Sustainable Sugarcane Initiative

Methodology to Quantify Water Efficiency Outcomes from Seedling Nurseries (beta)

Table Of Contents

1. Applicability

This methodology is specific to an adaptation of a particular planting method for sugarcane, which is part of the much more comprehensive package of practices known as the Sustainable Sugarcane Initiative (SSI). The following conditions reflect the applicability of this Water Benefits methodology to project activities.

- The methodology quantifies the absolute reduction in water consumption resulting from the application of Sustainable Sugarcane Initiative (SSI) methods, which replace prevailing, less efficient sugarcane cultivation practices. Not all of the interventions of SSI are quantified for the purpose of generating WBCs in this methodology. The key focus is shifting particular stages of sugarcane cultivation from the farm to water efficient seedling nursery facilities. These activities lead to significant water conservation and are described in Section 4.1.
- This methodology requires a baseline scenario where farmers have not already made use of the SSI techniques described in Section 2. This means that farmers purchasing seedlings from nurseries, and counted as beneficiaries, must confirm that they cultivated sugarcane according to conventional practice as indicated in the baseline description prior to the project activity (this may be done as part of the Local Stakeholder Consultation).
- Project representative must give evidence directly to the Gold Standard Foundation that grown seedlings are in fact planted on farms outside the nursery. This can be confirmed through a purchase agreement or other documentation.
- This methodology cannot be used to quantify water-efficient agricultural practices concerning crops other than sugarcane (e.g. conversion to system of rice intensification – SRI – for water-efficient rice cultivation or another crop-specific cultivation technique that conserves water). Such techniques can be found in corresponding crop-specific or intervention-specific methodologies.
- The methodology applies to both single and bundled farms that are grouped within the same representative spatial boundary and agro-climatic zone (tropical or sub-tropical) that make use of the water efficient seedling facilities required for SSI in the project scenario.
- The stages of cultivation relevant to this methodology do not rely on rainwater but rather depend entirely on irrigation from groundwater resources and therefore there is no surface water return flows / runoff from the irrigated fields. Where surface water is considered as an irrigation source, a full environmental impact assessment of groundwater resources and the associated dependant ecosystems must be undertaken.
- Only irrigation using pumped systems for the baseline and/or project activities will be considered in this methodology. Gravity-fed irrigation or other techniques will be covered by other methodologies.
- This methodology does not apply to the conversion from current land use practices which have lower water usage than that of the SSI approach. Specifically, this includes converting land from the cultivation of crops that require less water (e.g. tomatoes) to sugarcane, or converting unused land to sugarcane cultivation.

2. Introduction to SSI

The Sustainable Sugarcane Initiative (SSI) is a method of sugarcane production that involves the use of fewer seeds, less water and appropriate utilization of fertilizers and land to achieve higher yields.

The practices that govern SSI are:

- Establishing a nursery in which sugarcane seedlings are raised from single-budded cane chips. This contrasts with traditional cultivation practices that involve planting entire portions of the cane from the previous year's harvest as seed (propagules) rather than isolating the bud chip.
- Transplanting young seedlings (25-35 days old) from the nursery directly into the farmers' fields. This removes the need to flood the field with water during the first month after planting (as is done under prevailing practices) to allow seed cane from previous harvests to sprout. In normal cases, flooding is required regardless of whether the farmer uses flood or drip irrigation using significantly more water per sprout than the off-site nursery.
- Maintaining wide spacing (1.5 to 2.7 X 0.6 m) in the main field. This reduces the number of seedlings required per unit of area while also enhancing the health of the plant.
- Encouraging organic methods of providing nutrients, plant protection and other intercultural practices. By default, SSI requires less inorganic fertilisers since planting patterns are wide and geometric in nature. This enables the farmer to use less in a more targeted way.
- Practicing intercropping for effective utilization of land and maintaining ground cover. Farmers typically have to wait more than a year to get some income or return from their sugarcane fields. Using SSI crop patterns provides an opportunity to use the wide space between rows to cultivate other crops, mostly short duration legumes, to earn some income while also providing nutrients to the field.

The benefits vary depending on how farmers put these principles into practice, either individually or in combination.[1] When these principles are followed in combination, they work in a synergistic way to save inputs and achieve higher yields per unit area. For detailed instructions on how to implement SSI, please consult the user guide available at: http://www.agsri.com/images/documents/ssi/ssi_manual_2012.pdf

[1] An additional benefit of using SSI beyond the scope of water conservation is the possibility to increase the use of renewable biomass for energy generation. The processing of sugarcane into molasses or other sugar products requires energy, most if not all of which is supplied by burning bagasse (cane residue left after crushing). By making more seed cane available for crushing, SSI increases the amount of bagasse available for fuel as renewable biomass in boiling and steam production.

3. Ownership of the Water Benefit

A feature of the water benefits described in this methodology, as defined in Section 4.1, is that the water conservation occurs prior to the planting of the cane stalk into the sugarcane fields. This is done by carrying out the germination stage of sugarcane cultivation in separate seedling nurseries located off-site. As a result, the ownership of the water benefits is held by whatever entity owns and operates the seedling nursery(ies). While this water conservation can be achieved by any individual farmer on their own initiative, in most cases the incentive for doing so is extremely low due to the time and capital investments required. Therefore, a separate entity capable of producing a large number of seedlings at a competitive cost can make this water conservation possible through achieving economies of scale.

4. Calculation of Water Benefits

Specific guidance in this methodology focuses on the two components of water conservation described in Section 4.1 as they are directly attributable to SSI's water conservation techniques. These focus on shifting particular stages of sugarcane cultivation from the farm to water efficient seedling nursery facilities. Further SSI interventions may be addressed in other future iterations of this methodology.

4.1. The Scope of Water Volume Calculations under SSI

- **First component of water conservation – Reduction in Water Required for Germination**

  Sugarcane is propagated vegetatively resulting in the mature sugarcane from one growing season typically being planted directly in the field as seed to grow the next crop. Traditionally, farmers bury the cane and flood the field several times to ensure that the cane germinates which results in the usage of large volumes of water and wastage of significant amounts of cane without the guarantee that the seed will sprout. In addition, farmers in some regions (e.g. India) plant cane during the summer when water tables are already low. Under SSI, farmers plant 30-35 day old seedlings raised in an off-site nursery. The production of seedlings requires less water compared to traditional germination practice in the field. As a result, farmers conserve water otherwise used for flooding in the first 30-35 days.

- **Second component of water conservation – Water Efficient Use of Seed Cane**

  Under traditional practice, farmers require between 8-15 tonnes/ha of sugarcane to use as seeds for the next crop, and normally set aside up to 10% of their sugarcane harvest for this purpose. In addition, rather than isolating the bud as seed, farmers typically plant entire setts of cane, most of which could have been used to produce sugar as they are not required for the bud to sprout. Under SSI, farmers plant month old seedlings raised from bud seeds in a nursery off-site. At the nursery, the bud seeds are removed from the remaining sugarcane stalk, allowing the remaining cane to be processed for sugar. This directly contributes to a more efficient use of water, as less water is required to grow cane that is otherwise wasted. As a result, more existing seed cane may be processed for sugar production and relieve pressure on existing land and water resources.

The following sections give concrete guidance on how to calculate the water benefits resulting from the components described above in Section 4.1. In Section 4.2, the relevant equations are presented.

Specific guidance is then provided regarding monitoring approaches and defaults for all baseline and project variables in Sections 4.3 and 4.4.

4.2. Steps to Calculate Water Benefits Resulting from SSI

4.2.1. Water Saved in the Germination Stage through Seedling Production

Step 1: Quantify the water consumption under the baseline and for the project activity.

Baseline Condition

- Water used for germination (W_{GCH}) under the conventional method in m^3/hectare per planting season.

Project Condition

- Water used in the seedling nursery (W_{NH}) for the purposes of cleaning and seedling production. The volume of W_{NH} is an amount of water sufficient to produce enough seedlings to cover one hectare of crop growing area once they have been replanted (in m^3/hectare) per planting season.

Step 2: Calculate the difference in water consumed between baseline activity and project activity.

$$\Delta W = (W_{GCH}) - (W_{NH})$$

Where:

ΔW *is the water savings* (in m^3/hectare)*, based on the difference in water use between baseline activity and project activity.*

Step 3: Estimate water benefit resulting from project activity per planting season.

$$Q_G = \Delta W \times A_P$$

Where:

Q_G *is the quantity of water benefit resulting from the direct planting of seedlings after germination in the nursery in* m^3.[2]

A_P *is the crop production area affected by the project activity in hectares.*

[2] If more than one planting season occurs per year, it will be necessary to aggregate the water benefits across a twelve month period to facilitate the performance verification.

4.2.2. Water Saved By Reducing Wasted Seed Cane

Step 1: Quantify the water consumption and the seed cane required under the baseline and the weight of seed cane required for the project activity.

Baseline Condition

- Water used for growing sugarcane to maturity (W_{Req}) using conventional methods in m^3/tonne of sugarcane. This includes all stages of cultivation from germination to harvest in the absence of SSI methods.
- Number of three budded setts[3] required for planting per hectare using prevailing practice (S_H). See default figure in 4.4.2.
- Mass of whole uncut three budded seed cane sett (M_S) in kilograms.

Project Condition

- Mass of bud chips removed from three budded seed cane sett (M_B) in grams.
- Number of hectares under cultivation using SSI (A_{SC})

Step 2: Calculate the tonnes of seed cane required per hectare in the baseline (SC_T).

$$SC_T = [(M_S) \times (S_H)] \;/\; 1{,}000$$

Where:

SC_T is the amount of seed cane required per hectare using prevailing planting practice in tonnes for one planting season.

Step 3: Calculate the total water requirement to grow seed cane sufficient for one hectare of planting under the baseline (W_{SC}).

$$W_{SC} = SC_T \times W_{Req}$$

Where:

W_{SC} is the total water required in the baseline per hectare per planting season in m^3.

Step 4: Calculate the percentage of seed cane saved in the project scenario (SC_R).

$$SC_R = 1 - [M_B / \, M_S]$$

Where:

SC_R is the percentage of the seed cane crop that is recovered for processing by removing only the bud from the cane in the nursery.

Step 5: Calculate the water benefits per hectare in the project scenario (WB_H).

$$WB_H = W_{SC} \times SC_R$$

[3] Information on three budded setts can be found here: http://www.sugarcanecrops.com/agronomic_practices/planting_material/

Where:

WB_H *is the total water conserved in the project scenario per hectare per planting season.*

Step 6: Calculate total project water benefits resulting from the project activity (Q_{SC}).

$$Q_{SC} = WB_H \times A_{SC}$$

Where:

Q_{SC} *is the total quantity of water benefit resulting from the reduced use of seed cane in m^3 per planting season.*[4]

4.3.Monitoring Approach

- Baseline Scenario: Project participants must determine the baseline parameters based on eligible data.[5] Baseline factors derived from data do not require supplementary field measurements; however these factors must be conservative. Where possible a range of possible baseline factors from source literature should be presented to demonstrate conservatism within the baseline calculations above.
- The baseline parameters shall be fixed for the duration of the project period. In the case of renewed projects, the baseline must be re-evaluated and justified during each 7-year renewal.
- Project Monitoring Approach: The project owner shall conduct direct monitoring of project activities as per the guidance provided in Section 4.4.2.

[4] If more than one planting season occurs per year, it will be necessary to aggregate the water benefits across a twelve month period to facilitate the performance verification.

[5] Eligible data will be assessed on a case by case basis at the discretion of The Gold Standard Foundation. Such data may include academic, government, legal, intergovernmental, consultant or validated data generated by the projects themselves.

4.4. Data Collection

4.4.1. Project Boundary

Data collection relevant to project activities shall be conducted within a representative spatial boundary as defined in the WBCS Requirements Document.

4.4.2. Primary Variables

The variables discussed below, with the exception of M_B, are primary baseline variables required for the calculation of water benefits. These variables, including M_B, shall be fixed for the duration of the project period. In the case of renewed projects, the baseline must be re-evaluated and justified during each 7-year renewal:

Data/Parameter:	$\boldsymbol{W_{GCH}}$ **and** $\boldsymbol{W_{Req}}$
Data Unit:	m^3/hectare per planting season
Description:	Cumulative volume of water used in the germination phase (W_{GCH}) and for the growth of seed cane (W_{Req}) per hectare of growing area respectively.
Source of Data:	Eligible published data as described in 4.3 that reference the relevant crop and agro-climatic zone respectively.
Measurement Procedures:	Based on data that has been deemed eligible by The Gold Standard
Monitoring Frequency:	Factors derived from eligible published data as described in 4.3 must be selected only once.
QA/QC Procedures:	No QA/QC procedures are required.

Data/Parameter:	S_H
Data Unit:	21,000 three budded setts[6]
Description:	Number of three budded setts required for planting per hectare per planting season in the baseline scenario.
Source of Data:	FAO
Measurement Procedures	Default
Monitoring Frequency:	Fixed
QA/QC Procedures:	No QA/QC procedures are required.

Data/Parameter:	M_S and M_B
Data Unit:	M_B = 0.03 kg M_S = 0.332 kg[7]
Description:	Mass of seed cane required per cane stalk in the baseline and project scenario respectively in kilograms.
Source of Data:	Data was collected by AgSri Agricultural Services Pvt Ltd. during application of SSI techniques on pilot farms and seedling nurseries.[8]
Measurement Procedures:	Default
Monitoring Frequency:	Fixed
QA/QC Procedures:	No QA/QC procedures are required.

[6] This is the most conservative figure taken from FAO data on the number of three budded setts required per hectare of planting: http://www.fao.org/nr/water/cropinfo_sugarcane.html

[7] Conservative data collected by AgSri from sugarcane variety Co 86032, a medium girth variety in use in India. For more information see: http://www.sugarcane.res.in/index.php/downloads/newsletters/doc_download/128-co-86032-nayana-wonder-cane-of-the-decade

[8] http://www.agsri.com/

The variables listed below are relevant to project activities and must be monitored during the crediting period as indicated:

Data/Parameter:	W_{NH}
Data Unit:	m^3
Description:	Cumulative volume of water used in the nursery during the germination phase. Measured according to the number of seedlings required per hectare of growing area on the farm.
Source of Data:	Data was collected by AgSri Agricultural Services Pvt Ltd. during application of SSI techniques on pilot farms and seedling nurseries.
Measurement Procedures:	Default
Monitoring Frequency:	Fixed
QA/QC Procedures:	No QA/QC procedures are required.

Data/Parameter:	A_P and A_{SC}
Data Unit:	Hectare
Description:	Area of crop production using SSI in the project scenario
Source of Data:	Precise data must be obtained using global positioning technology such as handheld GPS devices, Google Earth's path/ruler tool (earth.google.com) or other similar tools.
Measurement Procedures	Using an individual survey of the farm plot using a handheld GPS device, the path/ruler tool in Google Earth based on a known farm address or other precise global mapping approaches, the number of hectares involved in the project activity must be identified based on their coordinates and quantified for each cultivated farm. A sum figure is taken of all hectares under cultivation to arrive at the total hectares affected by the project activity.
Monitoring Frequency:	Annually
QA/QC Procedures:	No QA/QC procedures are required.

4.5. Water Quality

No water quality requirements or restrictions are applicable at this time for the implementation of project activities which use this methodology beyond those outlined in the sustainability section of the requirements document.