Information Sheet

5.16 Assessing economic viability of Irrigation

Introduction

Irrigation is economically viable when the yield response to irrigation (full or supplementary) delivers enough additional revenue to cover the capital and operating costs of irrigation. Irrigation viability can thus be easily established by estimating the yield without irrigation (rainfed), then estimating the additional yield in response to irrigation and comparing the value of this additional yield to the cost of delivering that irrigation. SASRI recommends the use of the crop modelling tool, *MyCanesim Lite*, to simulate rainfed and irrigated yields for use in the economic viability calculations.

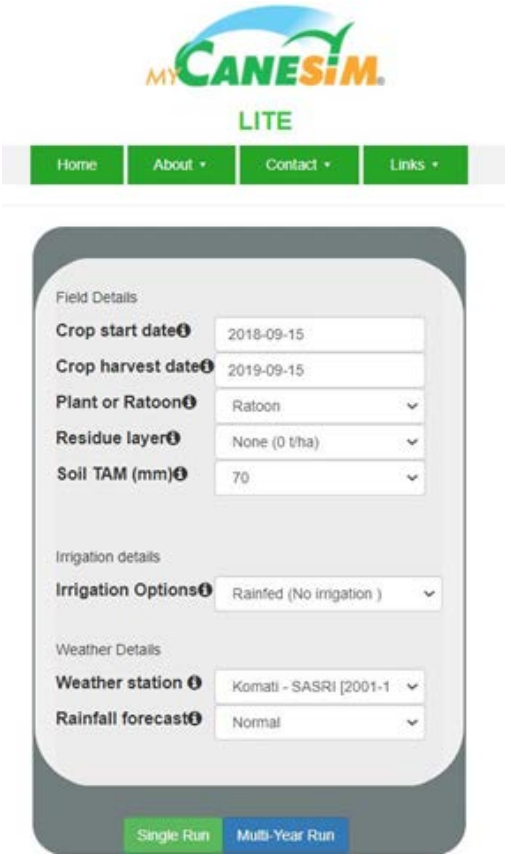
The program requires no login, allows users to choose inputs easily from drop-down lists, and rapidly generates the results at the click of a button.

Step-by-step guide

Step 1: Estimate rainfed yield

Launch the web version of MyCanesim Lite from https://sasri.sasa.org.za/agronomy/mycanesimlite/

Provide the following inputs by selecting from the drop-down options:



a) **Crop start and harvest date.** The harvest date can be set to be in the future and the program will allow the user to select a forecast rainfall sequence (See point g).

b) **Plant or ratoon.** Indicate whether this is a plant or ratoon crop.

c) **Mulch residue layer.** Select 0, 5, 7 or 10 t/ha of mulch residue left behind from a previous crop.

d) **Soil Total Available Water (TAW).** Choose an amount from the options that range from 30 to 150 mm. In the figure, this input is referred to as **TAM** (Total Available Moisture). The term is now being standardised as **TAW**.

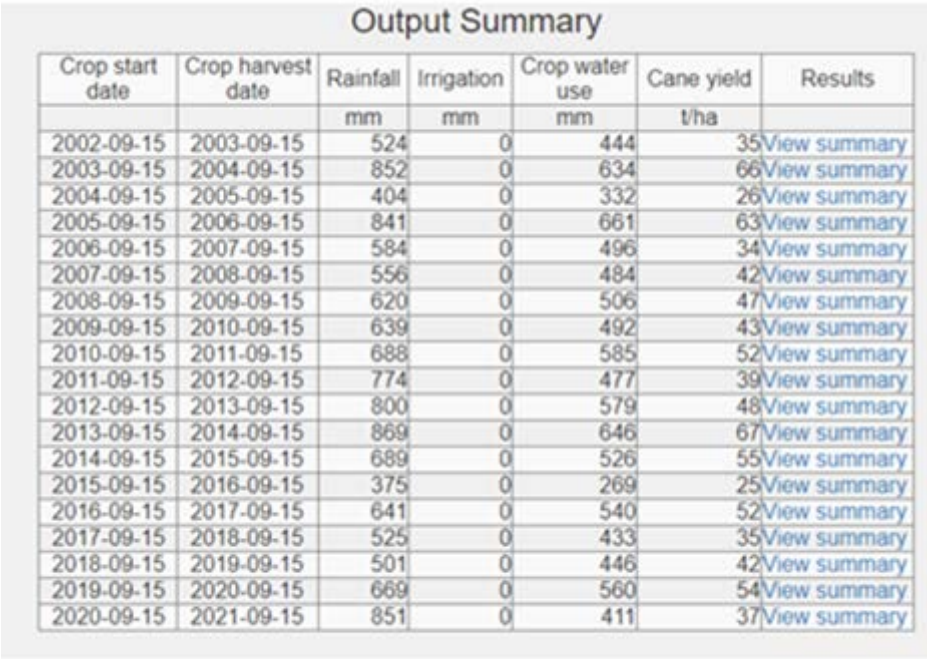
e) **Irrigation option.** Select **rainfed (no irrigation).** Note: other options are supplementary (some water applied but not always meeting crop demand, i.e. 35 mm on a 10 day cycle, which is an equivalent daily peak application of 3.5 mm) and full irrigation (irrigation scheduled to avoid crop water stress).

f) **The weather station.** Choose the weather station nearest to your field/site. If required, you can use the SASRI weather web (WeatherWeb: https://sasri.sasa.org.za/weatherweb) to locate the nearest automatic weather station.

g) **The rainfall forecast.** If the harvest date is set to be in the future, a rainfall forecast sequence is used, but you are required to select a dry, normal or wet forecast option.

h) Choose a **multi-year run**. A single year run will simulate according to the selected start and harvest date, i.e. the specific year. A multi-year run will simulate for all the years of available weather data, but still according to the selected day and month for the crop start and harvest. The multi-year run will allow the user to establish the average yield over several years, rather than depend on a single year which may not be representative of what usually happens.

The multi-year run presents a table of results simulated for different years/seasons. From this table, calculate the average cane yield over the years. In our example below, the average cane yield is **45 t/ha**. You may wish to click on the **seasonal data file** icon to download the data in a CSV (spreadsheet) format to assist with this calculation.



Output Summary

Crop start date	Crop harvest date	Rainfall	Irrigation	Crop water use	Cane yield	Results
		mm	mm	mm	t/ha	
2002-09-15	2003-09-15	524	0	444	35	View summary
2003-09-15	2004-09-15	852	0	634	66	View summary
2004-09-15	2005-09-15	404	0	332	26	View summary
2005-09-15	2006-09-15	841	0	661	63	View summary
2006-09-15	2007-09-15	584	0	496	34	View summary
2007-09-15	2008-09-15	556	0	484	42	View summary
2008-09-15	2009-09-15	620	0	506	47	View summary
2009-09-15	2010-09-15	639	0	492	43	View summary
2010-09-15	2011-09-15	688	0	585	52	View summary
2011-09-15	2012-09-15	774	0	477	39	View summary
2012-09-15	2013-09-15	800	0	579	48	View summary
2013-09-15	2014-09-15	869	0	646	67	View summary
2014-09-15	2015-09-15	689	0	526	55	View summary
2015-09-15	2016-09-15	375	0	269	25	View summary
2016-09-15	2017-09-15	641	0	540	52	View summary
2017-09-15	2018-09-15	525	0	433	35	View summary
2018-09-15	2019-09-15	501	0	446	42	View summary
2019-09-15	2020-09-15	669	0	560	54	View summary
2020-09-15	2021-09-15	851	0	411	37	View summary

▲ Figure 3: MyCanesim Lite output screen for multi-year run.

Step 2: Estimate irrigated yield

Now repeat the step above, this time choosing an irrigation option other than rainfed. All other inputs should be left unchanged. In our example below, the average cane yield with irrigation is **143 t/ha**.

However, the model assumes perfect management and performance of irrigation systems. Factors such as irrigation uniformity or poor system management will affect the yield attained. The following adjustment factors are recommended for corresponding levels of management: Excellent = 0.8, Good = 0.7, Poor = 0.5.

In our example, we assume excellent management, giving us 143 x 0.8 = **114 t/ha.**

Again, you may wish to click on the **seasonal data file** icon to download the data in a CSV (spreadsheet) format to assist with this calculation

Output Summary

Crop start date	Crop harvest date	Rainfall	Irrigation	Crop water use	Cane yield	Results
		mm	mm	mm	t/ha	
2002-09-15	2003-09-15	524	1365	1622	148	View summary
2003-09-15	2004-09-15	852	1050	1504	152	View summary
2004-09-15	2005-09-15	404	1470	1668	153	View summary
2005-09-15	2006-09-15	841	1190	1588	151	View summary
2006-09-15	2007-09-15	584	1190	1531	134	View summary
2007-09-15	2008-09-15	556	1085	1444	145	View summary
2008-09-15	2009-09-15	620	1155	1434	144	View summary
2009-09-15	2010-09-15	639	1085	1390	135	View summary
2010-09-15	2011-09-15	688	1085	1513	140	View summary
2011-09-15	2012-09-15	774	1085	1373	141	View summary
2012-09-15	2013-09-15	800	910	1310	134	View summary
2013-09-15	2014-09-15	869	875	1296	143	View summary
2014-09-15	2015-09-15	689	945	1304	148	View summary
2015-09-15	2016-09-15	375	1295	1428	142	View summary
2016-09-15	2017-09-15	641	945	1343	143	View summary
2017-09-15	2018-09-15	525	1015	1310	135	View summary
2018-09-15	2019-09-15	501	1120	1439	147	View summary
2019-09-15	2020-09-15	669	945	1337	142	View summary
2020-09-15	2021-09-15	851	1050	1309	139	View summary

Step 3: Calculate cane yield response to irrigation and increase in revenue

Up to this point we have dealt with the following elements to establish yield increase from irrigation:

a) Model estimated irrigated yield	143
b) Management adjustment factor	0.8
c) Adjusted irrigated yield (a x b)	114
d) Rainfed yield	45
e) Yield increase as a result of irrigation (c – d)	69

The average cane **yield increase,** as a result of irrigation = 114 - 45 = **69 tons/ha/annum**.

If the average RV % is 12 % and that the RV price is **R 4 875** per ton RV:

Expected increase in RV yield from irrigation $= 69 \frac{ton}{ha} \times \frac{12}{100} = 8.28\ tons\ RV\ /\ ha$

Expected increase in revenue from irrigation $= 8.28 \frac{tons\ RV}{ha} \times \frac{R\ 4\ 875}{ton\ RV} = R\ 40\ 365\ /\ ha/\ annum$

Therefore, the annual cost of irrigation (capital and running cost) for this example must be lower than **R 40 365** per ha per annum to make irrigation viable.

Costs of irrigation

Initially, viability can be determined at a high level using generic irrigation costs estimates. Cost estimates for the range of irrigation systems typically used in the South African sugarcane industry are published in Information Sheet 5.15: Irrigation Costs Estimates. This sheet suggests that a 2-3 ton increase in RV yield is generally required to meet the capital and operating cost of most irrigation systems (excluding the site-specific costs of pump stations, filters and main lines). The capital and operating costs for the different systems range from R 10 000 – R 13 000 per ha per annum, over the lifespan of the respective systems (10 – 15 years). These cost estimates, however, do not include the cost for pump stations, filters as well as mainlines. The costs for the pump, filter and mainline infrastructure are variable and must be determined and added in for each specific site and context. Hence, an irrigation design expert is required to conduct the detailed and site-specific analysis. In this regard, the simulated seasonal irrigation obtained from MyCanesim Lite, can also be used by designers to refine the cost of water and electricity for the specific site and seasons selected during model set up.

MyCanesim

MyCanesim is the more complex version of MyCanesim Lite, requiring more inputs and making more outputs available. It has additional inputs for the crop, such as the ability to set the row spacing, define soil properties, change CO_2 concentration levels, apply water restrictions and enter specific details for irrigation systems and complex strategies. MyCanesim allows the user to save scenarios under projects and view several reports. MyCanesim is useful for modelling specific local conditions but will require a specialist to assist with running the model.

MyCanesim Lite for smartphones

MyCanesim Lite is also available for smartphones from the Google play store or the Apple iStore. It works similarly to the web version described above, using the same inputs and underlying model. However, a limitation of MyCanesim Lite mobile is that a multi-year scenario cannot be run, and the results are not presented in the form of graphs. MyCanesim Lite mobile is recommended for single scenario simulations and yield estimates only. Unlike the web version, a user may save several scenarios for later re-simulation on the phone, for example, to make use of newly collected weather station data as the season progresses towards harvest.

Ashiel Jumman (Agricultural engineer: Irrigation) and Aresti Paraskevopoulos (Scientific Programmer)

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