

GEOSPATIAL TECHNOLOGIES FOR FLOOD MANAGEMENT IN PAKISTAN

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PAKISTAN**

AGENDA

- Introduction to Pak-RSO
- Geospatial Technologies for Flood Monitoring
 - Mitigation Stage
 - Preparedness Stage
 - Response Stage
 - Recovery Stage
- Geospatial Technologies for Landslide Monitoring
- Conclusion

SPACE APPLICATION CENTRE FOR RESPONSE IN EMERGENCY AND DISASTERS (SACRED) - PAK-RSO



- THE CENTRE PROVIDES SPACE BASED INFORMATION TO NATIONAL / PROVINCIAL DISASTER MANAGEMENT AGENCIES TO RAPIDLY ASSESS THE EXTENT OF NATURAL DISASTERS AND DAMAGES TO HUMAN LIVES, PROPERTY AND INFRASTRUCTURE.
- THE CENTRE ALSO PROVIDES ASSISTANCE TO REGIONAL COUNTRIES IN CASE OF NATURAL DISASTERS.

EMAIL: SACRED@SUPARCO.GOV.PK

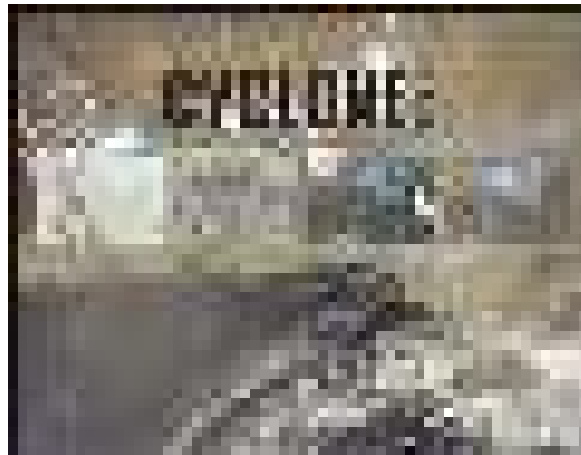
WEB: DISASTERWATCH.SGS-SUPARCO.GOV.PK

INTERNATIONAL COOPERATION IN DISASTER MANAGEMENT

International Charter Space and Major Disasters

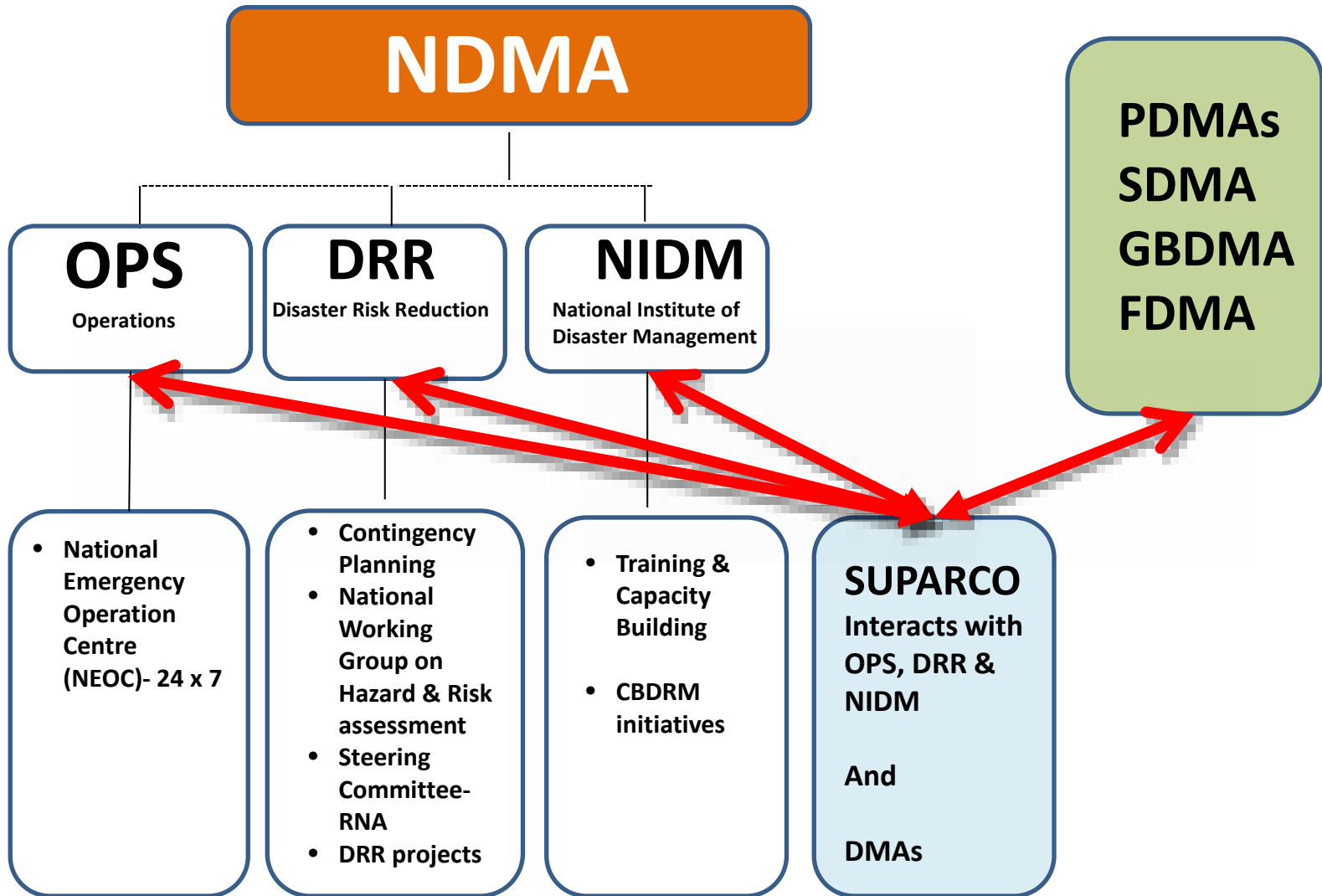
- ✓ The International Charter aims at providing a unified system of space data acquisition and delivery to those affected by natural or man-made disasters through Authorized Users
- ✓ On Behalf of NDMA, SUPARCO has been registered with Charter as Authorized User (AU)
- ✓ SUPARCO is host to UN-SPIDER Regional Support office in Pakistan
- ✓ SUPARCO is also Member of JPT-3 project of Sentinel Asia and is registered as Data Analysis Node (DAN)
- ✓ SUPARCO is also Member of APSCO Disaster Management Framework

DISASTER MONITORING – PAST EXPERIENCE



During Natural Disasters, SUPARCO provided technical support to various national Organizations NDMA, PDMAs and International Agencies ICIMOD, UN-FAO etc

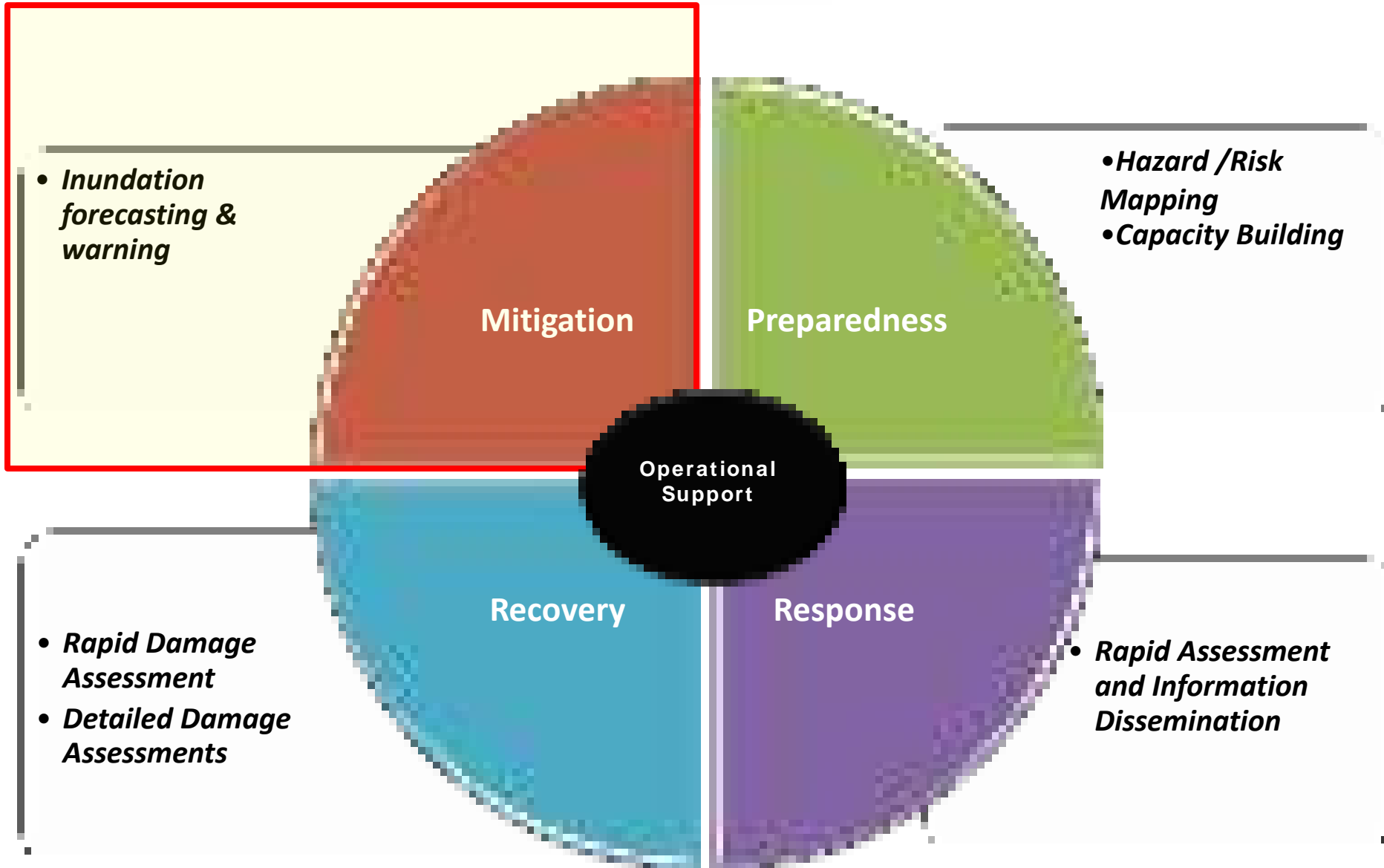
NATIONAL COORDINATION & SUPPORT MECHANISM



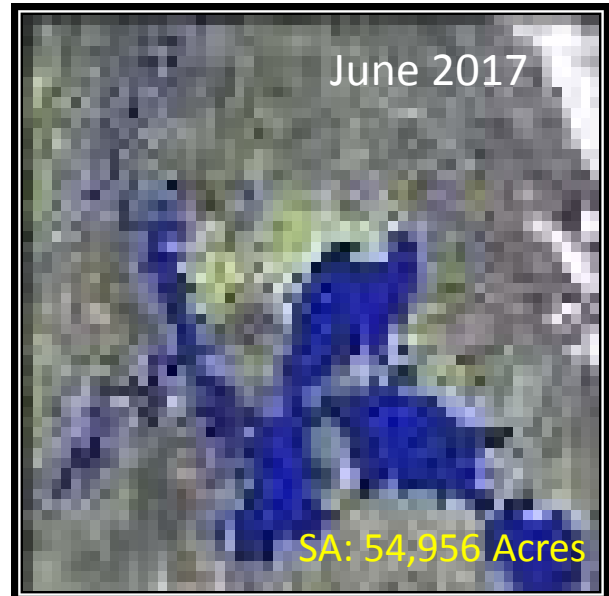
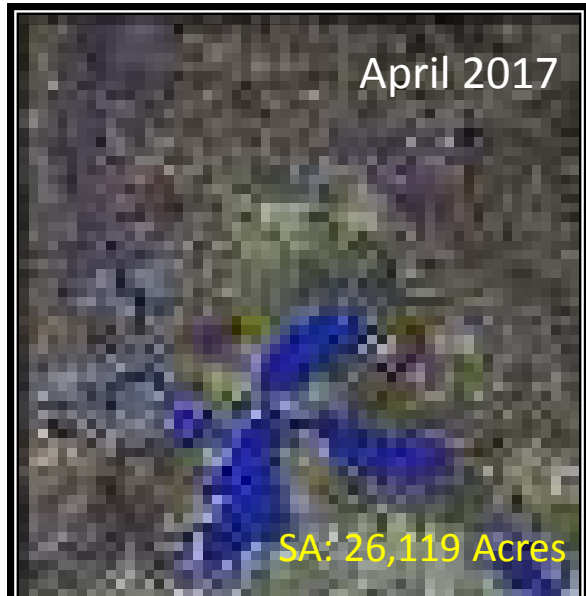
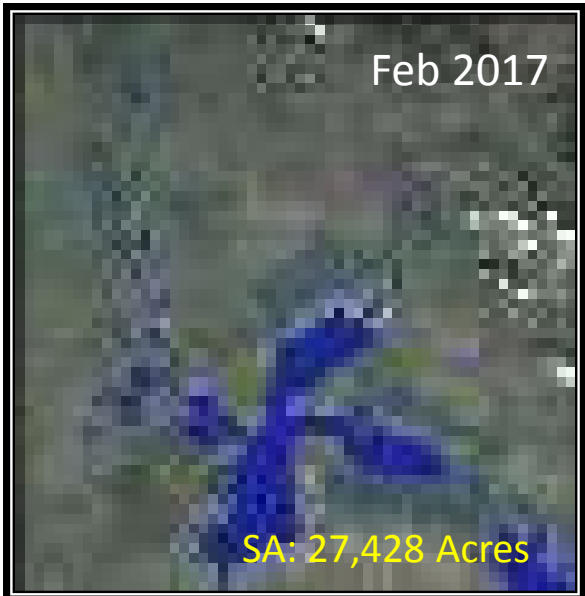
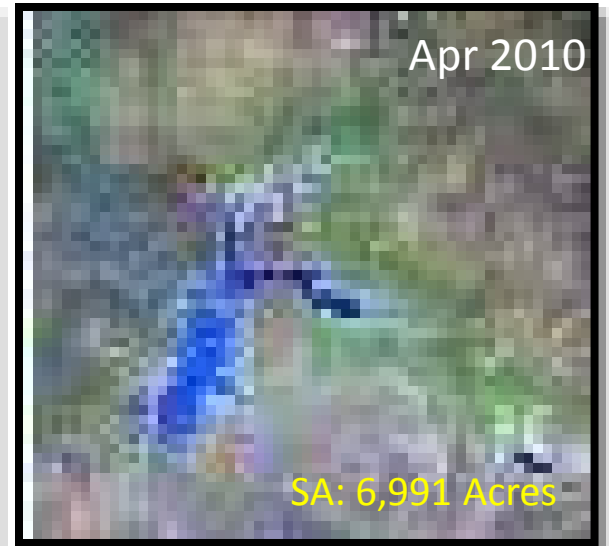
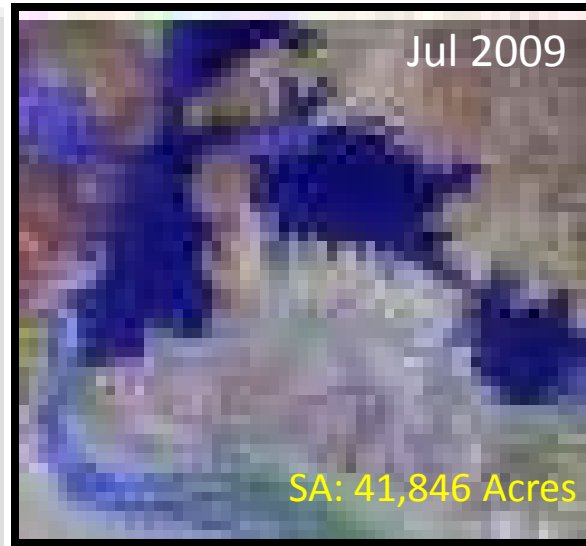
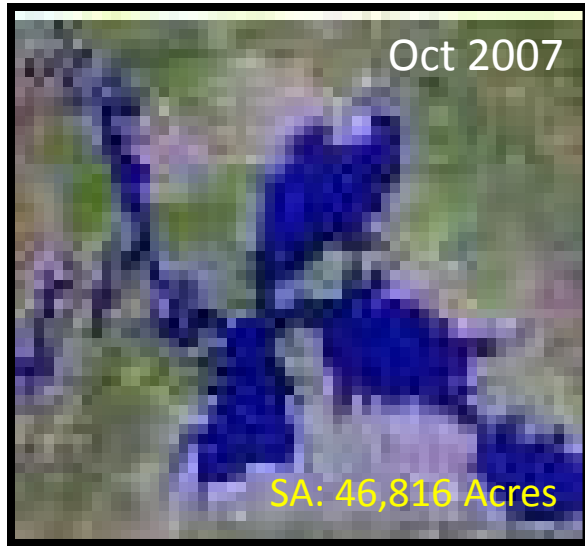
GEOSPATIAL TECHNOLOGIES FOR FLOOD MANAGEMENT



GEOSPATIAL TECHNOLOGIES FOR FLOOD MANAGEMENT



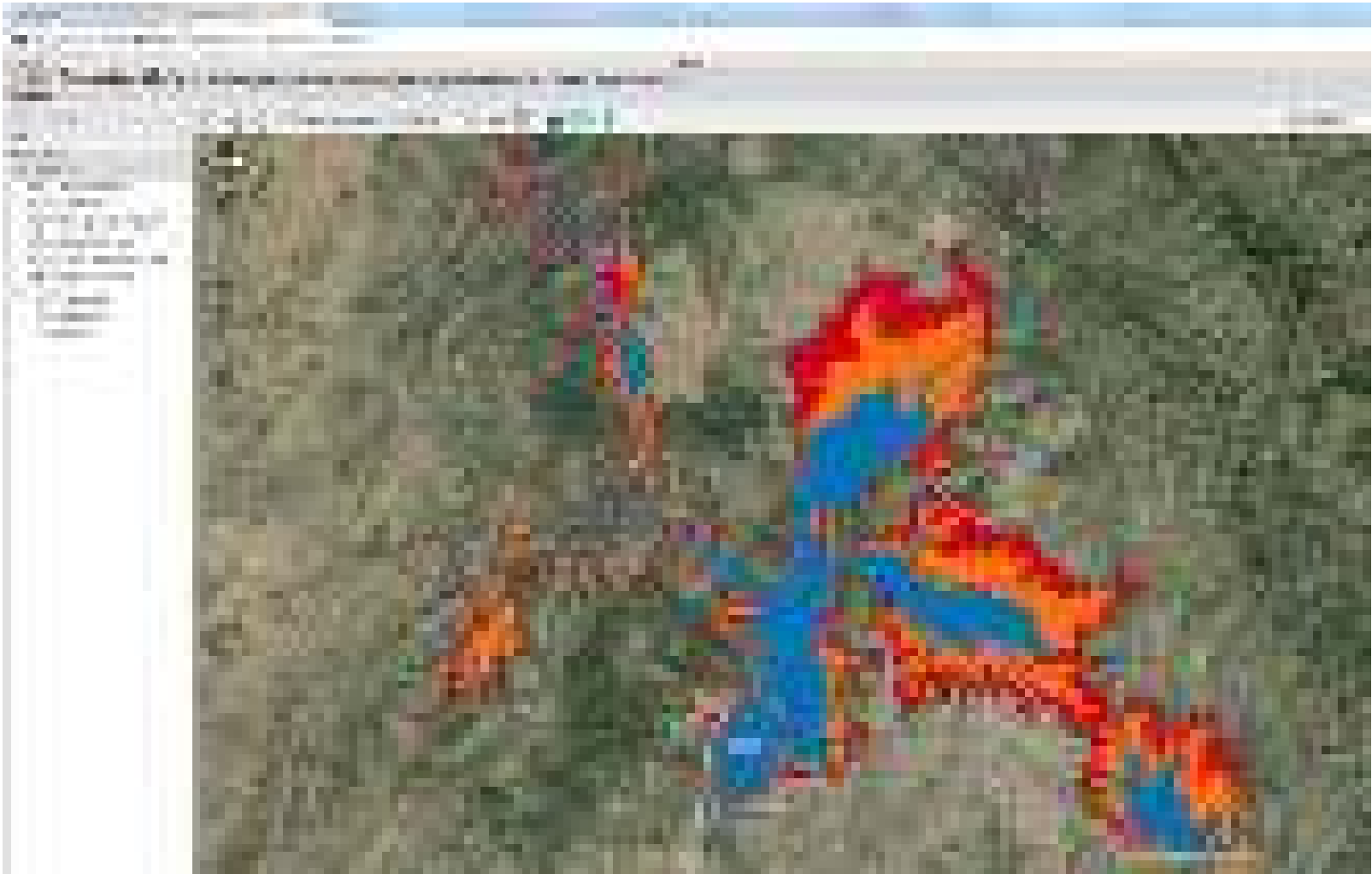
DAMS MONITORING – SURFACE WATER DYNAMICS



SA = Surface Area of reservoir

DAMS MONITORING – SURFACE WATER DYNAMICS

Water Occurrence Density 2013-15



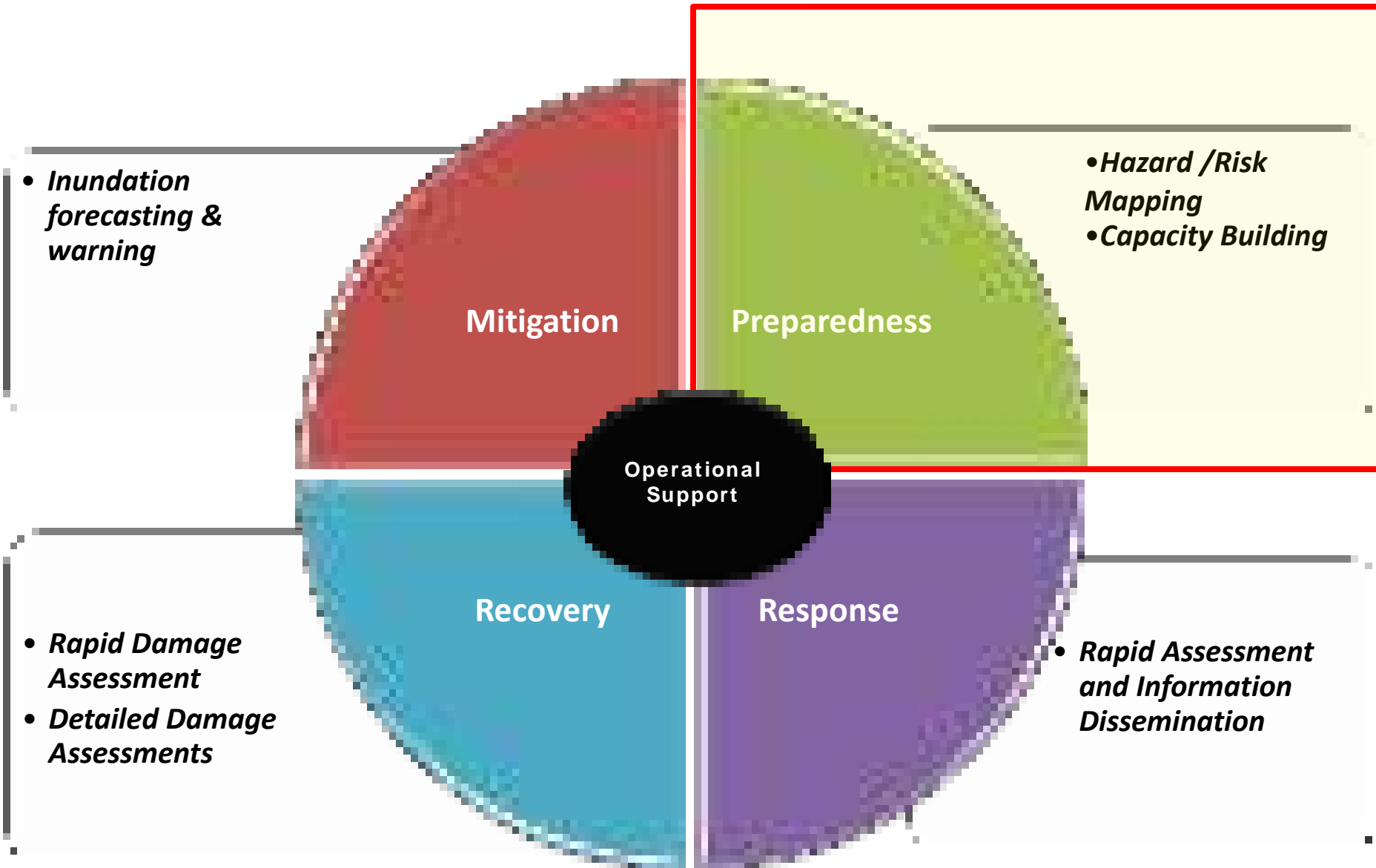
MONITORING OF ENCROACHMENT REMOVAL IN PUNJAB AND SINDH

FOLLOWING THE FLOODS OF 2010, PID PUNJAB AND SINDH CARRIED OUT ENCROACHMENT REMOVAL ACTIVITIES ALONG RIVER INDUS.

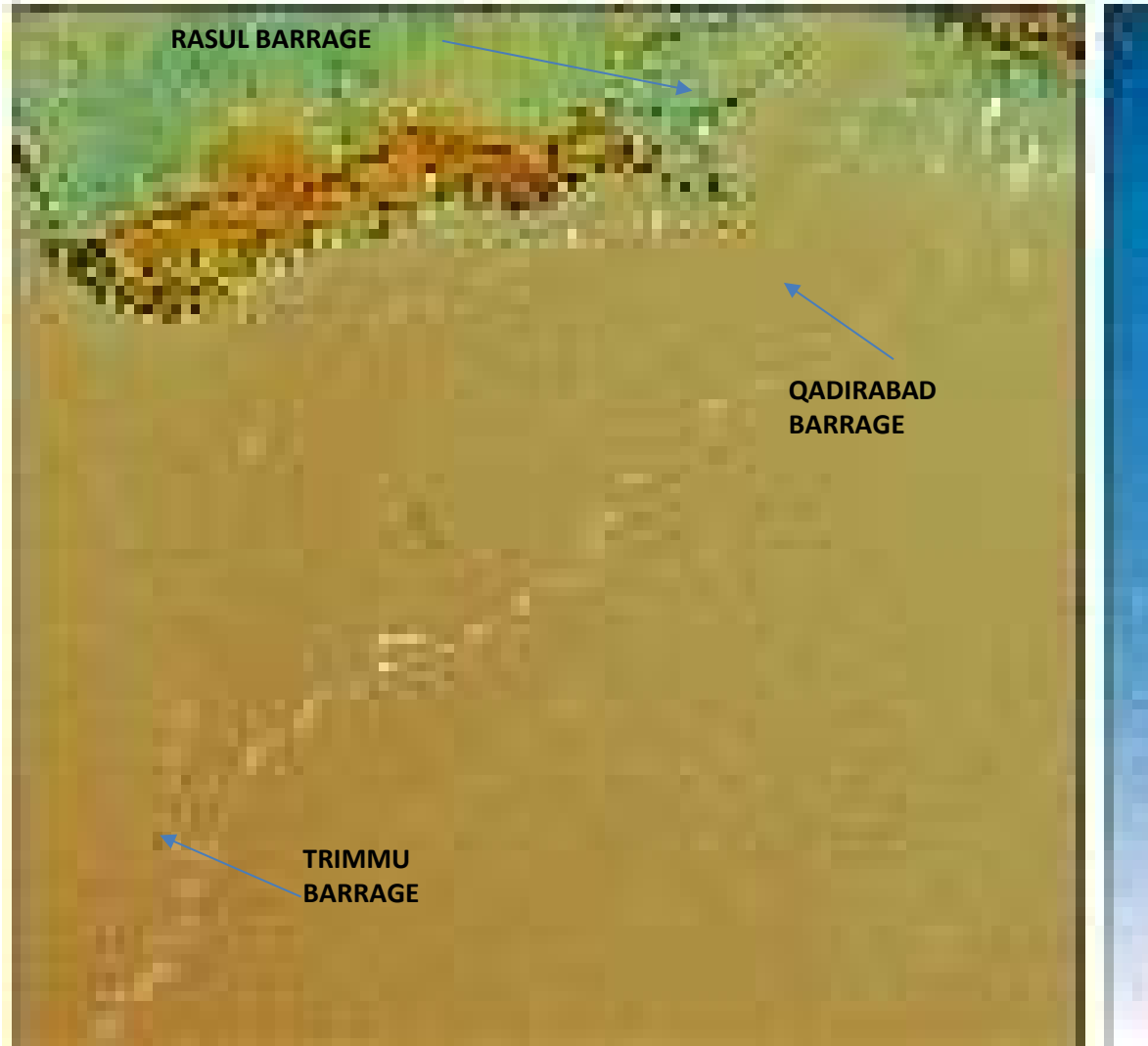
SUPARCO CARRIED OUT MONITORING OF ENCROACHMENT REMOVAL BASED ON 1.5M SPOT-6/7 SATELLITE IMAGERY



OPERATIONAL WORKFLOW



FLOOD MODELING AND INUNDATION FORECASTING



Simulation results show how flood waters progress along Jhelum and Chenab rivers causing heavy inundations.

FLOOD MODELING APPLICATIONS – FLOOD 2014

Maximum simulated inundation extent for 2014 around Trimmu and Athara Hazari.



Devastation caused by 1992 floods around Trimmu and Athara Hazari. Vulnerable areas can be identified.



FLOOD HAZARD MAPS

Copyright 2010 by the University of Illinois at Urbana-Champaign

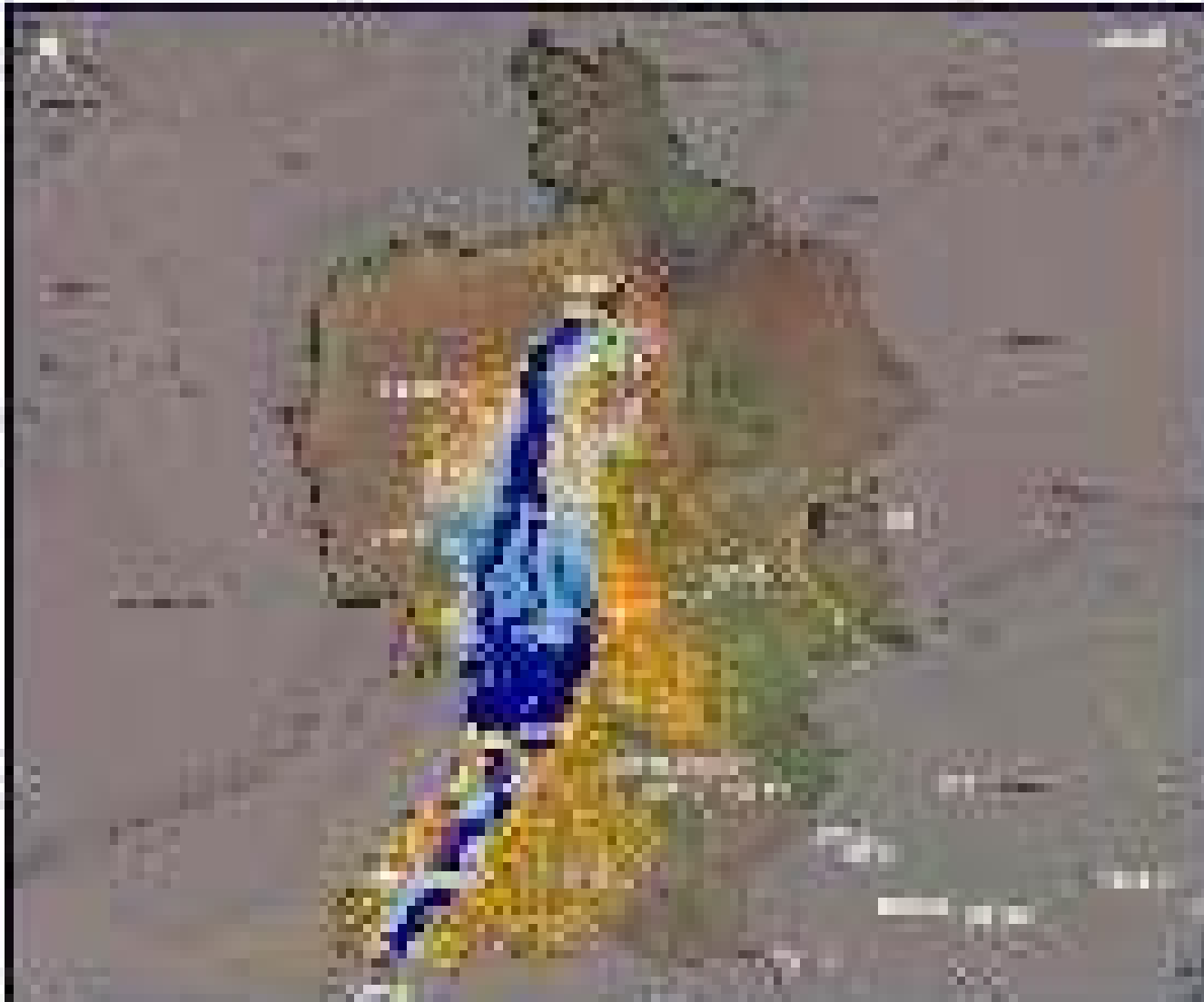


Figure 1. Flood hazard map of the Illinois River valley. The map shows the river channel (blue) and the floodplains (yellow and orange). The floodplains are defined as the areas that are inundated by the river during high water. The map is a vector map, which means that it is made up of lines and shapes that can be scaled without losing quality.



The flood hazard map is a vector map, which means that it is made up of lines and shapes that can be scaled without losing quality. The map is a vector map, which means that it is made up of lines and shapes that can be scaled without losing quality.

Navigation icons including a home button, a search icon, and a refresh icon. The text 'Copyright 2010 by the University of Illinois at Urbana-Champaign' is visible at the bottom right.

MULTI-HAZARD VULNERABILITY RISK ASSESSMENT (MHVRA)

Objective

National Disaster Management Authority (NDMA) intends to carryout Multi Hazard Vulnerability and Risk Assessment (MHVRA) in 49 x vulnerable districts spread across Pakistan as part of the National Disaster Management Plan (NDMP).

Flood and Drought Hazards



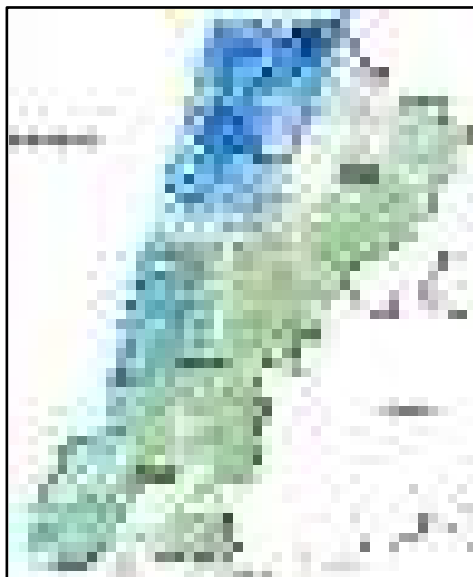
Landuse and Landcover



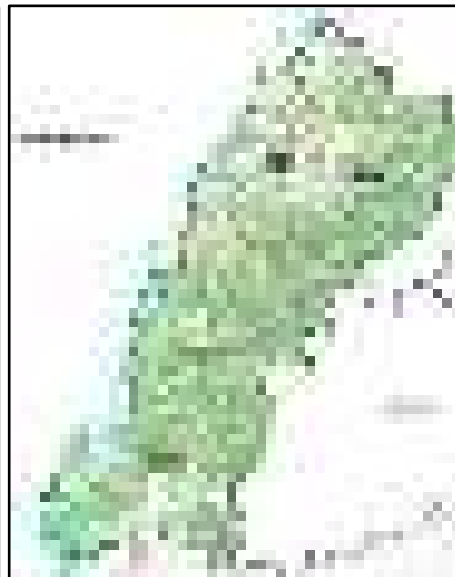
Spatial Analysis



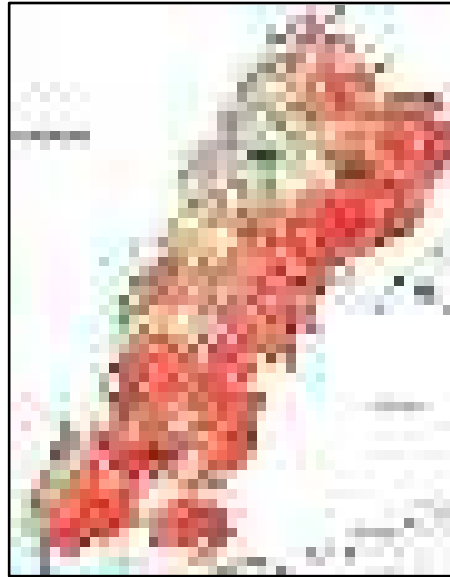
Rabi and Kharif Crops



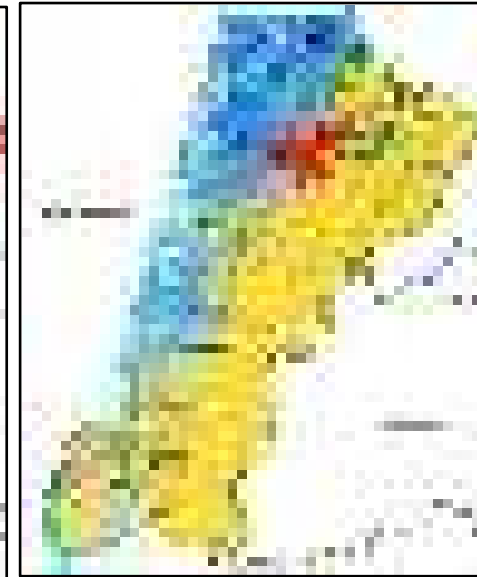
Kharif Crop Exposure to Drought



Rabi Crop Exposure to Flood

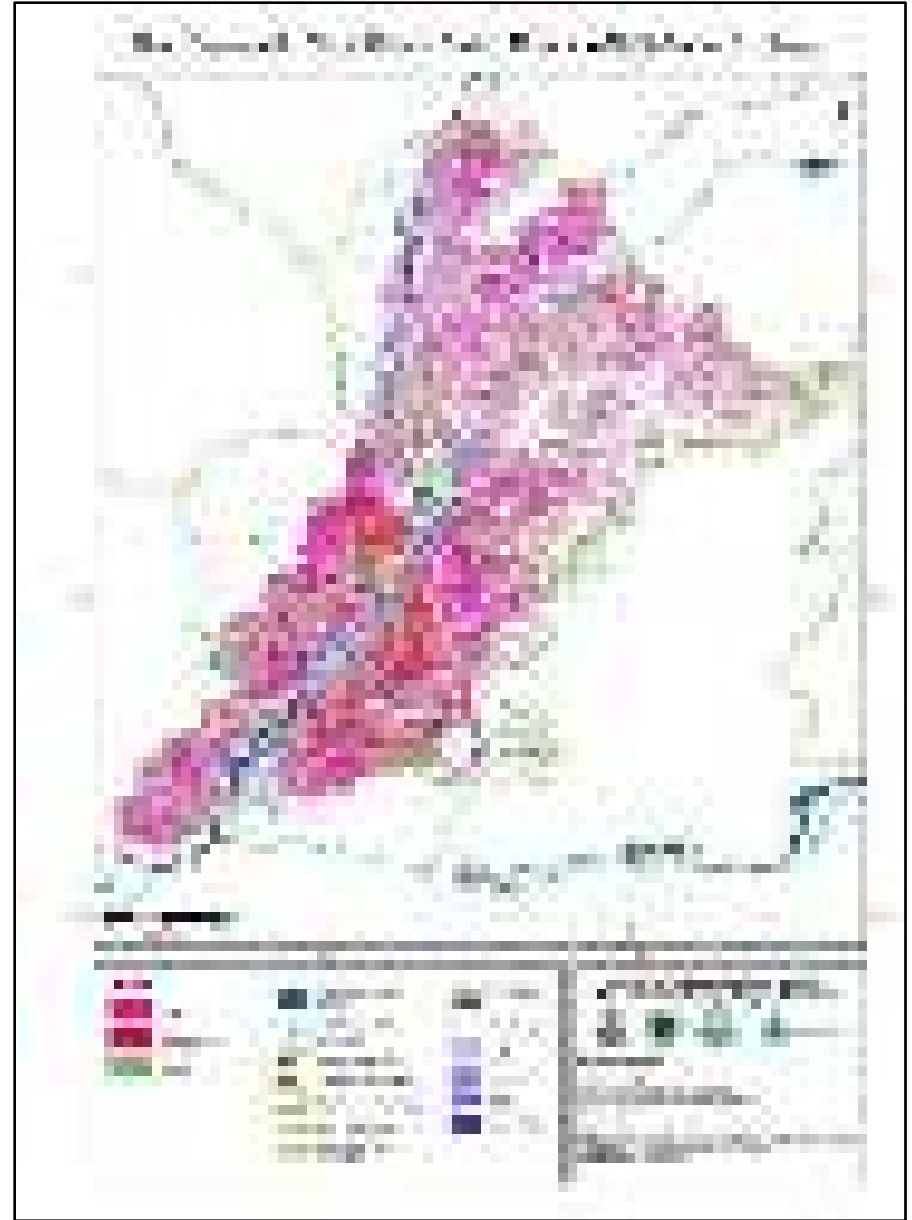


Rabi Crop Exposure to Drought



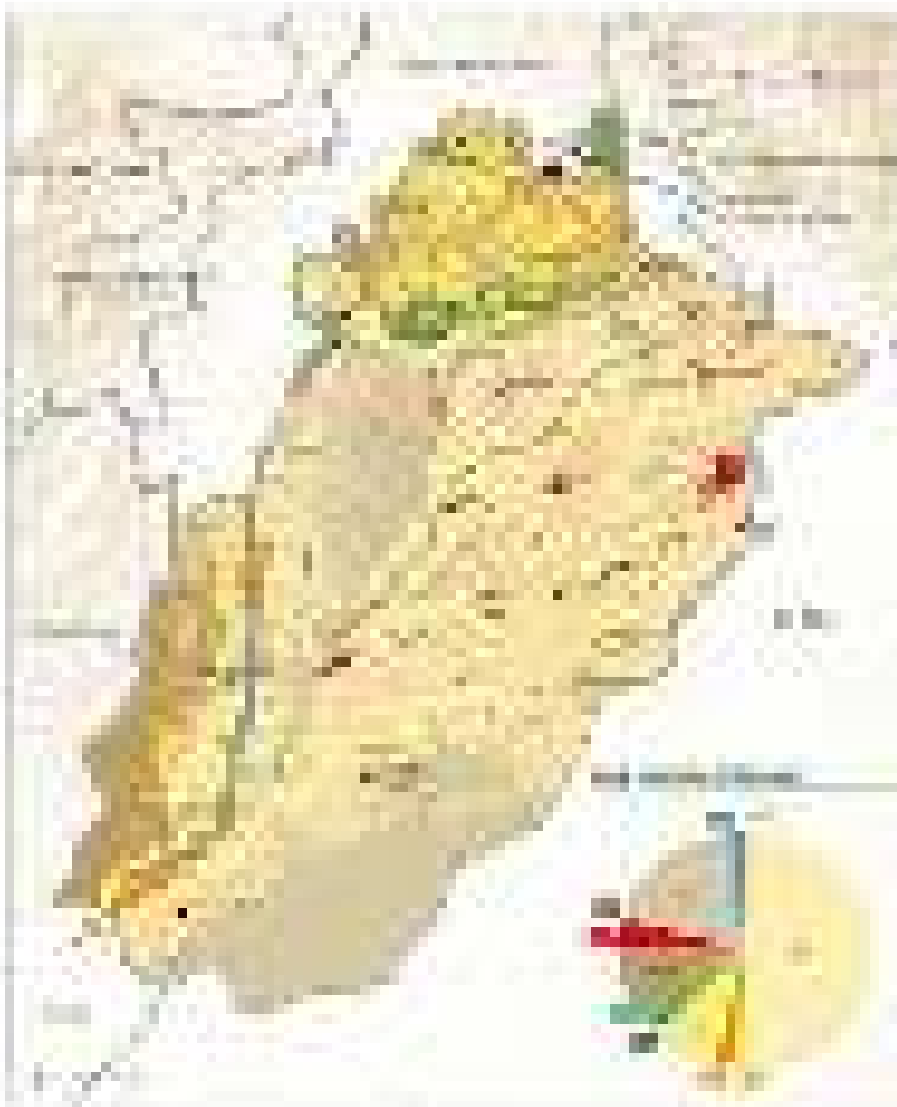
LULC Exposure to Flood

MULTI-HAZARD VULNERABILITY RISK ASSESSMENT (MHVRA)



LANDCOVER AND LANDUSE

PUNJAB

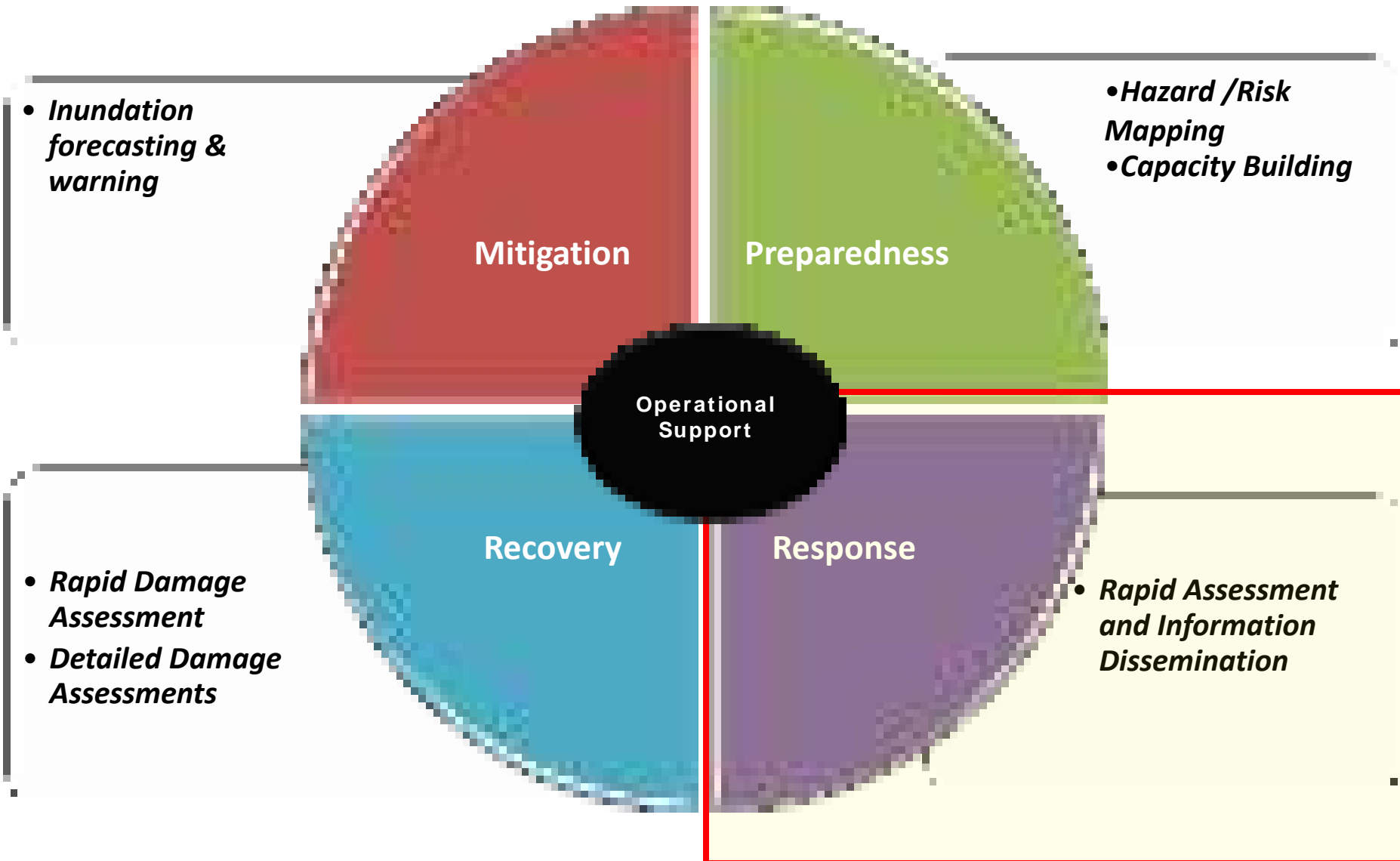


SINDH



- STANDARDIZED LANDCOVER CLASSIFICATION ATLASES HAVE BEEN PREPARED BY SUPARCO COVERING SINDH, PUNJAB AND KP, WHEREAS LCCS ATLAS FOR BALOCHISTAN IS IN PROCESS.

GEOSPATIAL TECHNOLOGIES FOR FLOOD MANAGEMENT



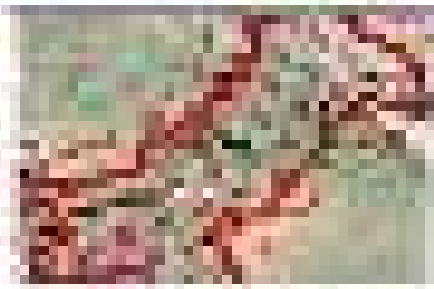


Table 1. Data points for the contour map.

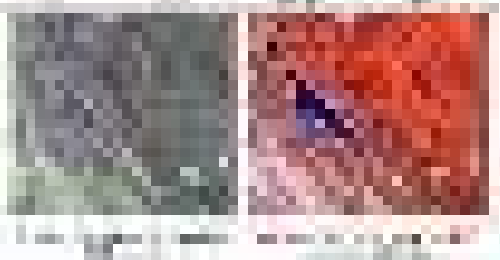
X	Y	Z
1	1	10
1	2	15
1	3	20
1	4	25
1	5	30
2	1	12
2	2	18
2	3	23
2	4	28
2	5	33
3	1	14
3	2	20
3	3	25
3	4	30
3	5	35
4	1	16
4	2	22
4	3	27
4	4	32
4	5	37
5	1	18
5	2	24
5	3	29
5	4	34
5	5	39

Interpolation:
 The process of estimating values at unmeasured locations based on the values at measured locations.

Contour Lines:
 Lines connecting points of equal value (e.g., elevation).

Contour Interval:
 The vertical distance between adjacent contour lines.

Contour Map:
 A map showing lines of equal value (e.g., elevation) on a surface.



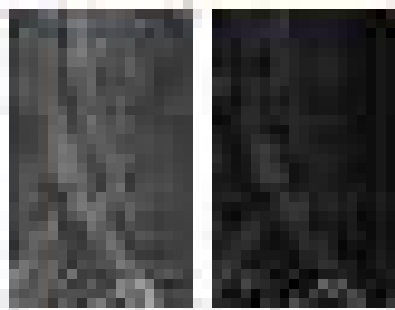


Figure 1: Aerial view of the field showing the layout of the different colored sections.



Figure 2: 3D topographical map of the field showing elevation changes across the area.

The following table provides a summary of the data collected from the field during the experiment. The data is organized by section and includes measurements of area, volume, and other relevant parameters.

The data was collected using a combination of ground-based measurements and aerial photography. The accuracy of the data is estimated to be within 5%.

Section	Area (m ²)	Volume (m ³)	Other Parameters
Section 1	1500	1200	...
Section 2	2000	1800	...
Section 3	1800	1500	...
Section 4	1200	1000	...
Section 5	1000	800	...



Section	Area (m ²)	Volume (m ³)	Other Parameters
Section 1	1500	1200	...
Section 2	2000	1800	...
Section 3	1800	1500	...
Section 4	1200	1000	...
Section 5	1000	800	...



Area	Description	Area (sq ft)	Area (sq yd)
1	Field	10,000	1,111
2	Field	10,000	1,111
3	Field	10,000	1,111
4	Field	10,000	1,111
5	Field	10,000	1,111
6	Field	10,000	1,111
7	Field	10,000	1,111
8	Field	10,000	1,111
9	Field	10,000	1,111
10	Field	10,000	1,111
11	Field	10,000	1,111
12	Field	10,000	1,111
13	Field	10,000	1,111
14	Field	10,000	1,111
15	Field	10,000	1,111
16	Field	10,000	1,111
17	Field	10,000	1,111
18	Field	10,000	1,111
19	Field	10,000	1,111
20	Field	10,000	1,111
21	Field	10,000	1,111
22	Field	10,000	1,111
23	Field	10,000	1,111
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26	Field	10,000	1,111
27	Field	10,000	1,111
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93	Field	10,000	1,111
94	Field	10,000	1,111
95	Field	10,000	1,111
96	Field	10,000	1,111
97	Field	10,000	1,111
98	Field	10,000	1,111
99	Field	10,000	1,111
100	Field	10,000	1,111

Field Area

The following table shows the area of each field in square feet and square yards. The total area of all fields is 1,111,000 square feet, or 122,333 square yards.

Field Area Summary

Total Area: 1,111,000 sq ft (122,333 sq yd)

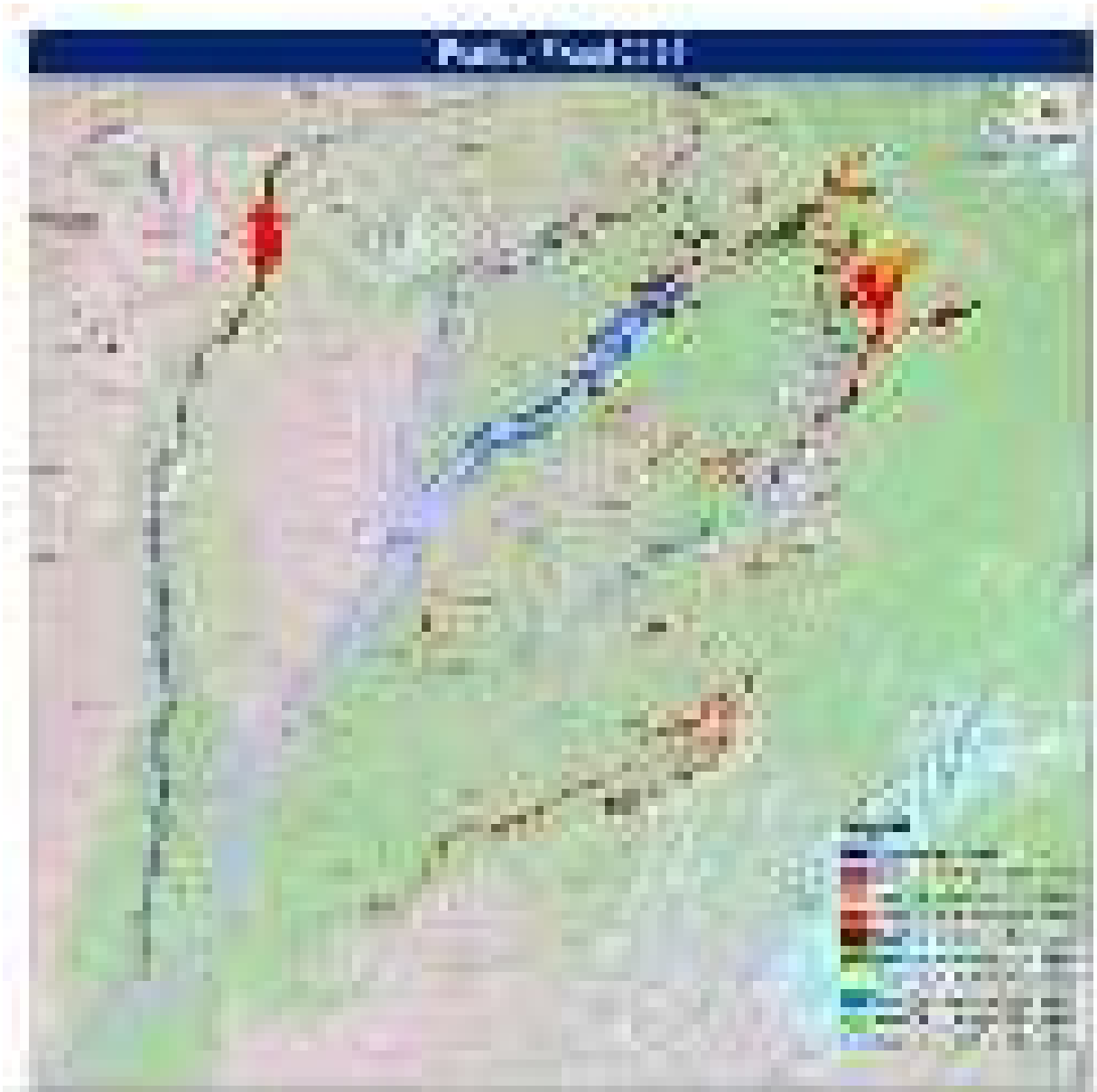
Field No.	Area (sq ft)	Area (sq yd)
1	10,000	1,111
2	10,000	1,111
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6	10,000	1,111
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11	10,000	1,111
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13	10,000	1,111
14	10,000	1,111
15	10,000	1,111
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The following table shows the area of each field in square feet and square yards. The total area of all fields is 1,111,000 square feet, or 122,333 square yards.



Area of each field in square feet and square yards

DAILY MONITORING OF RIVERS - MODIS



DAILY MONITORING OF RIVERS - MODIS



MONITORING OF RIVERS

FOR THE YEAR 2018-19

Good Water Quality

Polluted

BOD/BIP

Legend

- Green: Good Water Quality
- Yellow: Polluted
- Red: BOD/BIP

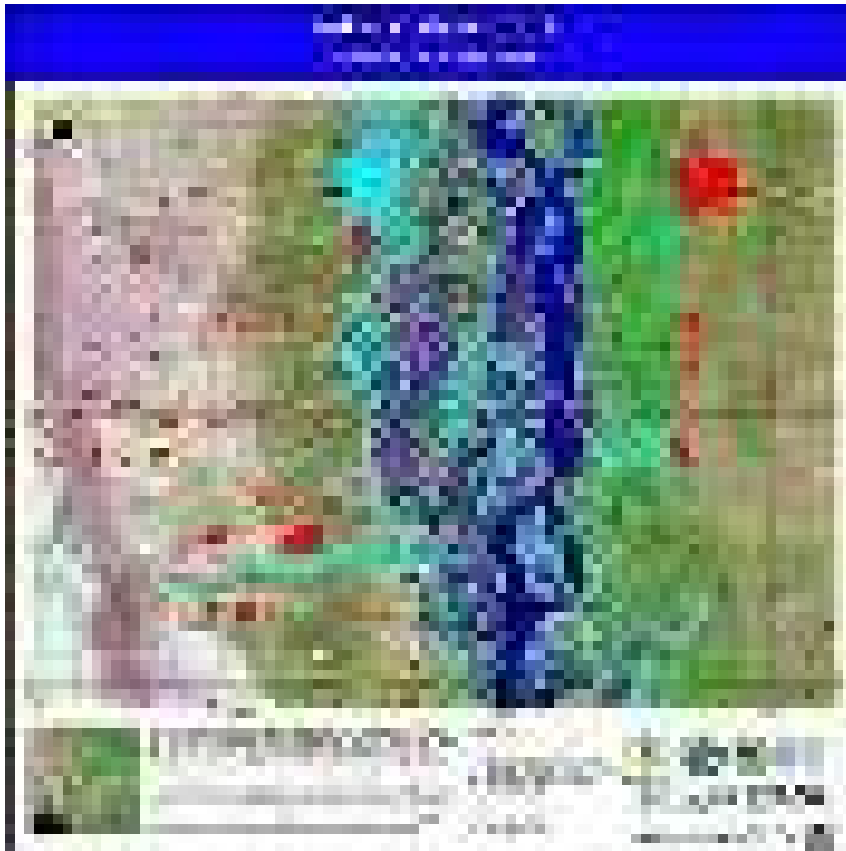
FOR THE YEAR 2018-19

MONITORING OF RIVERS

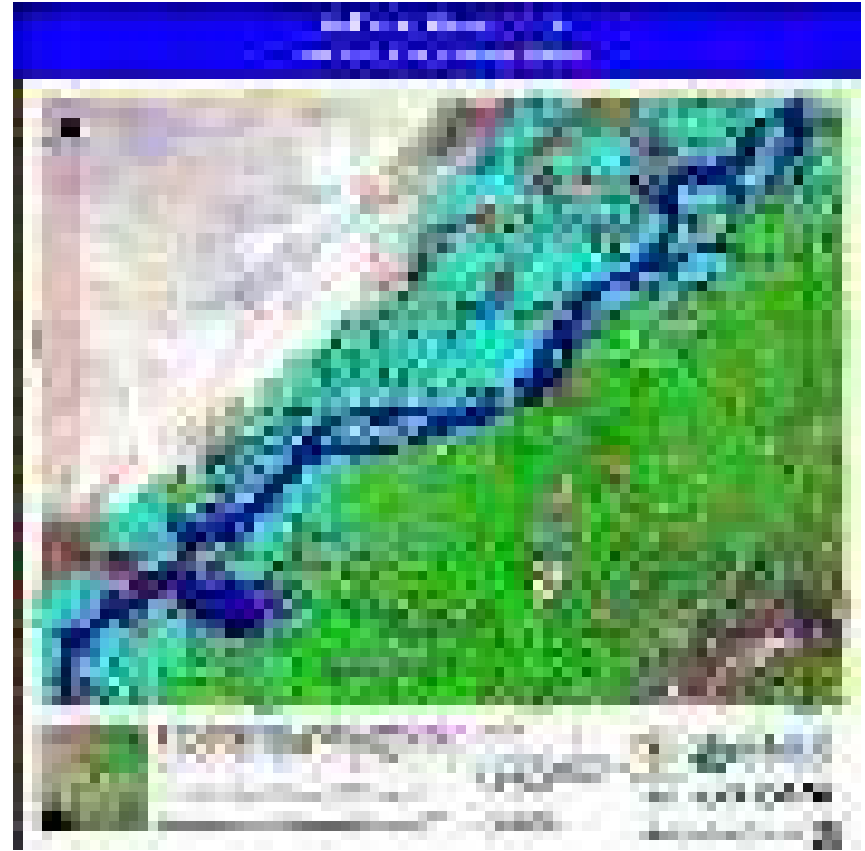


MONITORING WITH SAR

ALOS PALSAR-2 and Sentinel-1 data



Inundations along Lala creek and Indus in Layyah District



Inundations in Rajanpur District due to flash floods and riverine flooding in Indus

THE DISASTER HOTSPOTS ARE MONITORED USING VARIOUS SATELLITE PLATFORMS AND INFORMATION SOURCES TO PROVIDE A COMPLETE PICTURE TO THE DISASTER MANAGEMENT STAKEHOLDERS AND RELIEF AGENCIES.

DETAIL DAMAGE ASSESSMENT AND MAPPING

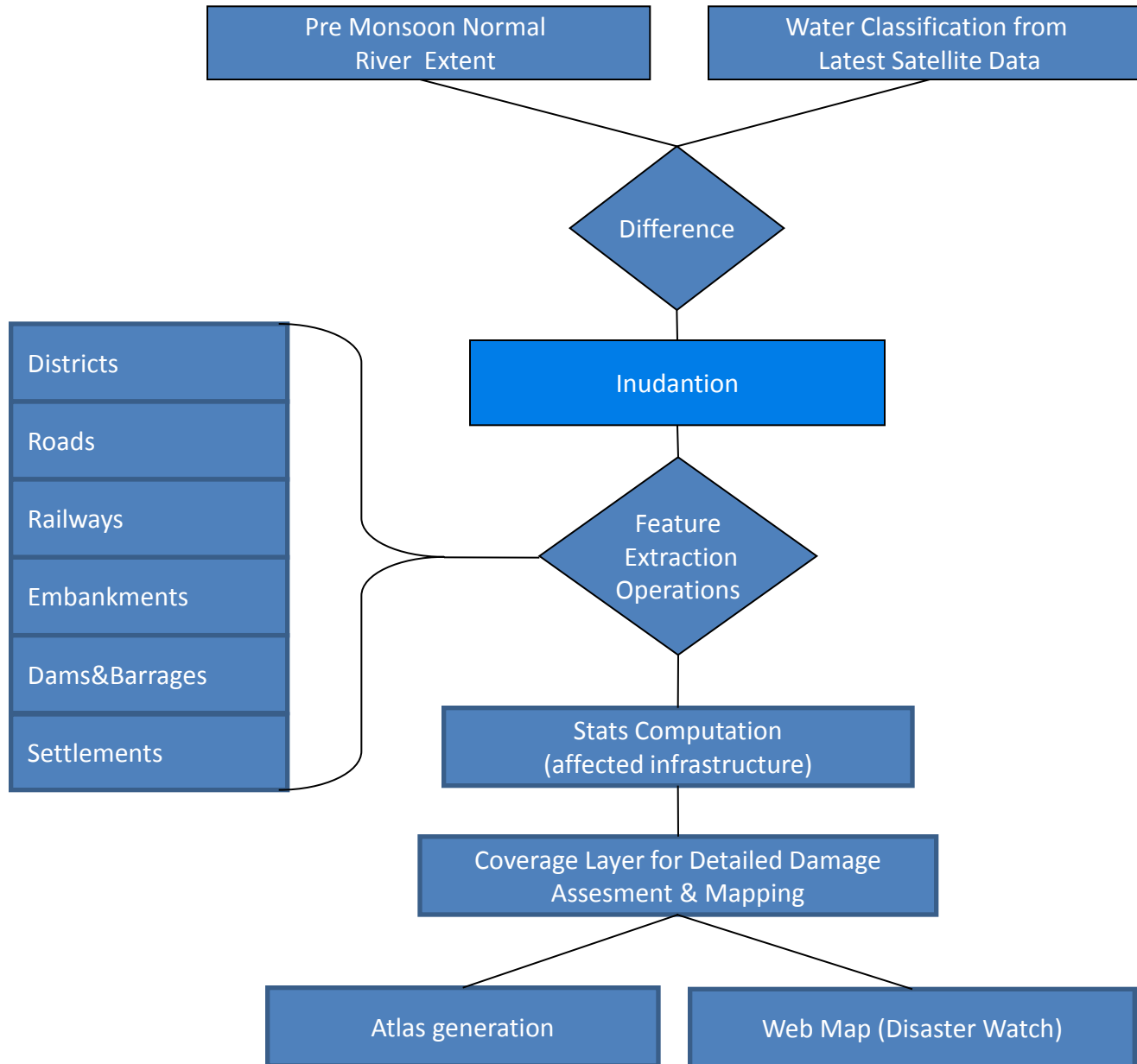
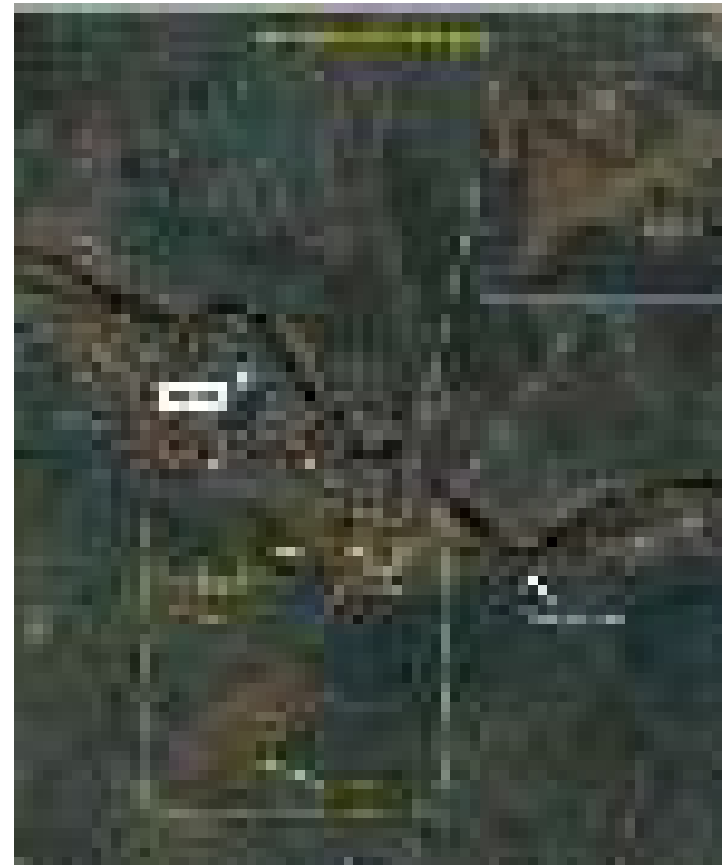
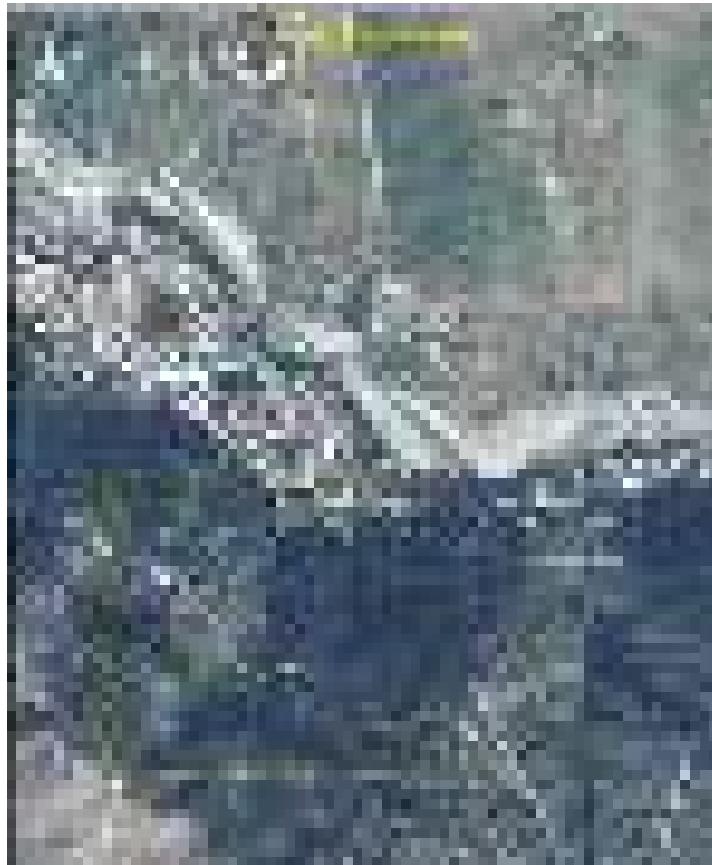




Figure 1 A large mural in a classroom at a university in the United States. The mural is a colorful abstract design that includes a central blue and green shape, possibly representing a stylized figure or a landscape element, surrounded by various other colors and patterns. The background is a textured, light-colored surface.

MONITORING OF LANDSLIDE – KARORA 2016

A landslide triggered by monsoon rains hit over 30 houses at Karora Area, District Shangla, KP on 02 July 2016. Heavy rains and landslides also blocked Swat-Bisham road.



Imagery: GF-2 Date: 07-07-16

Spatial analysis was performed on 0.8 m GaoFen-2 Satellite data provided by UN-SPIDER Beijing office in collaboration with Chinese National Space Administration (CNSA).

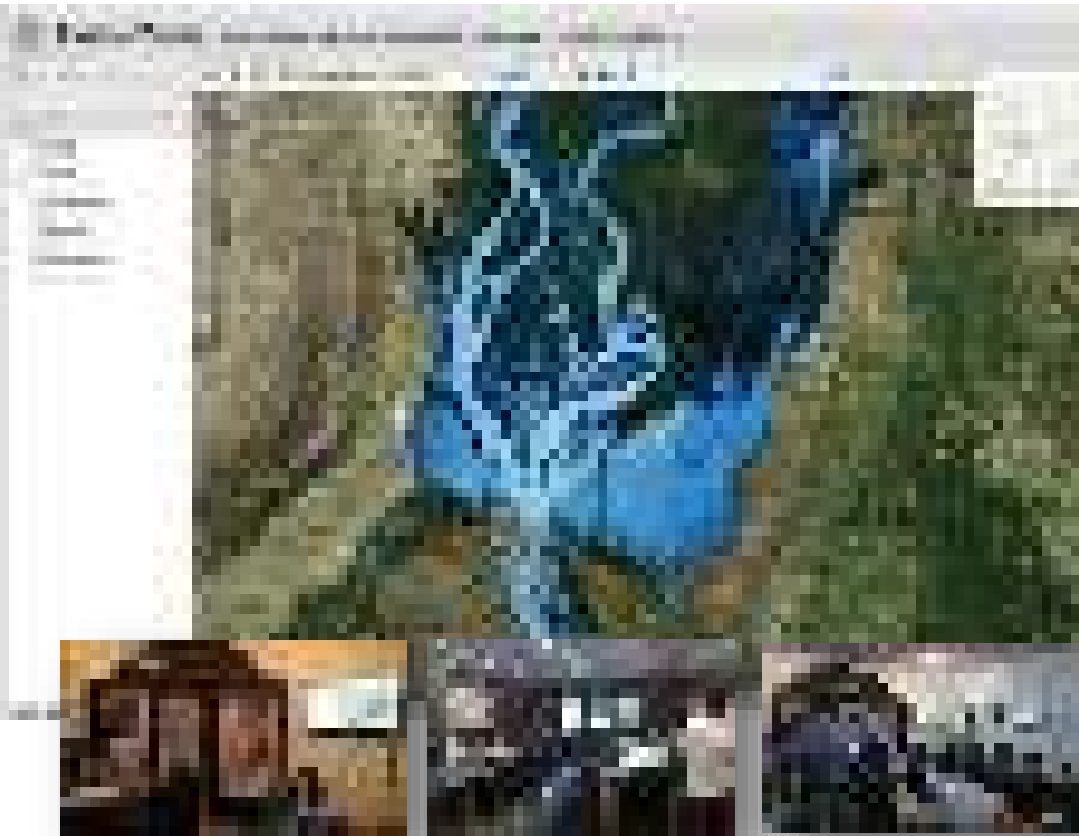
MONITORING OF LANDSLIDE – HAVELIAN 2015



Spatial analysis was performed on 0.5 m Pleiades Satellite data.

NEAR REAL-TIME SUPPORT THROUGH **DISASTERWATCH**

DISASTERWATCH DEPLOYMENT AND INTEGRATION WITH NDMA AND PITB



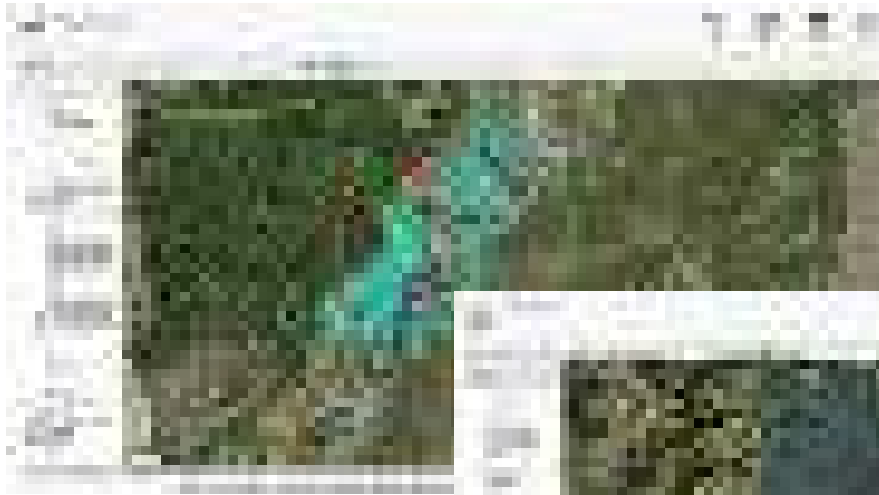
SUPARCO's DisasterWatch web portal being utilized and referenced at a press-conference in Flood control room, S&GAD (Civil Secretariat) Punjab and PDMA Punjab control room.



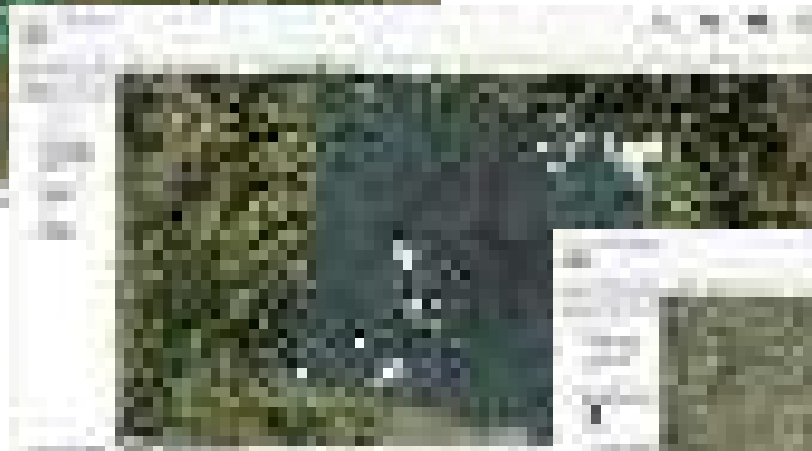
- **THE INFORMATION IS DISSEMINATED TO FLOOD MANAGEMENT STAKEHOLDERS AT EVERY LEVEL THROUGH INDIGENOUSLY DEVELOPED WEB-BASED VISUALIZATION PLATFORM 'DISASTERWATCH', PRINTED MAPS AND STATISTICS.**
- **DISASTERWATCH PORTAL HAS ADDITIONALLY BEEN INTEGRATED AT WITH THE NDMA AND PUNJAB GOVERNMENT'S OFFICIAL WEBSITES, THROUGH WHICH, RESCUE / RELIEF AND FLOOD MANAGEMENT ORGANIZATIONS SUCH AS RESCUE 1122, PID, BoR, P&D ACCESS LATEST SATELLITE BASED DATASET AND SPATIAL INFORMATION FOR PLANNING AND RELIEF ACTIVITIES.**

DISASTERWATCH PLATFORM

USING DISASTERWATCH FOR DISSEMINATION OF SPATIAL DATA AND ANALYSIS



CROP DAMAGE ASSESSMENT



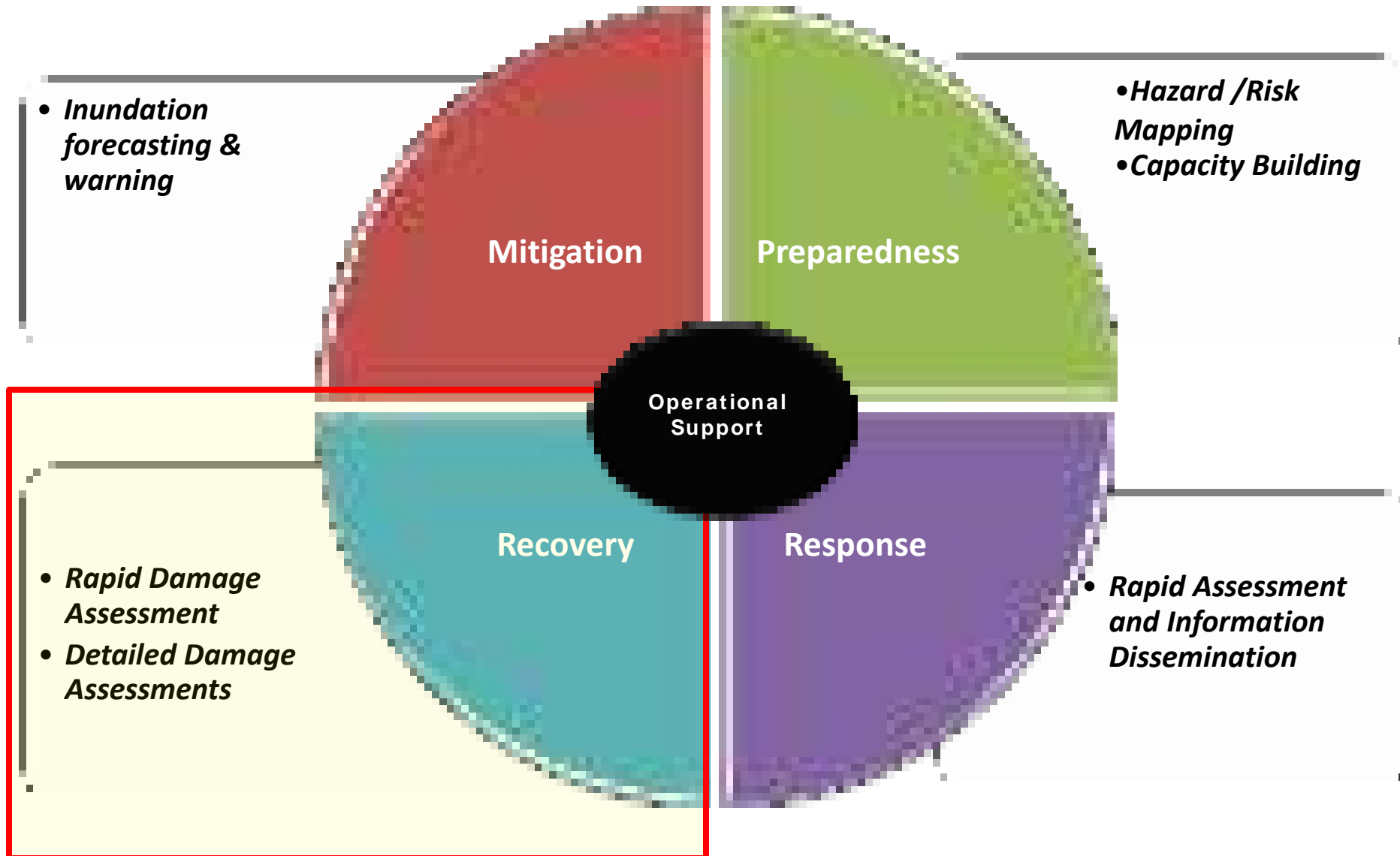
RAPID DAMAGE ASSESSMENT



WATER-OCCURENCE BASELINE

- THE DISASTERWATCH PLATFORM HAS BECOME THE CENTRAL WEB PORTAL FOR DISSEMINATION OF VARIOUS SATELLITE BASED ANALYSIS AND VALUE ADDED PRODUCTS AND SOLUTIONS. THE DISASTERWATCH PORTAL CURRENTLY PROVIDES ANALYSIS AND SATELLITE BASED INFORMATION FOR EARTHQUAKE, FLOODS, LANDSLIDES AND DROUGHT

GEOSPATIAL TECHNOLOGIES FOR FLOOD MANAGEMENT



MONITORING OF KEY INFRASTRUCTURE

The image displays a satellite view of a coastal region. A red marker is placed on the map, with a red line extending to the left and the text "412.2" below it. Two yellow arrows originate from the marker: one points to a smaller inset image of a coastal structure, and the other points to a larger inset image of a coastal landscape. To the right of the satellite map is a document page with a map and text.

The document page on the right contains a map of the same coastal area, with a red marker and a red line labeled "412.2". Below the map is a table with the following text:

Station	Location	Depth	Water Type	Water Level	Water Temperature	Water Quality
1	Station 1	10m	Open Ocean	10m	10m	10m
2	Station 2	10m	Open Ocean	10m	10m	10m
3	Station 3	10m	Open Ocean	10m	10m	10m
4	Station 4	10m	Open Ocean	10m	10m	10m
5	Station 5	10m	Open Ocean	10m	10m	10m

MONITORING OF BANK EROSION



HOUSE DAMAGE ASSESSMENT – FLOODS 2015



SUPARCO WAS REQUESTED BY THE GOVERNMENT OF PAKISTAN TO ASSIST IN VALIDATION OF HOUSE DAMAGE ASSESSMENT SURVEYS. THE VALIDATED DATA IS THEN USED FOR THE DISBURSEMENT OF COMPENSATIONS BY THE GOVERNMENT.

CONCLUSION

- The role of the Geospatial technologies in flood monitoring is proven
- Flood Modeling play a great role in Flood Hazard Assessment and mapping
- Multiple datasets should be used for the flood monitoring including Optical as well as SAR
- In-situ data must be used with earth observation for damage assessment