Scan from Annual Report 1981, p. 50-54, International Institute for Land Reclamation and Improvement (ILRI), Wageningen, The Netherlands.

On website https://www.waterlog.info

At the end new figures are added on salt tolerance of crops which is made possible by new developments in the statistical analysis of field data by means of segmented regression (see https://www.waterlog.info/croptol.htm)

Crop yields, soil salinity, and watertable depth in Pakistan

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The Drainage and Reclamation Institute of Pakistan (DRIP) has been investigating the soil and Water management conditions in the Khairpur East Pilot Area for some time. The aim of the investigation is to compare these conditions before and after the installation of a drainage scheme and so judge the effectiveness of the drainage.

Because the drainage scheme has not yet been fully implemented, a comparison of pre-drainage and post-drainage conditions is not yet possible. The pre-drainage situation, however, has been fully described, and it provides interesting information. Some of the salient points of the pre-drainage situation will be presented in this article. The data used here have been derived from the DRIP report no. IO: 'Kharif cropping in the Khairpur East pilot area' by K.J. Lenselink, Ch. Talib Ali, Anwar-ul-Haq and H.J. Nijland.

Figure l depicts the 'relation' between the depth of the watertable and the salinity of the top soil. As can be seen, there is no straight-forward relation between the two. The figure confirms what has been observed more often in irrigated land: there is not necessarily a correlation between salinity and high watertable.

Figure 2 shows the relation between grain yield of sorghum and depth of watertable. It can be seen here that variations in watertable depth do not influence the yield when the watertable is deeper than 0.6 m below the soil surface. When the watertable is shallower than 0.6 m, yields decline. The relation between watertable depth and yield is not linear. If the watertable depth of 0.6 m is taken as a breakpoint, however; the relation can be approximated by two straight lines: an upward sloping line in the range of watertable depths of 0-60 cm and a horizontal line in the range of watertable depths of 60 cm and more.

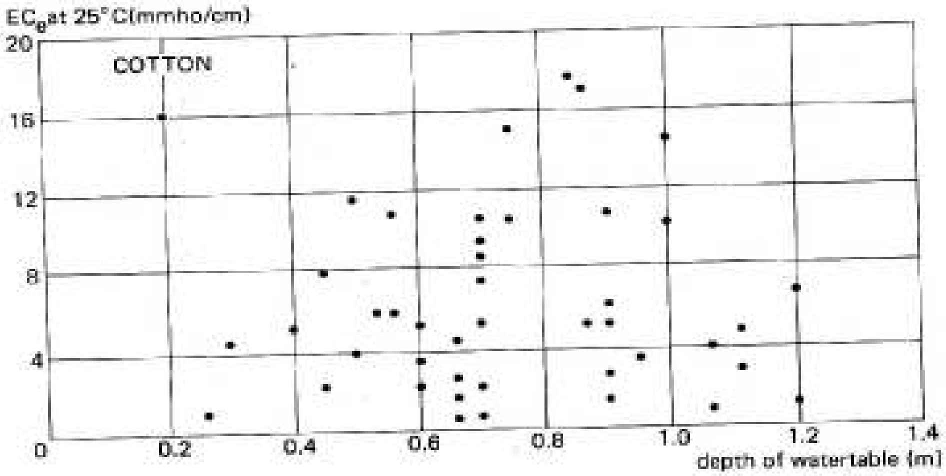


Figure 1. Relation between soil salinity (expressed in electric conductivity of saturation extract of topsoil) and depth of watertable at harvest date

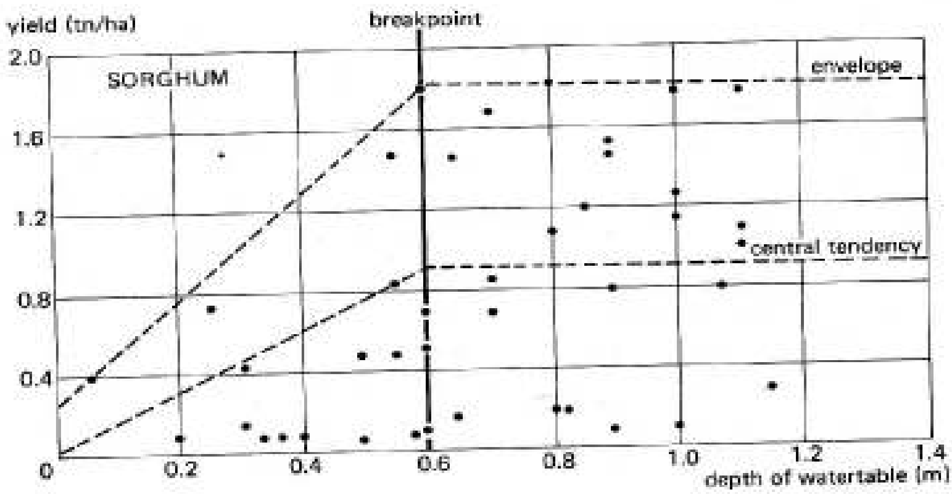


Figure 2. Relation between yield of sorghum and depth of watertable at harvest date

A similar pattern is observed in Figure 3, which refers to cotton yields.

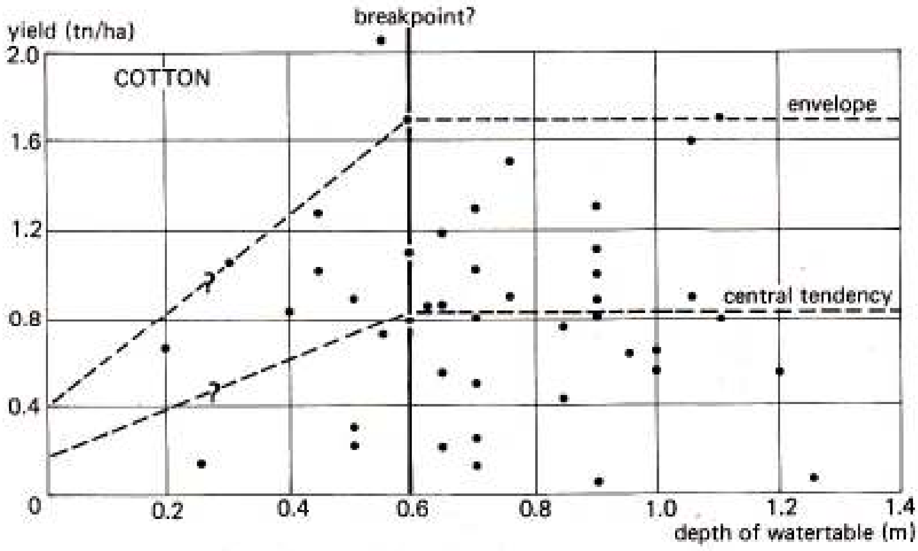


Figure 3. Relation between yield of cotton and depth of watertable at harvest date

One would need more yield observations at shallow watertable depths to confirm the existing relation in the shallow range and to render it statistically significant. For the deeper watertable, on the other hand, it is perfectly clear that there can be no significant yield increase at increasing depths of the watertable. Hence, drawing the watertable down to levels deeper than 60 cm by drainage is not worth the cost.

Judging from the number of points with watertable depths of less than 0.6 m, about 20 to 30 per cent of the area has a problem of high watertables. The majority of the low yields cannot be explained by poor drainage. They must be due to other cultivation conditions.

Figure 4 presents the relation between the grain yield of sorghum and soil salinity. As in the earlier figures, a breakpoint is clearly Visible. Below EC values of 8, the yield does not react to changes in ECe Salues, and if there were any reaction, the phenomenon would be obscured by other effects which are much stronger. Above ECe values of 8, the yields become less with increasing EC , although more data are required to substantiate this relgtion. Cotton appears to be somewhat more salt-tolerant than sorghum, as the breakpoint seems to be at an ECe value of around I2 (Figure 5).

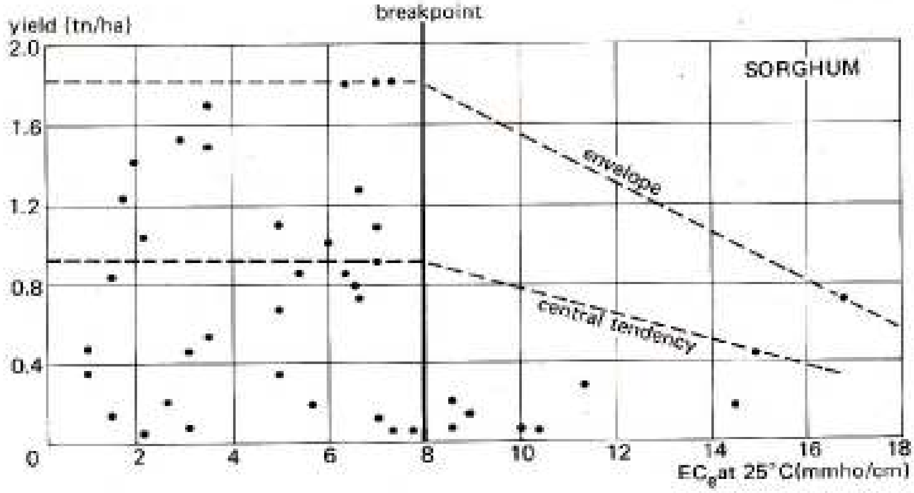


Figure 4. Relation between grain yield of sorghum and soil salinity (EC_e) at harvest date. (For explanation EC_e see Figure 1.)

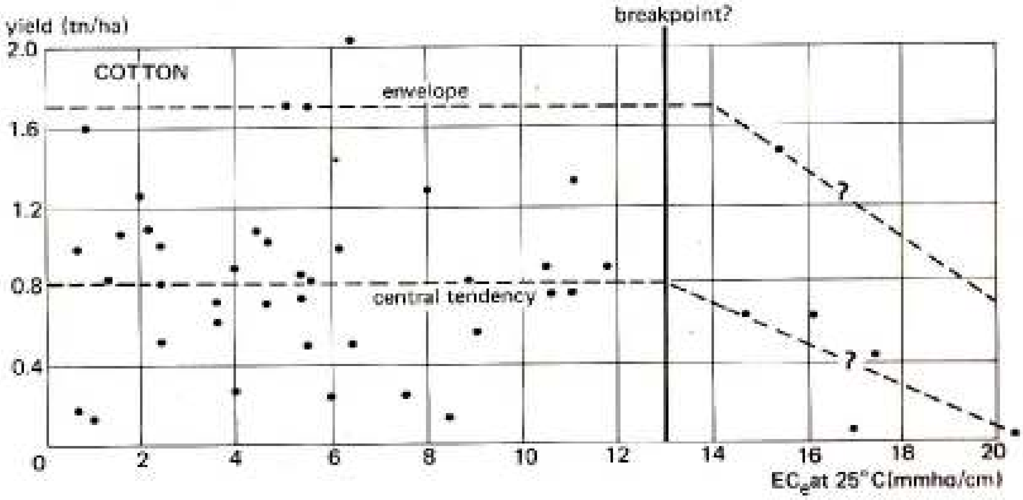


Figure 5. Relation between yield of cotton and soil salinity (EC_e) at harvest date. (For explanation of EC_e see Figure 1.)

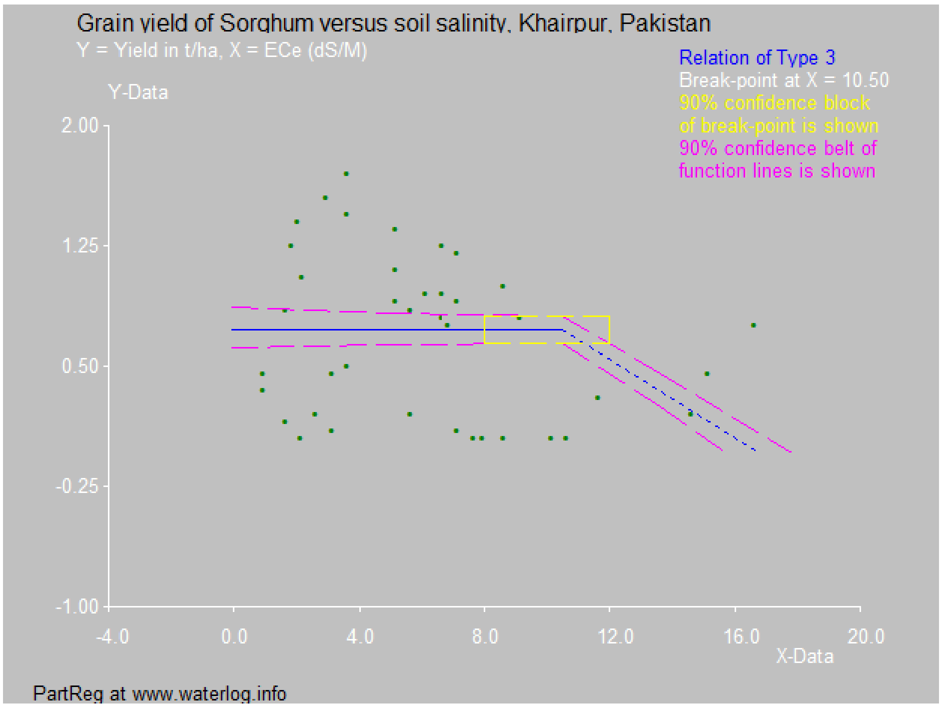
Judging from the number of points with EC >8 (sorghum fields) and ECe>l2 (cotton fields), aboutelO to 20 per cent of the area has.salinity problems. An insignificant minority of points indicate both drainage and salinity problems at the same time. Any overlap of effects can therefore be ignored.

Under the assumptions that the installation of a drainage system cures all drainage problems as well as all salinity problems (which is possible only if at the same time irrigation is so practised that it allows regular leaching of the fields), the graphs provide an opportunity to estimate the yield increase that will result from drainage.

Since the above assumptions are only partly realistic and since only a minority of sample points will benefit from drainage, the yield increase will probably not be dramatic. Continuation of the crop-cutting survey after the installation of the drainage system should provide the final answer to the question of yield increase.

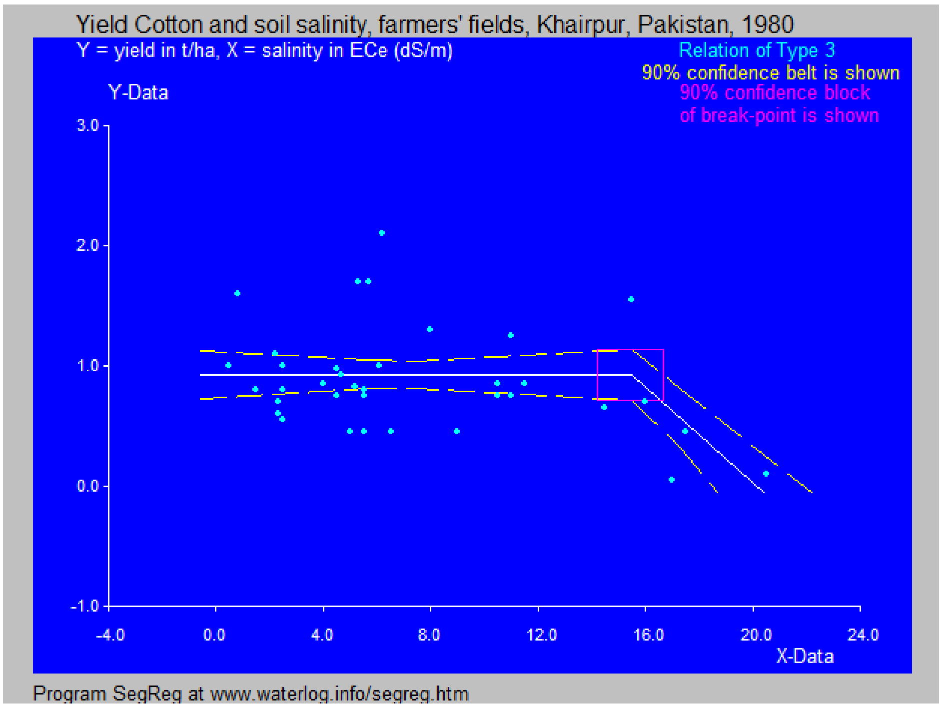
ADDENDUM

Made possible by new developments in the statistical analysis of field data by means of segmented regression



Sorghum is salt tolerant up to an ECe of 10.5 dS/m

Figure made by PartReg (www.waterlog.info/partreg.htm)



Cotton is salt tolerant up to an ECe of 15.5 dS/m

Figure made by SegReg (www.waterlog.info/segreg.htm)