

SHORT, NON-REFEREED PAPER

SOIL SALINITY MANAGEMENT: QUESTIONNAIRE RESULTS ON FARMER PERCEPTIONS, KNOWLEDGE LEVELS AND PRACTICES

JUMMAN A¹, VAN HEERDEN PS², VAN ANTWERPEN R^{1,3},
VAN RENSBURG LD³ AND ADENDORFF M¹

¹South African Sugarcane Research Institute, P/Bag X02, Mount Edgecombe, 4300, South Africa

²Picwat, PO BOX 11632, Universitas, 9321, South Africa

³University of Free State, Department of Soil, Crop and Climate Sciences,
Faculty of Natural Sciences, PO BOX 339, Bloemfontein, 9300

ashiel.jumman@sugar.org.za

Abstract

Production on 20% of irrigated sugarcane land in South Africa is affected by salinity. To facilitate effective extension interventions, farmers' current perceptions, knowledge levels and practices needed to be captured. A structured questionnaire survey was conducted with 34 commercial sugarcane growers, farming an area of 18 174 ha (17% of the sugarcane area under irrigation in South Africa). The questionnaire comprised 51 questions, of which 23 were 5-point Likert-scale questions used to test five hypotheses (H1-H5). The remaining questions captured baseline data and supplemental information, with the aim of testing knowledge and perceptions of soil salinity. The hypotheses test results suggested that participants adequately perceived the threat of salinity (H1) and also have sufficient knowledge about the causes (H2) and the preventative and corrective measures for salinity management (H3). In addition, the sample of farmers appeared to be satisfied that the benefits of salinity management outweigh the costs (H4). The only hypothesis which was accepted was that the benefits of preventative and corrective measures *did not* outweigh the implementation effort (H5).

In stark contrast to H1–H4 test results, data from other questions indicated very little evidence of implemented practices or measures aimed at addressing the problem, that is (a) no consideration of salinity in irrigation scheduling (66% of sample); (b) few examples of controlled leaching being implemented (12% of sample); (c) little differentiation in irrigation strategy for saline and non-saline soils (26%); and (d) very little tracking of water quality and soil salinity status. In conclusion, farmers were aware of the salinity threat, but were not actively engaged in addressing the problem. Farmers were uncertain about the effort required to implement salinity management. Extension activities should extend to beyond just knowledge sharing. Interventions should create the opportunity for exposure to implementation on smaller scales and learning and upskilling through practical experience.

Keywords: salinity, adoption, farmer perception, knowledge, management practices.

Introduction

Hillel and Vlek (2005) reported that soil salinity was widespread, pervasive and inherent enough to question whether irrigation could be sustained for long periods. In the South African sugarcane industry MacVicar (1971), (as quoted by Johnston, 1978), reported that 20% of irrigated land (21 000 ha) is adversely affected by waterlogging or salinity or both. Estimates based on past surveys indicated that 14% of irrigated areas in KwaZulu-Natal and 6% in Mpumalanga are affected (Backeberg *et al.*, 1996). The current extent of the salinity problem in the sugarcane industry is unknown.

The main reason for conducting this farmer survey was to assess the perceptions and levels of knowledge with regards to salinity management in order to inform the design and execution of a 'technology dissemination and knowledge exchange' initiative, funded via a Water Research Commission (WRC) project, to reduce the occurrence and ill-effects of salinity by improving the adoption and uptake of preventative and corrective measures. Although soil sodicity is also a problem in the South African sugarcane industry, the focus of this paper was to assess the grower's inherent knowledge of salinity.

Methodology

A structured questionnaire survey was conducted with 34 commercial sugarcane farmers, farming an area of 18 174 ha in the Pongola, Umfolozi and Felixton mill supply areas. The questionnaire comprised 51 questions, of which 23 were 5-point Likert scale questions (Likert, 1932 and Uebersax, 2006) used to test five hypotheses (H1-H5). Since no comparable research results were found, boundaries of acceptance or rejection were defined to facilitate the acceptance or rejection of each hypothesis. The cut-off boundary was defined as the average value plus one times the standard deviation ($\mu+1\sigma$), which was equal to 84%, assuming the responses from the sample followed a normal distribution. Each hypothesis was subsequently either accepted or rejected, based on the number of statements accepted or rejected by the cut-off boundary. The remaining questions were closed-ended questions capturing baseline data and supplemental information with the aim of testing knowledge and perceptions of soil salinity. The results for the remaining questions were presented illustratively. The responses were either summed or counted to illustrate the distribution of responses.

Results

By way of example, in the first hypothesis (H1), the list of questions which were used to test the hypothesis and the hypothesis test result is presented below. For each question, participants had to indicate if their responses agreed or disagreed by selecting one of the following options: definitely differ, partially differ, neutral, partially agree or definitely agree.

H1: Farmers do not perceive salinity as a threat

The following questions were used to test H1:

- Q 29: In saline soil, water is less available to the plant?
- Q 30: Poor germination can be expected on a saline soil?
- Q 31: The take-up of some plant nutrients is reduced on saline soils?
- Q 33: The production of natural vegetation is reduced on saline soils?
- Q 34: The variation of natural vegetation is less on saline soils?

The results for H1 are shown in Figure 1. The cut-off boundary of 84% is depicted by the horizontal (red) dashed line.

The cut-off boundary was exceeded by 'agree' and 'partially agree' responses for all five questions relevant to hypothesis H1. For this reason, H1 is rejected. The data suggests that farmers in the sample population adequately perceive salinity as a threat. The remaining hypotheses (H2–H5) were tested in a similar way. The results are summarised in Table 1.

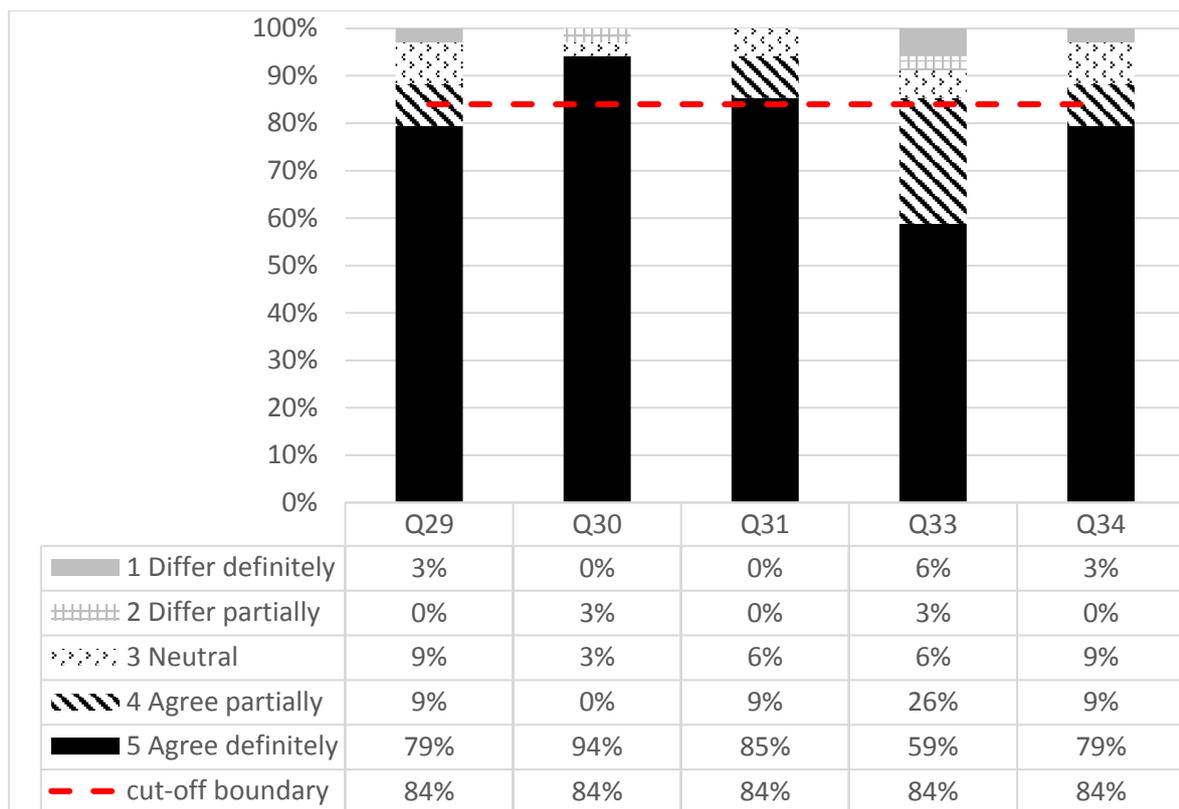


Figure 1. Percentage of respondents who perceive the harmful effects of salinity.

Table 1. Summary of hypothesis test results.

No.	Hypothesis	Result
H1	Farmers do not perceive salinity as a threat	Rejected
H2	Farmers do not understand the causes of salinity	Rejected
H3	Farmers do not have knowledge of preventative and corrective measures	Rejected
H4	The benefits of preventative and corrective measures do not outweigh the costs	Rejected
H5	The benefits of preventative and corrective measures do not outweigh the implementation effort	Accepted

The participant farmers appear to adequately perceive the threat of salinity (H1) and also have sufficient knowledge about the causes (H2) and the preventative and corrective measures for salinity management (H3). In addition, the sample of farmers appear to be satisfied that the benefits of salinity management outweigh the costs (H4). The only hypothesis which was accepted was that implementation effort can hinder or reduce the benefit gained from salinity management interventions (H5).

The rejection of the first four hypotheses suggests that the participant farmers have an understanding of salinity problems. Additional data, however, is presented to demonstrate that despite claiming to have the right perception and knowledge, farmers are not adequately addressing the salinity threat.

In Table 2, 71% of the respondents indicated that there were visible signs of salinity on their farms. In addition, despite the fact that the questionnaire focused on salinity, a number of growers also included sodicity as a problem. Growers listed the visible signs of salinity as salt

crystals on the surface and stunted growth, and that of sodicity as dispersed soils with poor water infiltration, waterlogging and stunted crop growth. In addition, 56% of the farmers reported signs of a shallow water table, while 94% of the participants indicated that some form of drainage was being used. Despite this awareness of the threat of salinity, 38% of the respondents did not use any tool and depended on their own experience to schedule irrigation, while 66% did not consider salinity in the irrigation scheduling decisions at all (data not shown). In addition, 85% and 53% of the respondents did not monitor soil water or irrigation water quality, respectively.

Soil salinity status can be derived from soil pH, electrical conductivity (EC) and Sodium Adsorption Ratio (SAR). The expectation was that, should farmers perceive salinity as a problem, they would be working to address this problem and through the process, farmers should have acquired a fair amount of knowledge about the diagnostic variables and the associated critical values. This, however, was not the case. As shown in Table 2, the participant farmers had fairly low levels of knowledge about the salinity status of their own soils. The percentage of participant farmers who did not know the pH, EC and SAR values were 41, 68 and 53%, respectively.

Table 2. A selection of results of the supplemental questions testing knowledge levels, perceptions and current salinity management practices.

Question	% answered 'Yes'	% answered 'No'	% answered 'Don't know'
1. Visible signs of salinity?	71	29	0
2. Signs of water table?	56	41	6
3. Drainage installed?	94	6	0
4. Soil water monitored?	15	85	0
5. Irrigation water quality monitored?	47	53	0
6. Is soil pH known?	59	41	0
7. Is Electrical Conductivity (EC) of problem soils known?	32	68	0
8. Is Sodium Adsorption Ratio (SAR) of problem soils known?	47	53	0
9. Apply leaching?	12	88	0
10. Is leaching a good practice?	59	26	15

To further corroborate the idea that farmers were not doing enough, the data in Table 2 indicates that 15% of the respondents did not know whether leaching was a good practice, whereas 26% indicated that leaching was not a good practice. Of greater concern though, was that while 59% of the respondents believed that leaching was a good practice, as many as 88% of the farmers did not apply leaching.

Conclusion

It appears that although farmers were claiming to perceive salinity as a threat to sugarcane production, their actions (or lack thereof) do not show evidence of actively addressing the salinity threat. Beyond an indication of the low knowledge levels amongst farmers, the data also provides clues that farmers do not really perceive salinity as a big enough threat to warrant conscious/purposeful tracking of important parameters or the implementation of preventative and corrective measures.

Alternatively, when farmers perceive that the effort to implement salinity management is greater than the benefit gained (hypothesis result H5), they can make a conscious decision not to implement the appropriate measures. In other words, farmers may 'know of' the threat,

causes and solutions for salinity, but may not necessarily have the will to implement solutions. It is recommend that technology transfer efforts should extend to beyond just knowledge sharing. Interventions should aim to create the opportunity for learning and upskilling through practical experience, experimentation or initial implementation on smaller scales. In this way, the uncertainty and doubt with regards to implementation effort versus benefit can be addressed.

Acknowledgements

The authors would like to gratefully acknowledge SASRI extension specialists, Marius Adendorff, Alex Searle and Tshifhiwa Radzilani, who assisted with conducting the interviews, and the Water Research Commission (WRC) for funding and support of the larger project.

REFERENCES

- Backeberg GR, Bembridge TJ, Bennie ATP, Groenewald JA, Hammes PS, Pullen RA and Thompson H (1996). Policy proposal for irrigated agriculture in South Africa. Water Research Commission Report KV 96/96. Pretoria. p 119.
- Hillel D and Vlek P (2005). The sustainability of irrigation. *Advances in Agronomy* 87: 54-84.
- Johnston MA (1978). Soil salinity and sodicity problems in the South African sugar industry. MSc thesis. Univ. Natal, South Africa, p10.
- Likert R (1932). A Technique for the Measurement of Attitudes. In: *Archives of Psychology*, Editor Woodworth RS, No 140, New York, Vol 22: 1-55.
- Uebersax JS (2006). Likert Scales: Dispelling the Confusion. Statistical Methods for Rater Agreement. <http://ourworld.compuserve.com/homepages/jsuebersax/likert.htm>.