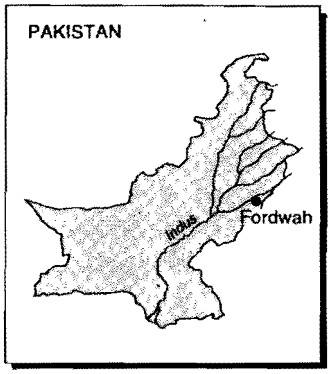
# ITIS in the Field: Water Quality

**PAKISTAN**




## Remote Sensing Applied to the Assessment of Salinity in Irrigation Systems: Some Results Obtained in Punjab

### INTRODUCTION

Among the 270 million hectares of irrigated surfaces, it is admitted that 100 million have been, or will soon be, brought out of cultivation due to waterlogging, or soil salinization, or both, as a result of irrigation (Smedema 1995). Accurate information to assess the magnitude of these problems for specific irrigation schemes and to identify solutions for improvements is rare. Thus, satellite remote sensing represents a great potential for salinity assessment, especially in large irrigation systems such as those existing in Pakistan.

Since 1994, Cemagref and IIMI have been cooperating to develop an integrated approach to assess the impact of changes in irrigation management on agricultural production and salinity. The approach is currently developed and tested in a large irrigation system in Pakistan, a country with 17 million irrigated hectares, where there are soil salinization concerns around 20 percent of the area. The irrigation system selected for testing the integrated approach is the Chishtian Subdivision of the Fordwah/Eastern Sadiqia Irrigation System, South Punjab. With a command area of 69,000 hectares, the Chishtian Subdivision is fed by the Fordwah Branch Canal, and includes a mix of perennial (receiving canal water the year-round) and non-perennial (receiving canal water during the kharif or summer season only) secondary canal or distributaries. Surface water is complemented by groundwater of lower quality (higher salt content), pumped by more than 4,400 private tube wells installed by farmers in the command area of the Chishtian Subdivision.

This article briefly presents the first results obtained in the assessment of soil salinity using remote sensing techniques.

### SOIL SALINITY MAPPING

Several studies have already been completed on the assessment of soil salinity using remote sensing, but they have not been very successful. The original method developed by Tabet (1995) relates the vegetation and brightness indexes derived from SPOT XS to visual observations of salinity indicators.

The obtained classification enables to identify mainly the areas of high salinity (66% of well classified fields), and non-saline areas (80% of well classified fields). The areas with low to medium salinity are more difficult to identify. Current studies try to improve these results by using several SPOT and Landsat-TM images on the same cropping season, and by validating visual observations with soil analyses undertaken in laboratories. This classification provides a first map of salinity on the irrigated area.

### ANALYZING THE DISTRIBUTION OF SOIL SALINITY IN RELATION TO OTHER SPATIAL FEATURES

When the limits of the watercourse tertiary command areas and the topography are displayed along with SPOT-derived salinity maps, it is possible to obtain preliminary information on some of the causes of salinity. Though it would be necessary to model transfers of salts from tube well water to fields, two trends have been identified for two sample watercourse command areas:

- *Primary salinity* is related to local morpho-pedogenetic conditions, and, in the present case, located in micro-depressions with more clayey soils corresponding to old meanders of the Sutlej River. Spatial and temporal dynamics of this salinity type are not well explained yet, but they may be due to the proximity of the water table with vertical and lateral salt transfers and due to seasonal climatic conditions (Tabet et al. 1997).

- *Secondary salinity* is related to irrigation practices, and, in the present case, to the use of low quality groundwater, more saline than canal water: salinity then appears where canal water is rare or even absent (for example, the tail of the watercourse), and/or where groundwater represents an important part of irrigation water.

## PRELIMINARY CONCLUSIONS

Though these first results are encouraging, they are mostly limited to areas where salinity and/or sodicity is already high enough to yield salt crusts on soil and/or salinity patches with vegetated areas, corresponding to a poor crop growth. The detection and the assessment of lower levels of salinity/sodicity within vegetated fields are difficult, mainly because satellite images of common spatial resolution of 20 meters do not allow to get precise information from small fields of 1 acre (0.4 ha), and also because the impact of salinity, and particularly of sodicity, on crop growth and electromagnetic properties needs to be further explored to understand how it can be derived from remote sensed information.

## REFERENCES

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