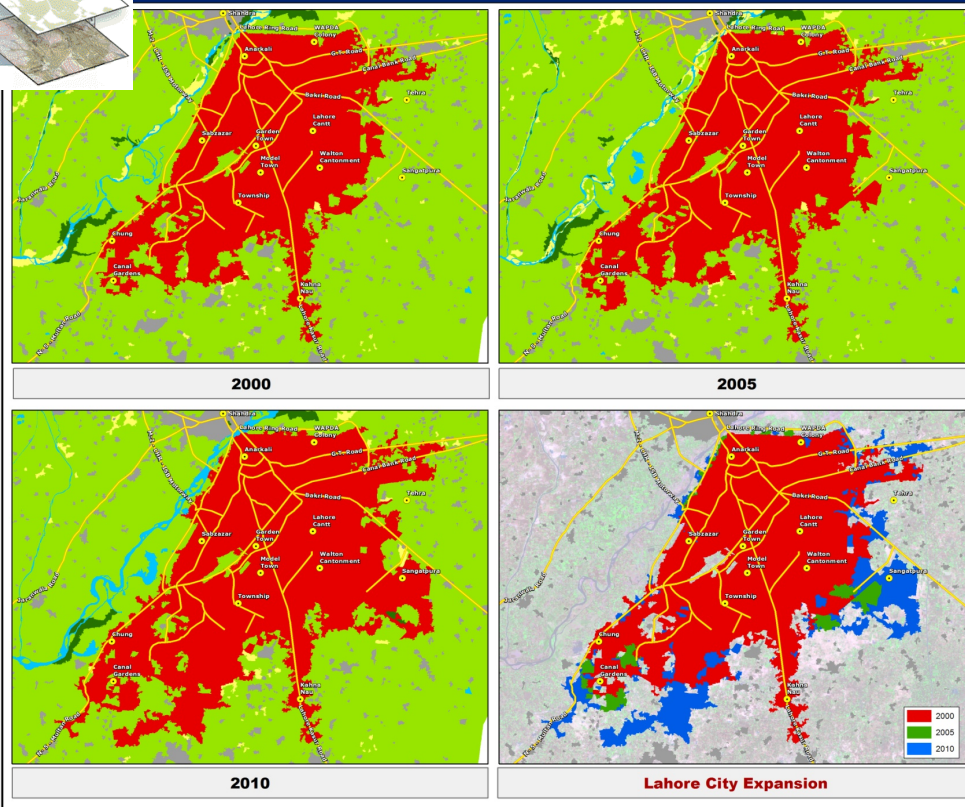
Land use Temporal Analysis

YEAR 2000

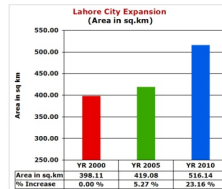
YEAR 2010



Urban Landcover Map of Lahore for Years 2000, 2005 & 2010



- Lahore City
- Other Settlements
- Open/Barren Land
- Agricultural Land
- Rocky Area
- Natural Vegetation
- Water Bodies

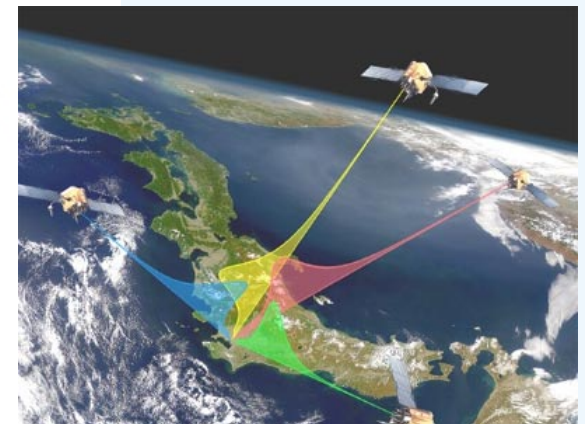
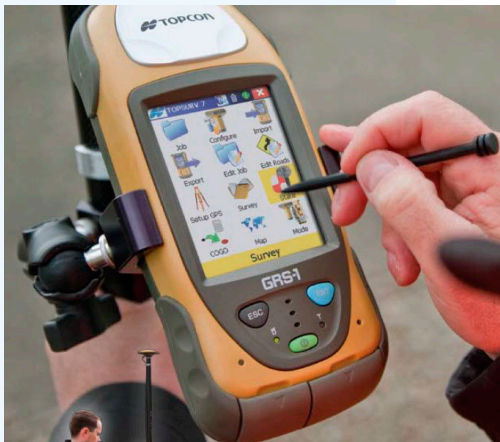




Geospatial Technologies

Global Navigation Satellite Systems (GNSS)

- Navigation, precision and Location Based Services (LBS)



Geospatial Technology Application of GNSS at Micro Level

Crop Reporting System for Crop Reporting Offices of the country

Mobile GIS for field data

Crop sowing

Crop production

Cultivated land area

Soil type

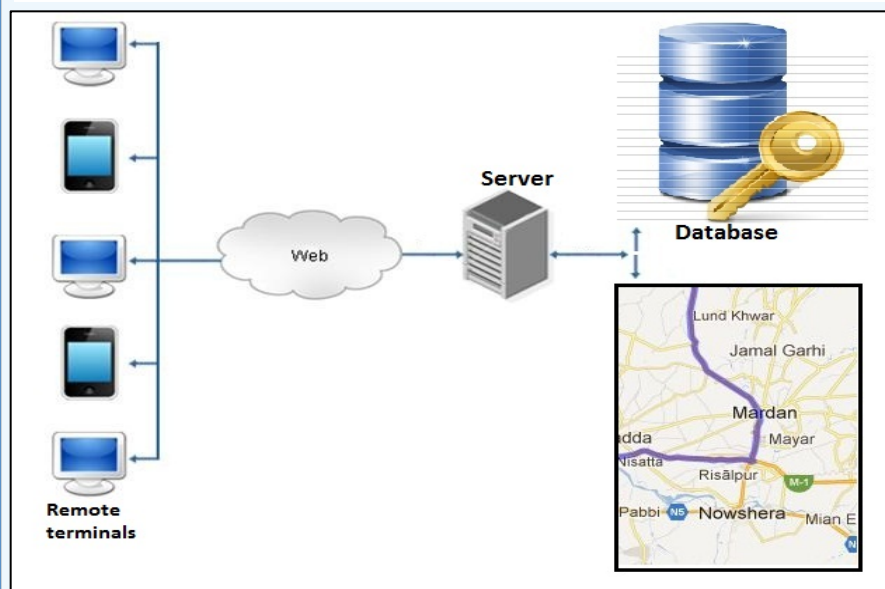
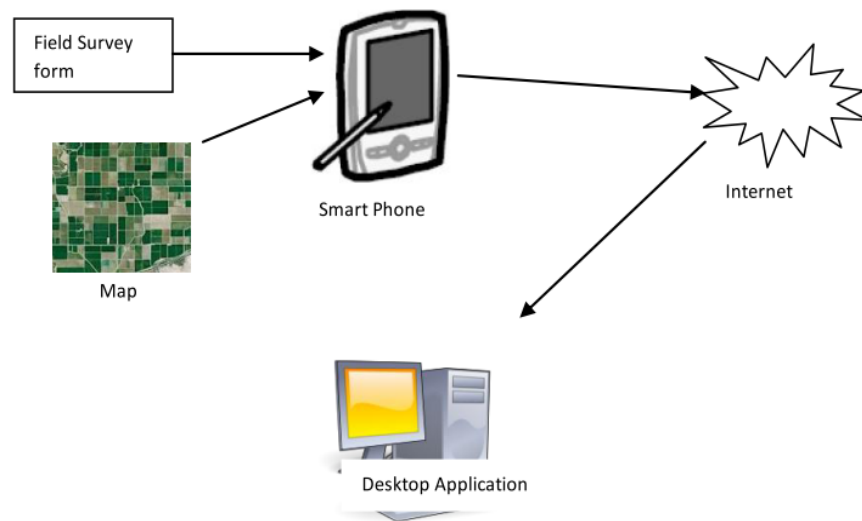
Water sources

Land ownership

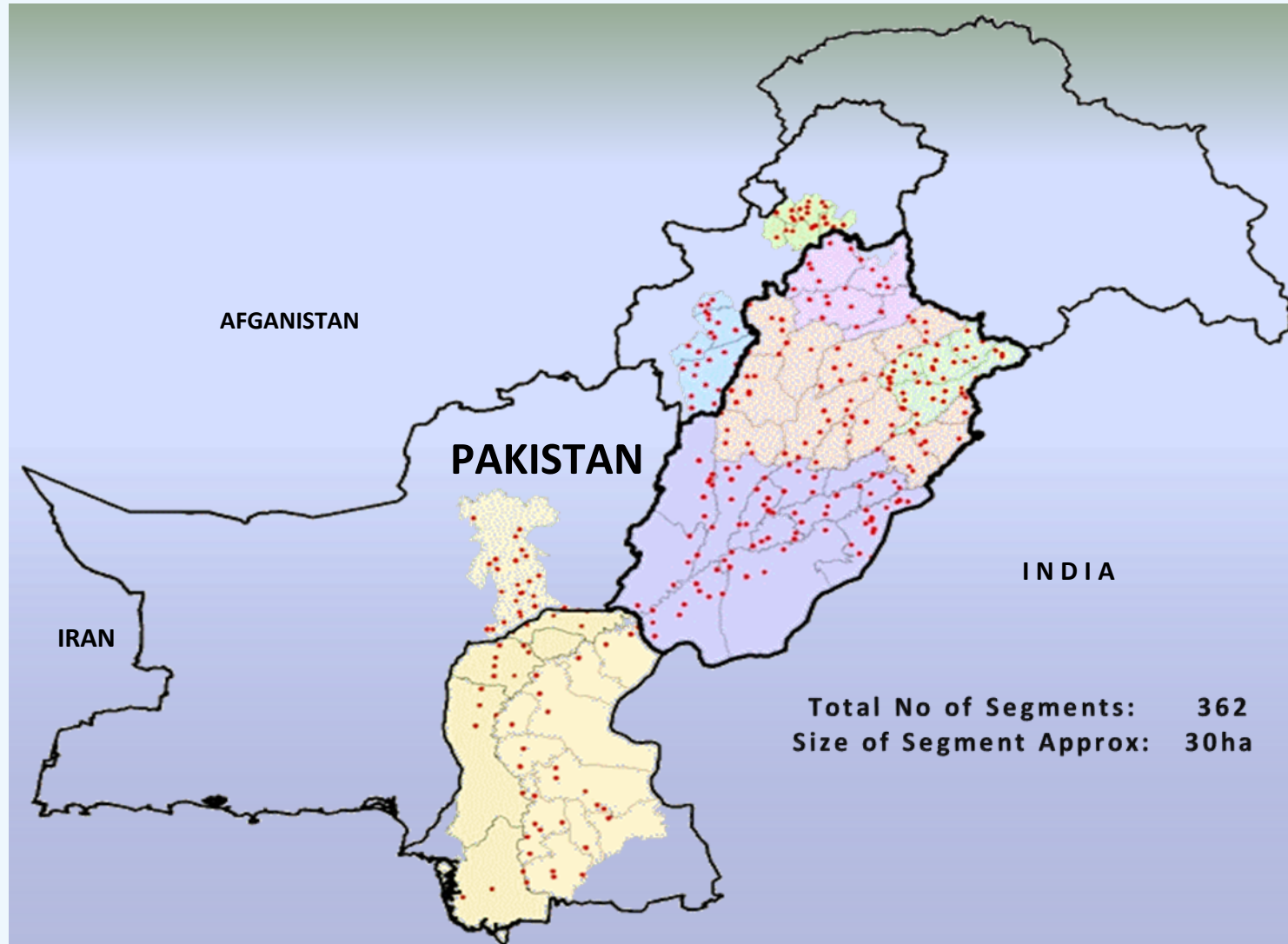
Land revenue

Real time Data Transmission to central repository/server

Visualization, analysis and reporting

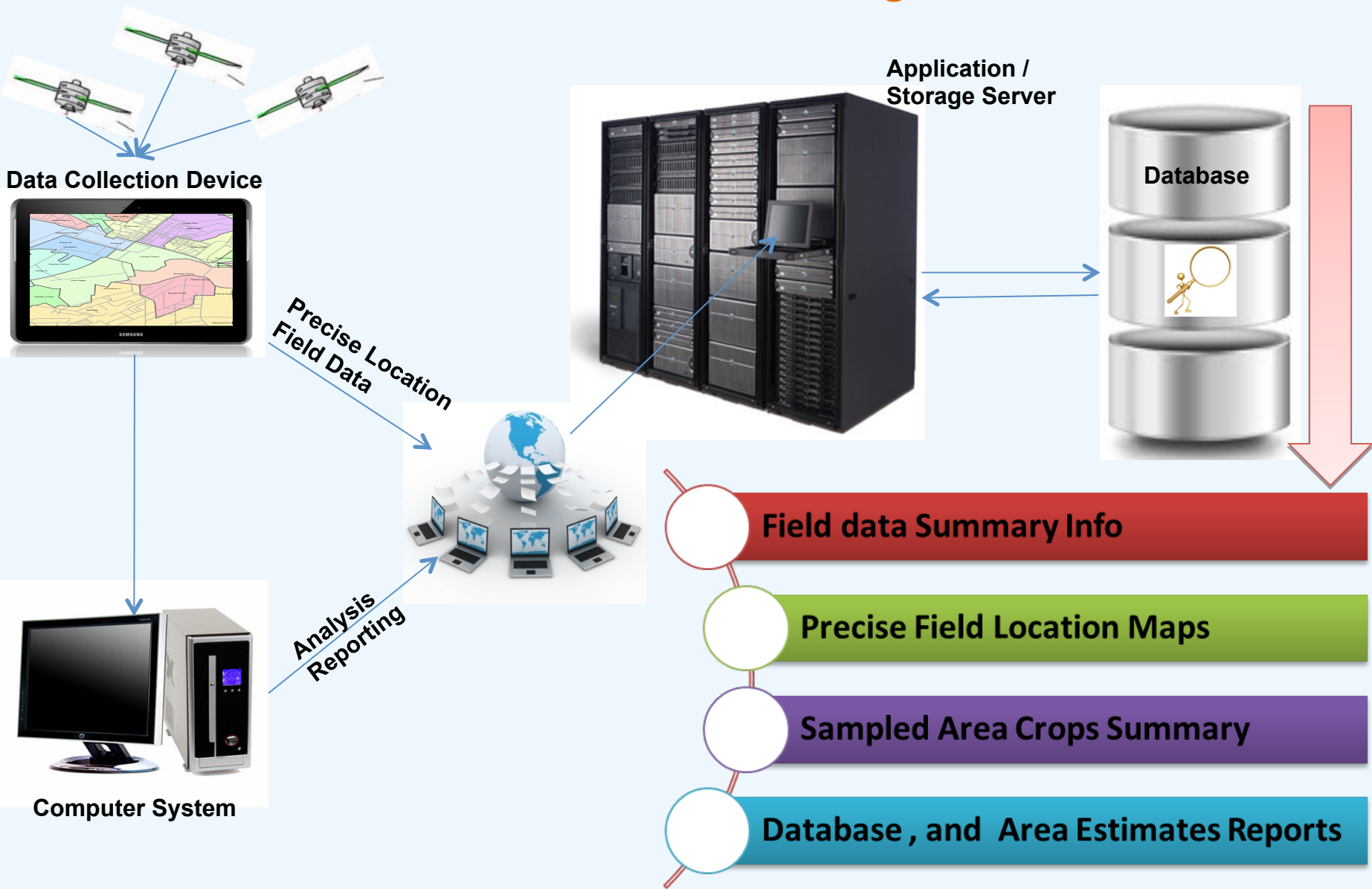


Micro Level Sample Sites





Architecture and Design



Mobile Application

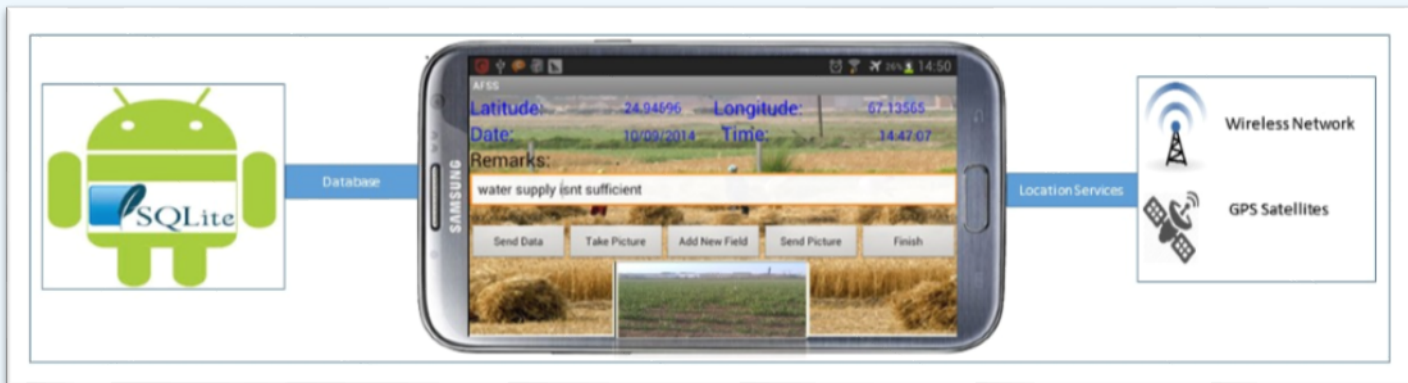
Android based smart phone application data collection related to agriculture field.

Capability to collect data with the minimum user inputs

Enriched with the GNSS capabilities to store precise location field/crop

Historical data connectivity for verification and onsite selection

Camera integration to snap ground photo of crop to monitor actual crop growth/condition





Field Data Collection



Field survey plan:

Selection of segment for survey from land use

Seasonal survey plan with team information

Survey start date time stamp

Precise location information

Central server for real time data transmission

Local database for offline records



A screenshot of a mobile application interface for field data collection. The interface is displayed on a black background with a status bar at the top showing a blue triangle and a green battery icon. The form consists of several input fields and a button:

- AFSS**: A grey header bar with the text "AFSS".
- Survey ID:** A text input field containing "SUR 11013".
- Segment ID:** A dropdown menu showing "PXC754" with a downward arrow.
- CR Name:** A text input field containing "Rameez Ahmed".
- SUPARCO Team:** A text input field containing "SPARC 002".
- Server Address:** A text input field containing "119.157.23.78".
- Latitude:** The value "24.9466734" is displayed below the server address field.
- Longitude:** The value "67.134884" is displayed below the latitude field.
- Save and Next:** A large grey button at the bottom of the form.



Field Data Collection



Field Information:

Information regarding agriculture field within the segment (Actual area, crop harvested, owner name and production history)

Additional remarks/observations regarding particular field, latitude/longitude of surveyed field and date time of survey.

Geospatial data mapped on GIS

Geo-tagged ground photo

Synch to spatial database on server and on local device in offline mode

AFSS

Field Information

Segment ID:
PXC754

Field ID:
0001

Crop:
Wheat(Gandham)

Area:
12

Latitude:
24.9466734

Longitude:
67.134884

Date:
11-12-2012


Time:
11:25:17

Remarks:
Required in time delivery of water

ServerIP **119.157.23.78**

Send Data Take Picture Add New Field Send Picture

Finish





Field Data Collection



Ground Information:

Overall segment observation

Information related to segment like sowing patterns, sowing date, soil type, crop growth, major crop, irrigation system and additional remarks/observations regarding overall segment.

All information is tagged with precise location and date time stamp

The screenshot shows a mobile application interface for field data collection. At the top, there is a status bar with a signal strength indicator, a battery icon, and the time 12:00. Below the status bar, the text 'AFSS' is displayed. The main content area is titled 'Ground Information' and contains the following fields:

- Segment ID:** PXC754
- Sowing Date:** Early Sowing (dropdown menu)
- Soil Type:** Clay (dropdown menu)
- Crop Growth:** Low (dropdown menu)
- Major Crop:** Cotton (dropdown menu)
- Irrigation System:** Canals (dropdown menu)
- Remarks:** N/A (text input field)
- Latitude:** 24.9466734
- Longitude:** 67.134884

At the bottom of the form, there are three buttons: 'Send', 'Save', and 'Exit'. Below the buttons, the server address is displayed as 'Server: 119.157.23.78'.

Communication Server application

Data connections status between field and central location

Validation of records

Parsing of received data to respective database fields

Validation of location information with its position stored in database at server end

Entries to spatial database

Binding ground photos and geospatial information at central location

Summary of received data and active surveys

Communication Server Module						
	S.NO.	Connected Clients	Port	IP	Connection Time	Connected
	1	Zaheer	44441	202.69.56.221	11/11/2012 11:15:31	Yes
	2	lbrar	44447	202.69.56.14	11/11/2012 12:01:04	Yes
	3	Umer	44439	202.69.56.74	11/11/2012 15:27:38	Yes
	*					
Summary						
Connected Clients: 3		Recieved Records: 17		Valid Records:15		
Active Clients: 1		Records: with Pic :11				

Central Repository

- Central repository acts as central server
- Binds GIS and field geospatial information for viewing, analysis and reporting

FAO - Area Frame Sampling System

Form Details
 Sent by User: Team 1
 Location: Chung, Multan Rd, Lhr
 Geo Tagging
 Longitude: 74.1578259
 Latitude: 31.3998864

Start

Map Satellite

Map data ©2012 Google Imagery ©2012 GeoEye - Terms of Use Report a map error

SegmentID	FieldID	Crop	Area	Latitude	Longitude	Dates	Times	Remarks	PicturePath	Status
TGH342	2513	Canola(Sarsoun)	8	31.5646246	74.3047781	11/11/2012	9:39:41	remarks of field	\\storage\sdcard0\	Recieved
PCZ042	0001	Onion(Piyaaz)	6	31.3998864	74.1578259	11/11/2012	11:13:22	area paramter	c:\inetpub\wwwro	Recieved
PCZ042	0001	Wheat(Gandham)	6	31.3998864	74.1578259	11/11/2012	11:21:58	newidame	c:\inetpub\wwwro	Recieved

Reporting

15-Jul-2013

Crop Reporting Services,Punjab

General Information

SurveyID: K_2013_1
Village :- Sahiwal

Sr. No	Khasra	Crop	Area
1	1	Candla(Sarsoun)	2
2	21	Wheat(Gandham)	497
3	232	Candla(Sarsoun)	552
4	2554	Wheat(Gandham)	14,452
5	325	Maize(Makai)	2
6	32532	Maize(Makai)	28
7	333	Wheat(Gandham)	664,068
8	44	Wheat(Gandham)	44
9	555	Massam(Massami)	25
10	577	Wheat(Gandham)	12
11	788	Cabbage(Band Ghobi)	6
Total Area =			680,286

SurveyID: R_2013_1
Village :- Shekhupura

Sr. No	Khasra	Crop	Area
12	0001	Onion(Piyasaz)	6
13	0001	Wheat(Gandham)	6
14	0005	Wheat(Gandham)	8
15	001	Wheat(Gandham)	5
16	001	Wheat(Gandham)	6
17	0085	Wheat(Gandham)	96
18	2323	Onion(Piyasaz)	239
19	233225522	Wheat(Gandham)	4,544
20	33	Wheat(Gandham)	25
21	35	Wheat(Gandham)	45
22	354	Wheat(Gandham)	6
23	55	Wheat(Gandham)	45
24	56	Wheat(Gandham)	246
25	635	Wheat(Gandham)	59
26	639	Wheat(Gandham)	32
27	663	Wheat(Gandham)	9
28	6635	Peas(Matar)	555
29	6635	Wheat(Gandham)	555
30	699	Wheat(Gandham)	55,673
31	76	Cabbage(Band Ghobi)	787

Page 1 of 2

15-Jul-2013 Crop Reporting Services,Punjab

Crop Information

SurveyID: K_2013_1
District:- Sargodha
Tehsil:- Sahiwal (Sardogha)
Village :- Sahiwal

Crop Name	Total Area of Crop	Total Number of Fields
Cabbage(Band Ghobi)	6	1
Maize(Makai)	28	2
Massami(Massami)	25	1
Wheat(Gandham)	679,673	5

Total Area = 679,732

SurveyID: R_2013_1
District:- Shekhupura
Tehsil:- Shekhupura
Village :- Shekhupura

Crop Name	Total Area of Crop	Total Number of Fields
Cabbage(Band Ghobi)	8,575	2
Onion(Piyasaz)	242	2
Peas(Matar)	555	1
Wheat(Gandham)	62,459	18

Total Area = 71,831

General Information (Village)

Crop Summary (Village)

Implementation at Crop Reporting Services

- Hands on training for stake holders
- Demonstration of the system for data collection in the field



Conclusion

- Use of geospatial technology at macro and micro levels is highly effective and efficient in land use planning and management
- Integrating technology is cost and time effectient solution

Thank you