Location:	Chasma Right Bank, Pakistan
Contractor:	KfW, Frankfurt, Germany
Period:	1999 - 2002

Scope of the project

The construction of the Chasma Right Bank Irrigation (CRBI) project in Pakistan is near to completion. The construction of the irrigation system took place in three phases. Stage I was completed in 1986 and stage II in 1994. The construction of stage III should according to the plan be finished by mid 2002. The project is located in the North West Frontier Province (NWFP) and Punjab Province. The main canal (CRBC) off-takes from the right bank of the existing Chasma barrage and extends southwards. The distribution system comprises 63 distributaries along with minors and four link feeders.

The Kreditangestalt für Wiederaufbau (KfW) has invested in the construction of the main right bank canal (CRBC) and wishes to monitor the progress of land reclamation and agricultural development. In particular, KfW has expressed the need to know whether irrigation canal water is conveyed to crops

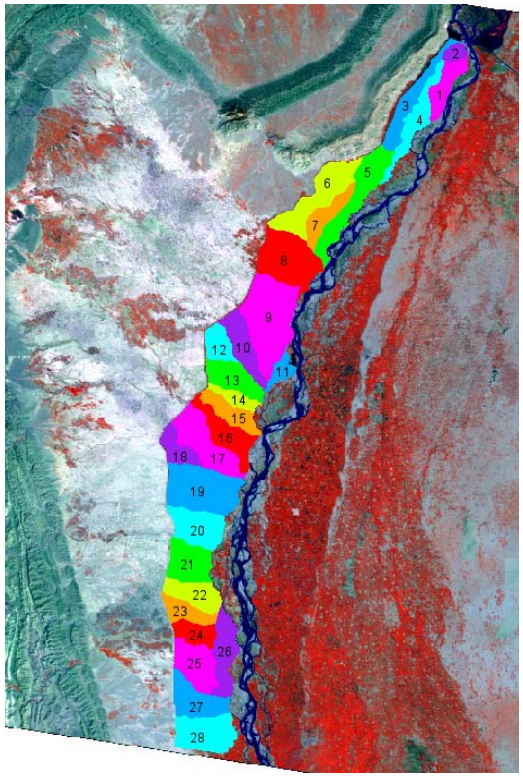

Figure 1: Polygons created to express the remote sensing data at aggregated scale levels. Polygons 11 and 26 tap water resources directly from the main Indus river

and how this development has evolved over the last four years (1999 to 2002). The irrigated area is expected to expand during the course of stage III of the CRBI project. Exact figures on the areas cropped and the water flows are not available or disputed. The latter information is difficult to obtain from classical field surveys.

Study approach

The progress of the agricultural developments in the project area during 1999 to 2002 has been monitored by means of satellite measurements. Raw Landsat satellite measurements have been converted into Leaf Area Index and soil moisture maps. Thereafter, these thematic maps haves been further interpreted into (i) cropping intensity, (ii) irrigation intensity and (iii) water logging intensity to evaluate the agricultural developments.

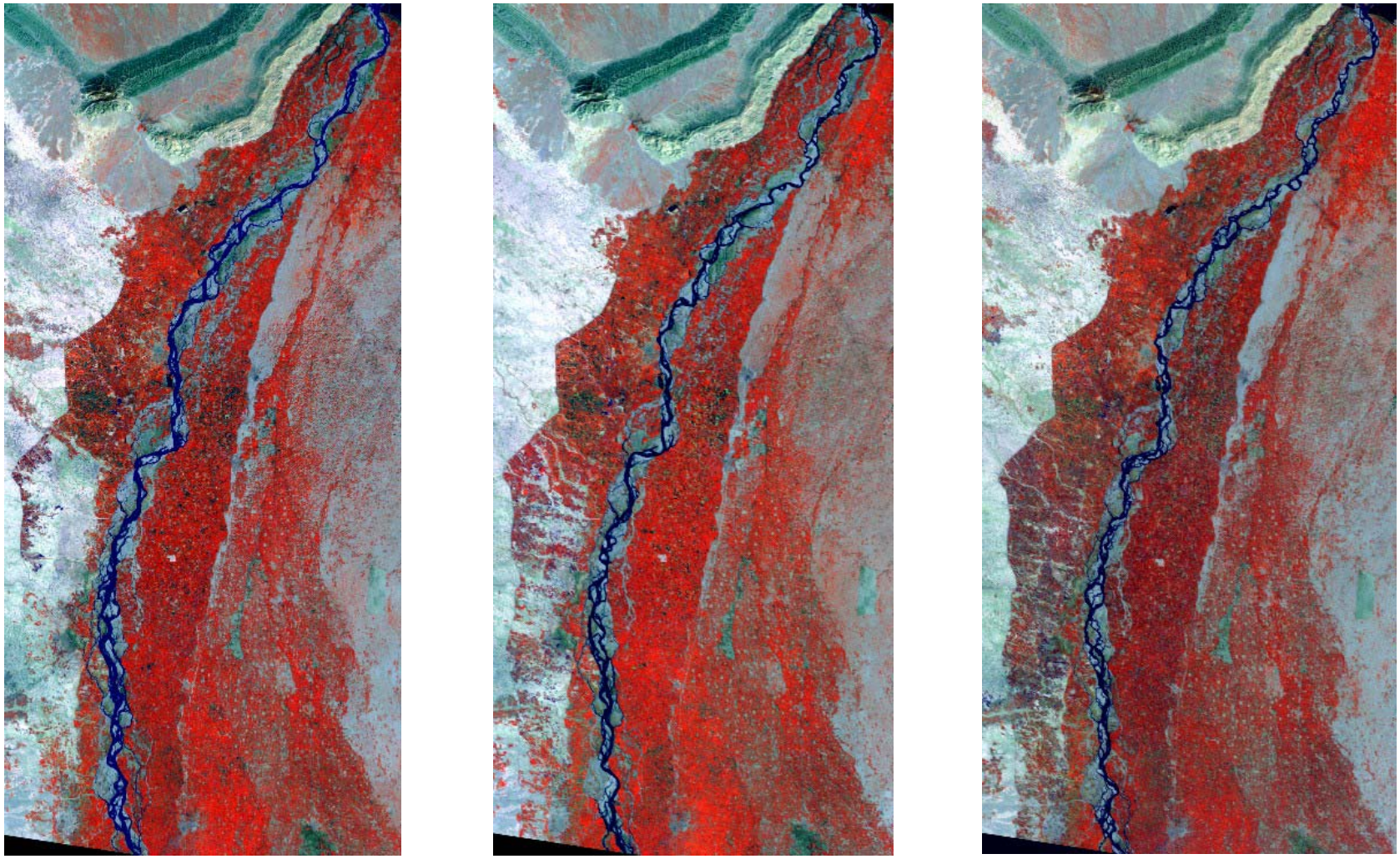

Figure 2: False colour composites of Landsat Enhanced Thematic Mapper images (RGB: 4,5,3) acquired during the winter season (path/row 151/38). Images were acquired on 17 March 2000, 4 March 2001, and 23 March 2002, respectively.

Results

The difference of the irrigated areas for the stage I and II zones between kharif 1999 and kharif 2002 is 87% on average, while it is 435% for the stage III canal command areas (see Fig. 2). This demonstrates that irrigation practices has commenced in the desert areas of stage III. The difference between rabi 2000 and rabi 2002 is 3% for the stage I and II areas, and the increment is 99% for the stage III construction area. Hence, the acreage for the stage I and II areas is stable for rabi and is still expanding further for kharif, despite they have been constructed 10 to 15 years ago.

The average irrigated area is 75,189 ha in kharif and 123,042 ha in rabi (2000, 2001 and 2002). This implies that overall 64% more land is irrigated in rabi as compared to kharif. The higher cropping intensity of rabi as compared to kharif is unexpected and ascribed to the quasi-constant canal flows and large seasonal variations in crop water use. Kharif crops typically consume 650 mm and rabi crops 350 mm. Discharge data

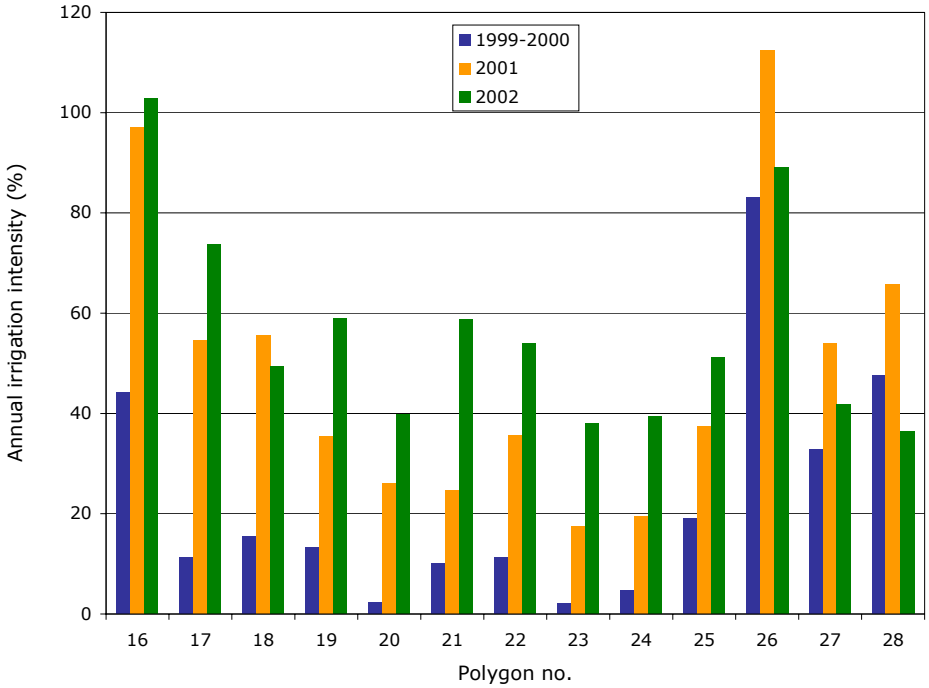

Figure 3: Changes of annual irrigation intensity of polygons 16 to 28 being located in the stage III area

are required to verify this hypothesis. It can also be related to the economical profits of certain crops, which prompts farmers to go for rabi crops.

The results reveal that the annual irrigation intensity of the complete project area (all three stages included) increases from 65% in 1999/2000 via 80% in 2001 to 93% in 2002. The stage I and II command areas have an annual irrigation intensity of 127% (2002) whereas the stage III command areas have an annual irrigation intensity of 58% only. As the maximum annual irrigation intensity is 200%, the stage

III areas have considerable growth potential, if water resources are sufficiently available.

A strong correlation between cropping intensity and soil moisture is found, and this is explained by the adaptive capacity of farmers to changing canal water deliveries. There is a good equilibrium between water delivery and crop water consumption – not only because of a satisfactory statistical coherence (R^2=0.96), but also because water logging does hardly occur in the tail end of the Chasma Right Bank Canal system. Soil salinity could not be detected in the whole Chasma area investigated.

Since there is a logarithmic relationship between soil moisture content and cropping intensity (Fig. 4), it is concluded that the stage III canal command areas need to receive more canal water deliveries to increase their low annual irrigation intensity of 58%. The management of the Chasma Right Bank Canal should give special attention to the reduced cropping intensities in kharif.

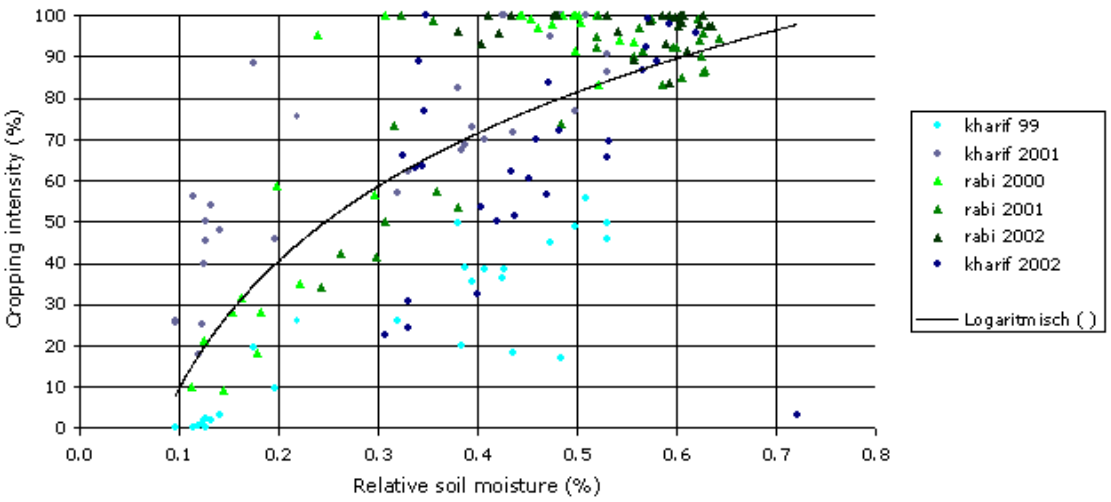

Figure 4: Relationship between cropping intensity (actual/maximum irrigated area) and relative soil moisture content for all 28 polygons and 6 Landsat images (n=168)

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