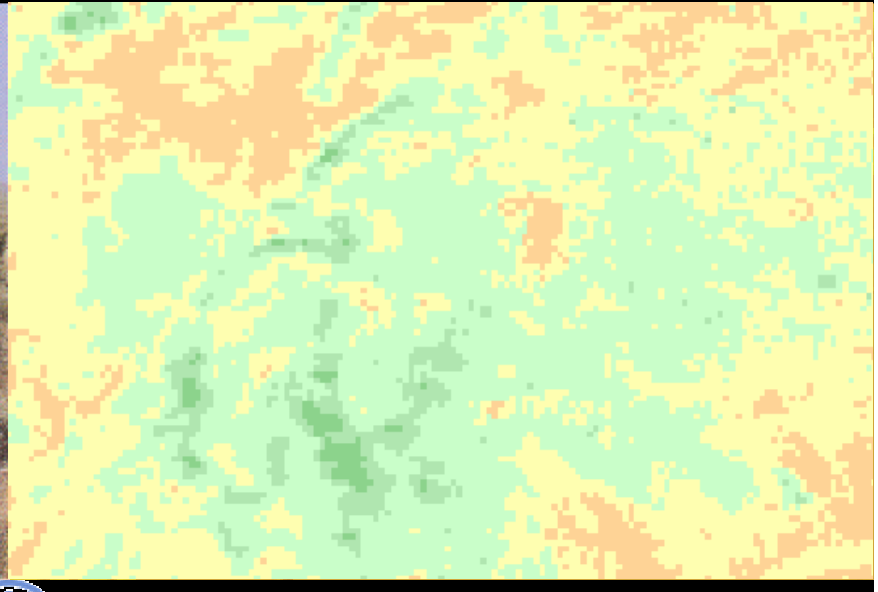
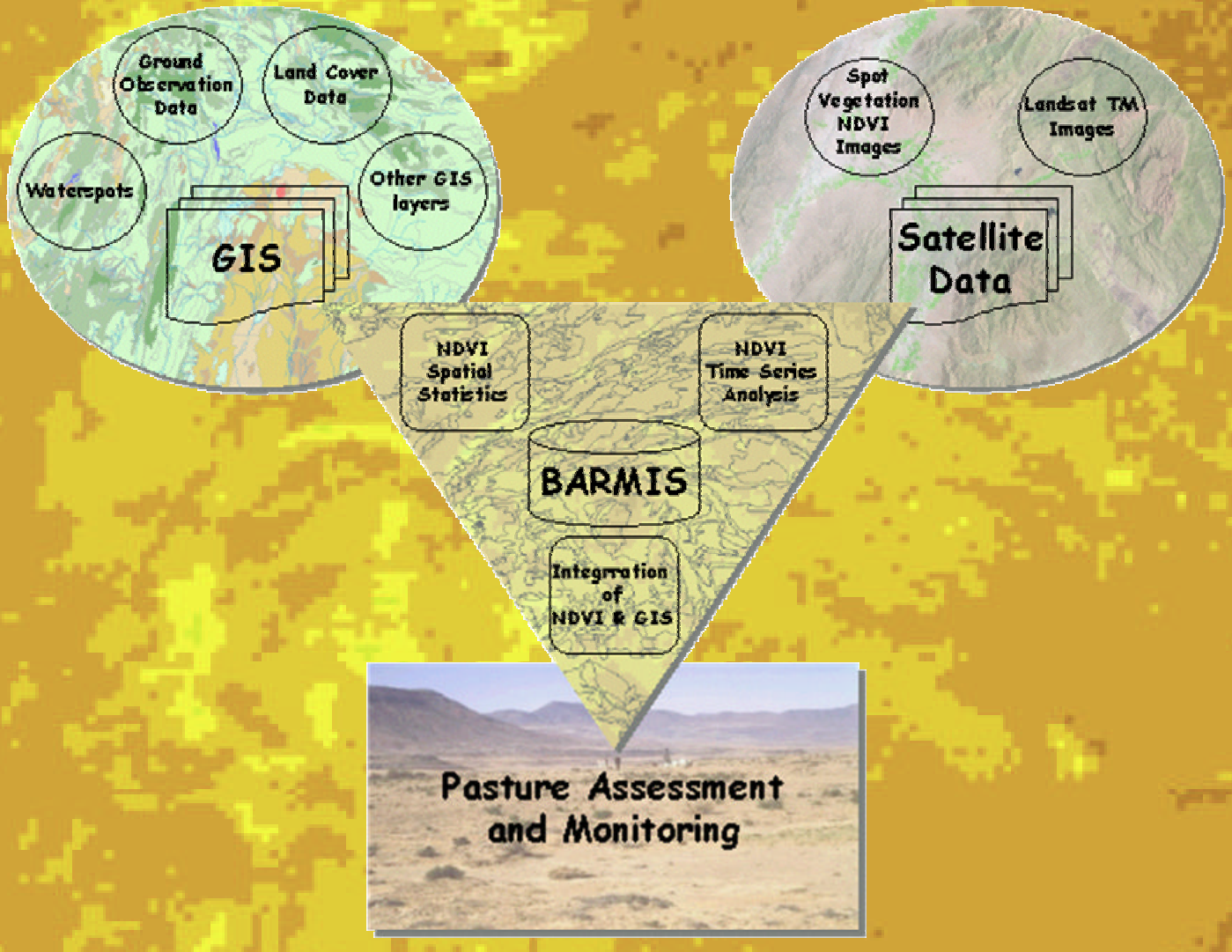
DEVELOPMENT OF A PASTURE ASSESSMENT AND MONITORING SYSTEM FOR PAKISTAN (PAMS)



THE NEED FOR MULTI-TEMPORAL SATELLITE BASED RANGELAND INFORMATION

- The human and livestock population in Balochistan (Pakistan) increases by 7% annually, largely influenced by Afghan refugees. This rapid development imposes a heavy load on the ecological system of the province. In order to answer this challenge an environmental monitoring system has been developed in the framework of the PAK/88/071 project of FAO.
- The Balochistan Rangeland Monitoring and Information System (BARMIS) is a PC-based stand-alone system providing data management and analysis tools through a user interface.
- Main objective of BARMIS is to support the rangeland monitoring of Balochistan by integrating data from remote sensing, GIS, and field observations.
- This provides significant multi-temporal and up to date information for the decision makers at the Integrated Rangeland Management Unit within the Forest Department of Balochistan.

The PAMS methodological approach



THE BALOCHISTAN RANGELAND MONITORING AND INFORMATION SYSTEM (BARMIS)

Introduction

- Managing natural resources effectively, and adopting measures to protect the environment, means drawing on as many sources of information as possible.
- Timely and accurate remote sensing and geographic information is a major data source for local, regional and global change monitoring.
- SPOT - Vegetation data was found to be very useful and accurate for the assessment and monitoring of regional and global vegetation change and condition on a long term and real-time basis.
- Most common vegetation monitoring methods use vegetation indices. The Normalized Difference Vegetation Index (NDVI), which can be directly calculated from Satellite data, is related to vegetation canopy characteristics such as biomass and percentage of vegetation cover.

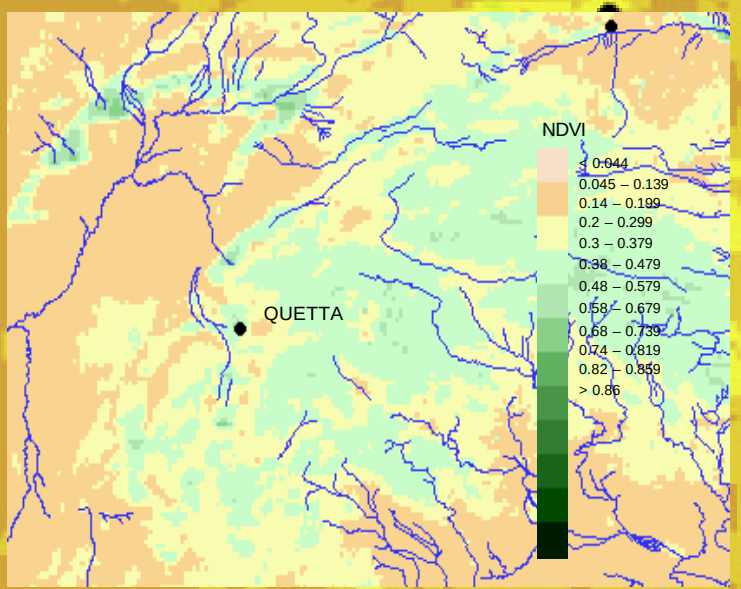
THE BALOCHISTAN RANGELAND MONITORING AND INFORMATION SYSTEM (BARMIS)

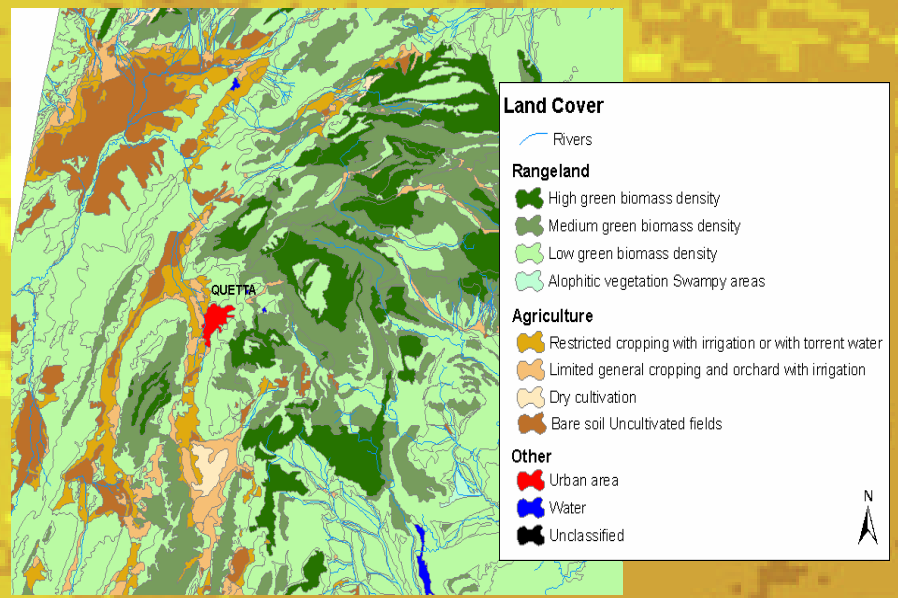
- The NDVI is therefore representative of plants' photosynthetic efficiency, and it’s time varying due to changes in meteorological and environmental parameters.
- The integration of this satellite derived information with geographic information such as land cover- and related digital maps, waterspots and distances to these, ground observation data like, vegetation cover and type, biomass and palatable biomass, etc. lead then to a powerful pasture assessment and monitoring system.

THE BALOCHISTAN RANGELAND MONITORING AND INFORMATION SYSTEM (BARMIS)

The software

- BARMIS is a GIS based software tool especially tailored for the investigation of the status of the rangeland in Balochistan. It allows a wide range of applications from getting a first overview of the rangeland conditions in near real-time using low resolution SPOT-Vegetation NDVI images, up to detailed spatial- and time series analysis by integrating additional information layers like digital elevation model (DEM), GIS and field data.





THE BALOCHISTAN RANGELAND MONITORING AND INFORMATION SYSTEM (BARMIS)

NDVI display and analysis

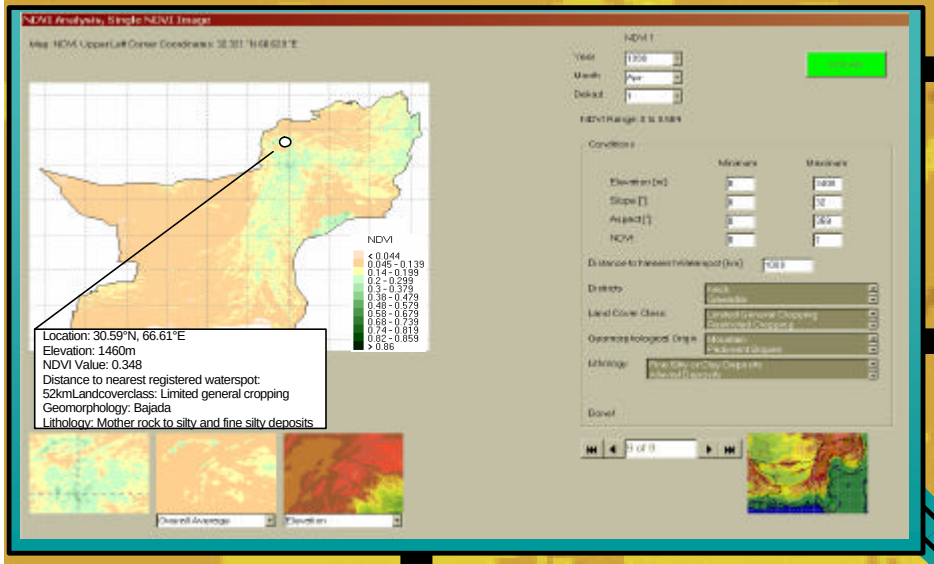
- The first function of BARMIS is the storage and display of NDVI images for each decade since April 1998, either for the whole of Balochistan or for any zoomed region.
- Furthermore, images showing the minimum, maximum and average values of the NDVI for long term periods or for annual or decade periods can be displayed for comparison.
- More information can be obtained from making difference images between current and reference years or decades.
- The displayed NDVI image can be further classified in order to show only the NDVI for specific user defined conditions like elevation, slope, distance to nearest water spot, land cover, etc.
- For the whole of Balochistan or for any chosen sub-region the system provides possibilities for in-depth spatial analysis by visualizing relationships between NDVI classes and altitude, slope, or aspect ranges.
- Moreover, for each of the selected areas or for the whole of Balochistan time series analysis can be done. A graphic utility shows the time series of NDVI for the selected region as well as its minimum, maximum and average annual cycle for reference purposes.

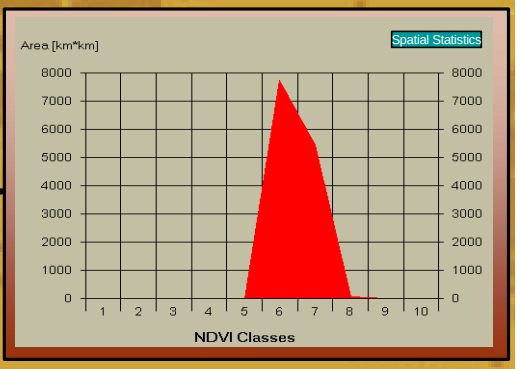
THE BALOCHISTAN RANGELAND MONITORING AND INFORMATION SYSTEM (BARMIS)

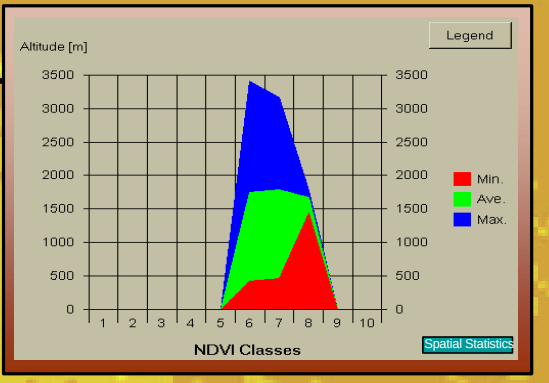
Biomass estimation

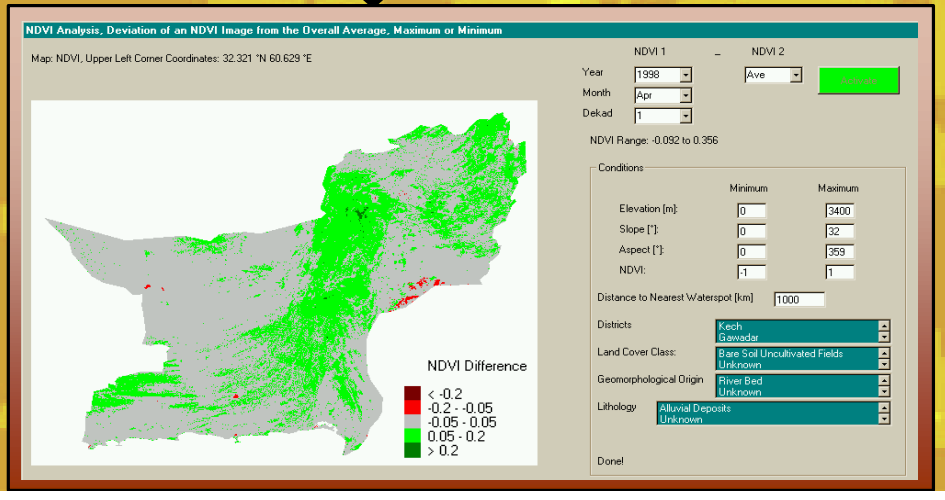
- One of the main aims of pasture assessment and therefore of BARMIS, is to obtain information about biomass and specifically palatable biomass of a specific region or for areas with similar geo-physical characteristics.
- The basis for the biomass estimates in BARMIS is a linear relationship between the NDVI value and biomass with parameters documented in literature.
- However, if for certain points in time both the NDVI and field measured biomass are known, then that specific relationship updates the linear regression parameters for that location of observation or for areas classified as being similar.
- Regional biomass estimates are derived using the same regression relation for all areas that are characterised by the same land cover and similar lithological and geomorphological conditions.

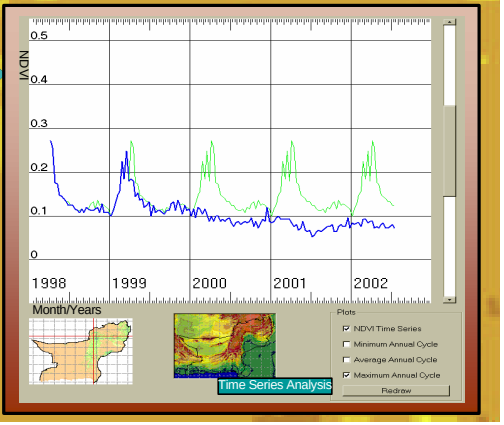
EXAMPLE OF BARMIS RESULTS











EVALUATION AND RECOMMENDATIONS

Advantages of satellite based rangeland monitoring and information systems

- Rapid increases in human and livestock populations along with diversion of grazing land to other uses, have contributed to increasing grazing pressures, particularly in arid and semi-arid environments.
- The assessment of grassland condition and productivity and the correct management of grazing lands and the design and execution of projects to improve sustainable extensive livestock production and enhance the living standards of traditional herders, is the major objective and outcome of an efficient rangeland monitoring and information system.
- Satellite based multi-temporal rangeland monitoring provides a synoptic and cost-effective evaluation over large areas at the same time.
- The integration of this remotely sensed information into a geographic information system allows to better link different data sources for the processing, evaluation and interpretation of rangeland information in order to obtain an accurate and innovative information system for decision makers.

EVALUATION AND RECOMMENDATIONS

Conclusion

- The methodology developed for the PAK/88/071 project of FAO demonstrated the capability and cost–effectiveness of multi-temporal satellite remote sensing integrated with a geographic information system for pasture assessment and monitoring in Balochistan (Pakistan).
- The Balochistan Rangeland Monitoring and Information System (BARMIS) is tailored for a region with specific environmental parameters, but the approach presented could be easily implemented in regions with similar environmental characteristics.