SHORT NON-REFEREED PAPER

ANATOMY OF THE SUSFARMS® IRRIGATION MODULE

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Abstract

The SUSFARMS® irrigation module is a succinct but comprehensive package of measures, reference material and recommendations in the context of irrigation better management practices. The module is logically structured to guide end users systematically from the irrigation planning and design phase, through to correct irrigation operation, monitoring, scheduling, maintenance and evaluation. The intention of this paper is to present the anatomy of the irrigation module in order to give end users a view of how the tool can be used to track irrigation performance and to easily identify areas where tangible benefits can be gained by implementing improvements. The framework of the module provides a clear and holistic list of key measures with an easy spreadsheet based scoring system for gauging performance of irrigation on the farm. For example, the energy use efficiency measure will purposefully point the end user to examine sizing and matching of motor and pump combinations, appropriate selection of ESKOM tariff structure and timing of pump operation relative to peak and off-peak hours. Over and above measures of performance, relevant reference material and recommendations are also available. An example is the useful schedule of preventative maintenance activities/tasks for each irrigation system. In the case of water quality, or soil salinity and sodicity, important flag-raising threshold values are presented in user friendly tables and charts. Increased usage of the tool is anticipated to stimulate greater planning and operational thinking and ultimately improved irrigation in the South African sugar industry.

Keywords: Irrigation Better Management Practices (BMPs), irrigation performance assessment, irrigation benchmarking, technology transfer, SUSFARMS®

Introduction

The Sustainable Sugarcane Farm Management System (Susfarms®) is a management tool to facilitate the production of sugarcane in a profitable, sustainable and environmentally responsible manner (Maher, 2007). The intention of this paper is to present an excerpt of the recently revised irrigation module in order to give end users a view of how the tool can be used to track irrigation performance. The Susfarms® tool consists of two components, namely the manual and a progress tracker. The manual comprises a set of measures which capture the suite of legal requirements and better management practices (BMPs). The progress tracker is a spreadsheet based tool allowing for self-assessment by easy allocation of scores for each measure. In this way a farmer can benchmark his current performance, track his progress periodically and easily identify areas where tangible benefits can be gained if improvement plans are implemented. This short paper will focus only on the irrigation BMPs. The Susfarms® manual can be referred to for more information on legal requirements.

Irrigation module

The irrigation module is categorised into irrigation planning and design, operation, monitoring and management. Engineering consultants and contractors are typically responsible for the design and installation of irrigation systems hardware. Hence, measures in the design and planning section are intended to help farmers ensure that flawed irrigation systems are not installed. Selected measures from the planning and design section are:

- The irrigation system can meet the daily peak crop water requirements (ET) (or some agreed proportion of the daily peak crop water requirement).
- The volume of water applied per irrigation event (target application depth) should not be greater than the storage capacity of the soil (total available water – TAW). In addition, the rate at which water is applied (emitter application rate) should not be greater than the rate at which the soil can absorb the water (infiltration rate).
- The irrigation system is designed in accordance with the SABI norms and standards (http://www.sabi.co.za/design.html) where SABI is the Suid Afrikaanse Besproeiings Instituut in Afrikaans or the South African Irrigation Institute in English.

Failure to meet any of the above can result in a flawed irrigation system.

After the irrigation system hardware has been installed and commissioned, the responsibility of management is handed over to the farmer. The remaining section deals specifically with irrigation management, for which the farmer is directly responsible. The performance measures for irrigation operation and monitoring include aspects such as operating a system according to design specifications by regularly checking pressure and discharge (flow), and scheduling irrigation using an appropriate method to prevent over- and under-irrigation.

The energy use efficiency measure purposefully points the end user to:

- examine sizing and matching of motor and pump combinations
- the appropriate selection of ESKOM tariff structure (Ruraflex, Nightsave and Landrate)
- timing of pump operation relative to peak and off-peak hours.

In addition to measures of performance, relevant reference material and recommendations are also presented. An example is the useful schedule of preventative maintenance activities/tasks for each irrigation system. In Table 1 the sprinkler preventative maintenance schedule and accompanying notes are provided as an example.

Table 1. Preventative maintenance schedule for sprinkler irrigation systems (Reinders *et al.*, 2010).

Action	With each cycle	Annually
Inspect the system for leakages	X	
Check system pressure and system flow	X	
Service air valves and hydrants		X
Check sprinklers for wear and replace springs, washers and nozzles where necessary		X
Flush mainlines		X
Replace rubbers at quick coupling pipes where necessary		X

Notes for Table 1:

After the irrigation season, and before the pipes are stored, the following must be done:

- Mark all the holes in quick coupling pipes with paint so that they can be repaired.
- Remove all gaskets from pipes if they are stored in the sun.
- Replace all damaged and hardened gaskets.
- Replace all worn male and female pipe fittings.
- Replace all dragline pipes that have more than three joints.
- Check standpipes for corrosion and replace where necessary.
- Ensure that all standpipes are the same length and straight.

Similarly, recommendations are made for the evaluation of irrigation systems at least every two years to ensure uniform and accurate application of water. In the case of water quality class, and soil salinity and sodicity, important flag-raising threshold values are available in user friendly tables and charts (van Antwerpen *et al.*, 2013).

To test suitability for irrigation, water should be analysed to determine:

- Electrical conductivity (representing total concentration of soluble salts), adjusted for dilution/leaching due to local rainfall (effective electrical conductivity (EEC) [mS/m]).
- Concentration of sodium (Na), calcium (Ca), magnesium (Mg), pH and bicarbonate, calculated as adjusted sodium adsorption ratio (ASAR).

The relationship between ASAR and EEC, as shown in Figure 1, is used to determine the quality class of irrigation water.

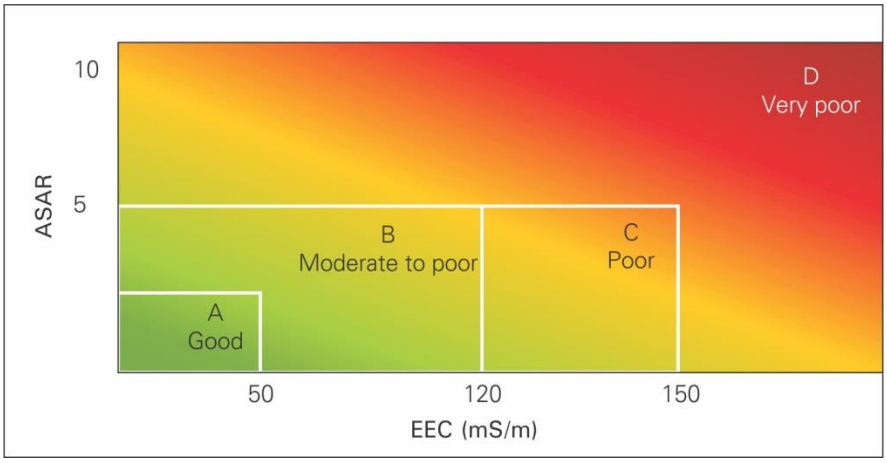

Figure 1. Water quality threshold values indicating suitability for irrigation.

Class A: Suitable for use on all irrigable soils.

Class B: Suitable for irrigation of freely draining soils only, e.g. Hutton, Shortlands and Fernwood soil forms.

Class C: This poor quality water may be used on freely draining soils if water of better quality is not available. Excessive salinity could affect the normal growth response expected under irrigated conditions. Short term salt build-up in the soil is likely to occur particularly during drought periods, but the situation should improve after good rain. Particular care should be taken to avoid waterlogging.

Class D: Under normal irrigation practices this water is considered to be unsuitable.

For salinity, annual soil samples are taken from irrigated lands and assessed for total soluble salts and sodium absorption ratio. The threat of salinity on sugarcane land, based on soil electrical conductivity values, is given in Table 2.

Table 2. Threshold values for soil salinity.

EC (mS/m)	Rating	Effect on cane growth
0 – 200	Non-saline	None
200 – 400	Slightly saline	Slight
400 – 600	Moderately saline	Severe
>600	Strongly saline	Very severe

The South African Sugarcane Research Institute (SASRI) recommends that soils suitable for irrigation have an SAR less than 15 and EC less than 200 mS/m in the top 600 mm of soil.

Conclusions

Increased usage of Susfarms® is anticipated to stimulate more focused and purposeful planning and operational thinking. Accompanied by extension interaction, the application of the irrigation module will help to identify problems areas and opportunities for improvement, ultimately improving irrigation in the South African sugar industry.

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