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SUSTAINABLE PRODUCTION OF RAW AND REFINED CANE SUGAR

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Abstract

Sustainable production is becoming an increasingly important issue in the process industries. In the cane sugar industry, pressure for sustainable production has come largely from the importers of ethanol from sugarcane. This has focused attention on sustainable production in the sugar industry in general. Some of the major producers of white sugar are aware of the advantages in the market place of sustainable manufacturing processes in terms of brand enhancement and are using the low carbon footprint of sugar to their advantage. This paper aims to introduce the main elements of sustainability and the major sustainability issues facing producers. The estimation of the carbon footprint for raw and refined sugar production is described and the aspects of production affecting greenhouse gas emissions are identified. Opportunities for refiners in terms of reducing the carbon footprint of their products and the implications are described. Attempts to certify production as sustainable have led to the need for formal certifiable sustainability standards in the sugar industry. The process of developing credible sustainability standards is described. Substantial progress has been made in this respect by the Better Sugar Cane Initiative (now referred to as Bonsucro) in the development of standards for the certification of sustainable production, paving the way for auditing and certification in 2011.

INTRODUCTION

Companies can no longer afford to ignore sustainability because it is central to long term competitiveness. Sustainability has been identified as a megatrend, which requires businesses to adapt and innovate or be swept aside (Lubin and Esty 2010). It is clear that there is a growing corporate move to address sustainable development and companies are beginning to appreciate that there are sound business reasons to adopt more sustainable production and processing practices. In addition, managing social and environmental risks is important for growers, processors, traders and food companies due to regulatory pressures as well as shareholder and consumer expectations. Increasingly environmental and social performance is affecting access to markets and to capital as well.

The pressure for a system to certify that sustainable practices are being adhered to has come largely from the market place. In particular this has come about due to the need to demonstrate sustainable production of biofuels, where for instance the import of biofuels into Europe requires that these fuels are produced following sustainable practices. A number of large industrial consumers of sugar also want to be able to certify that sugar and other ingredients in their products are produced by means of sustainable practices. Issues relating to sustainability in the cane sugar industry have been highlighted by Rein (2009).

Brazil has been most active in embracing and reporting sustainability performance. This is largely due to the need to meet sustainable standards in producing biofuels for export to first world countries. Most mills in Brazil are very conscious of environmental issues. Intensive re-forestation with indigenous trees is evident at a number of mills. Nurseries are maintained by the milling companies in Brazil, and thousands of trees are planted each year, restoring degraded and riparian areas. This is evident in other sugar producing countries as well.

In the absence of agreed standards for sugarcane, some mills are reporting their results based on the Sustainability Reporting Guidelines proposed by the Global Reporting Initiative (GRI 2008). Some industry environmental leaders have also been accredited to ISO 14001 for environmental management. The ISO 14001 standard requires facilities to set up objectives and targets, and to establish, implement and maintain programs to achieve these objectives and targets. The following issues should be considered in the process:

- Legal requirements
- Significant environmental aspects
- Technological options
- Financial, operational and business requirements
- Views of interested parties.

The cane sugar industry is well-placed as an agro-industrial business. Sugarcane is a particularly efficient crop in terms of its photosynthetic capacity to produce biomass. It contains a fibrous structure which provides a renewable fuel resource, and processing of the cane does not involve the use of any toxic or hazardous products or waste streams. Sugarcane produces more biomass dry matter per hectare than any other crop species. It can, therefore, have a strong positive influence on the environment and so has a great future in providing food and/or energy in a sustainable way.

WHAT IS SUSTAINABILITY?

There are various ways in which sustainability can be defined. A generally accepted definition would be along the lines of sustainable development providing for human needs without compromising the ability of future generations to meet their needs. Savage *et al.* (2009) elaborate on the difficulties associated with a precise definition of sustainability e.g. how are needs defined, and what are appropriate standards, now and in the future. The American Institute of Chemical Engineers defines sustainability as "the path of continuous improvement, wherein the products and services required by society are delivered with progressively less impacts upon the earth" (Cobb *et al*. 2007). They have devised a Sustainability Index for organizations, composed of seven critical elements:

- strategic commitment to sustainability
- safety performance
- environmental performance
- social responsibility
- product stewardship
- value-chain management
- innovation

The "triple bottom line", covering the three components of environmental responsibility, economic return (wealth creation), and social development is often cited as the criterion for evaluating businesses.

Environmental and social concerns have been the main reason for the calls for the inclusion of sustainability criteria in the international trade of biofuels. The major issues addressed in sustainability studies include the efficient use of resources, particularly energy, water and raw materials, waste generation and emissions which can lead to global warming, ozone depletion, acidification and eutrophication. Also important are sustainable agricultural practices, protecting biodiversity and ecosystem services, and labor practices. Economic sustainability is sometimes overlooked but is equally important. Improving business and technical efficiencies inevitably also benefits the people and the environment, and needs to be an integral part of any sustainability exercise.

MAJOR SUSTAINABILITY ISSUES

Standards and certification systems do not address the indirect land use effects, namely the displacement of agriculture into other areas and macro-effects such as rising food prices. Indirect land use change continues to be an area of concern, and will be for some time because of the difficulty in measuring its effects. Expansion in Brazil to produce increased quantities of ethanol from sugarcane has at the same time resulted in increased quantities of sugar. Thus the food security issue is somewhat different in the case of sugarcane. Nonetheless the issues are extremely complex and have been the cause of much controversy.

The Gallagher report prepared for the UK government released in 2008 concludes that GHG emission estimates must include the effects of indirect land use change and also include avoided land use from co-product production. The report called for lower targets for biofuel replacement of conventional fuels because of the effect on food prices. The report recommends that biofuel production should target only idle and marginal land and make more use of wastes and residues. It also calls for sustainability standards to be extended beyond biofuels to all agricultural production.

Biodiversity and High Conservation Value areas are also among the main concerns of many stakeholders. Some disagreement on what constitutes such areas and how they should be measured still exists. These are natural habitats where conservation or biodiversity values are considered to be of outstanding significance or critical importance. In addition, some standards require that crops must not be obtained from land with a high carbon stock, including wetlands, forest, diverse grasslands and peat lands. This generally excludes what has historically been in use as croplands.

The aspect of sustainability standards which perhaps attracts the most attention is the effect on climate change and in particular greenhouse gas (GHG) emissions. This is derived together with estimates of primary energy used and direct land use change effects.

A concern expressed by producers is that a need to meet sustainability standards will impose reporting and measurement demands which will soak up manpower, time and money. For there to be buy-in by sugar producers, there must be some benefits in adopting standards. These are likely to include:

- A means of self-assessment and performance improvement demonstration.
- A means of benchmarking against others.
- Some credits as a premium for producing sugar sustainably.
- For industries already meeting the conditions, a leveling of the playing fields in terms of meeting environmental and labor related issues.
- Management of risk and liability

- Enhancement of brand image and reputation

In the long run it is expected that conforming to such standards will save money, as inputs such as energy and raw material are used more efficiently, losses and wastage are minimized and manpower is used more productively.

GHG EMISSIONS

Current status

Estimation of the greenhouse gas emissions in production, otherwise known as the carbon footprint, is an essential part of any sustainability study. A number of studies have been done to estimate the net energy ratios and carbon emissions associated with bioethanol production. Different estimates of GHG emission savings relative to fossil fuels are obtained if different assumptions are made in the calculation procedure. Wang *et al.* (2008) estimate a reduction of 78% for ethanol transported to the US from Brazil; they estimate this will increase by up to 9 percentage points if cane burning is phased out. Data produced in Brazil indicates that bioethanol produced and used in Brazil shows GHG emissions savings of 89% compared with gasoline (BNDES, 2008).

The EU has compiled a Renewable Energy Directive (RED) which sets out how the emissions should be calculated for the production of a biofuel from any particular feedstock. Some GHG emission saving default values are given, assuming no land use change, to be used in the absence of primary data required for its calculation. Ethanol produced from sugarcane has the best default value of 71% emission saving relative to fossil fuels; emission savings using corn, wheat or sugar beet are significantly lower, varying between 16 and 52% depending on the feedstock and the process used.

The carbon footprint of sugar has received less attention. PAS 2050:2008 is a Publicly Available Specification, developed in the UK in conjunction with the Carbon Trust (BSI 2008). Recently, both British Sugar Corporation and Tate & Lyle have used this carbon footprint and labeling initiative to evaluate the carbon footprint of sugar, using a life cycle analysis approach.

A method of estimating net energy usage and greenhouse gas emissions has been developed, based initially on work done on biofuels (Rein 2010). The calculation routine was developed for use in the Bonsucro standards, which focus on the sustainability of the sugarcane industry.

Major issues

The main issues to be considered in estimating the carbon footprint are as follows (Rein 2010):

System boundary. It is essential to describe accurately the boundary of the system being examined, indicating clearly what is included and excluded.

Direct and indirect effects. Direct inputs are mainly fuel and power inputs, expressed in terms of the primary energy value (taking into account e.g. the efficiency of conversion of fuel to power, and the energy in producing gasoline and diesel). Indirect inputs include, in addition, the energy required for the production of chemicals, fertilizers and other materials used.

Land use change. The effect on the carbon stock of planting cane compared to its previous status needs to be accounted for. Only direct land use change is included at this stage.

Handling of co-products and multiple products. The method of allocating emissions to products can affect the estimates.

Default and secondary data. It is always necessary to make some assumptions in the absence of direct measurements. The value and source of the data used can have a substantial effect on computed emissions.
Capital embedded in capital goods. In general this is included in calculations in America and excluded in Europe.

Carbon footprint of raw sugar

Carbon dioxide (CO_2) from sugarcane emitted in combustion and in ethanol fermentation is considered zero CO_2 emission to the air, because this is the carbon taken in from the air during sugarcane growth. CO_2 emissions arising from biogenic carbon sources are excluded from the calculation of GHG emissions from the life cycle of products, except where the CO_2 arises from direct land use change. Methane (CH_4) and nitrous oxide (N_2O) from burning bagasse must be accounted for in GHG emissions. Methane and N_2O have global warming potentials 25 and 298 times that of CO_2 respectively (IPCC 2007). The carbon equivalent value is calculated by multiplying the mass of each of these gases by its global warming potential. This is added to the CO_2 evolved and expressed as CO_2 equivalent (CO_2eq). Therefore even small amounts of CH_4 and N_2O need to be considered in arriving at GHG emission estimates.

The carbon footprints of sugar and ethanol are very small when compared with other foods and fuels. Depending on circumstances, the carbon footprint of raw sugar is expected to be in the range of 200 to 500 kg CO_2eq/t sugar. Rein (2010) has shown that particular improvements can be achieved by focusing on the following, in roughly the following order of importance:

- Cogenerate and export power to the maximum extent possible
- Maximize cane yield and factory recovery
- Reduce the amount of fertilizer and chemical input, particularly N fertilizer
- Reduce the extent of cane burning
- Reduce the quantities of any supplementary fuels purchased
- Minimize irrigation power input
- Reduce cane transport distances
- Recycle water to reduce water intake

Export of power from a sugar cane mill can substantially reduce the carbon footprint. Levels of export of power above about 80 kWh/t cane can actually lead to a negative carbon footprint.

A critical issue is the effect of land use change. A cut-off date of January 2008 is adopted by the EU and Bonsucro, so that land use change before that date is not considered. However changing land from most forms of natural vegetation to cane imposes a substantial increase in calculated emissions.

Carbon footprint of refined sugar

The refiner needs to consider not only its own operations but also its entire network of suppliers, chief among these being the supplier of raw sugar. The GHG emissions in refining are almost entirely due to fuel used for steam and/or power generation. A refinery operating at a steam/melt ratio of 1.0 will require roughly 0.125 t coal to be burnt. Based on a coal net calorific value of 25 MJ/kg coal, this implies 3125 MJ in coal burnt, and based on an emissions value of 0.11 kg CO_2eq/MJ (from the EBAMM model, Farrell *et al.* 2006), an emission figure of 344 kg CO_2eq/t sugar melted. To this needs to be added the emissions associated with the production of coal (0.3 kg CO_2eq/kg coal) i.e. 38 kg CO_2eq/t sugar, giving a total of 382 kg CO_2eq/t sugar melted. This is of the same order of magnitude as the carbon footprint of the raws being melted.

If natural gas is used instead of coal, the situation is improved, since the GHG emissions associated with natural gas are about 60% of those when burning coal. This reduces the emissions level to about 230 kg CO_2eq/t sugar melted, but this is still high in relation to the raw sugar emissions.

The energy in chemicals manufacture and transport to site, as well as process water input, total about 35 kg CO_2eq/t sugar melted, and so are immaterial by comparison. Thus the choice of clarification and decolorization process in refining does not have a material influence. Likewise emissions from disposal of wastes are negligible by comparison.

Emissions from transport of raws to a destination refinery depend on the mode of transport. Long distance road transport significantly increases the carbon footprint, whereas emissions from transport by sea in a bulk carrier are relatively small. Unfortunately there can be wide discrepancies in databases referring to emissions due to transport (Plassmann *et al.* 2010). Different databases give significantly different values for emissions from bulk marine transport. These vary between 0.04 kg CO_2eq/(t.mile) and 0.002 kg CO_2eq/(t.mile). Using a value of 0.01 over a distance of 5000 miles leads to emissions of 50 kg CO_2eq/t sugar. This is still much less than the emissions due to fuel usage in refining, but transport emissions may be important if long overland deliveries are involved.

Hattori *et al.* (2008) report emissions due to transport of raws from Thailand to Japan to be 37 and 48 kg CO_2eq/t sugar for transport to the port and transport by sea to the refinery. Plassmann *et al.* (2010) report emissions for transport from Mauritius to Europe to be about 140 kg CO_2eq/t sugar.

Some of the emissions may be allocated to co-products produced. For instance a small percentage of the emissions may be allocated to molasses. Emissions may also be allocated to specialty products, allowing for any additional energy which may be used in their production.

The impacts of packaging and waste disposal have been found to be insignificant (Plassmann *et al.* 2010).

Options for reducing carbon footprint in refining

These relate almost exclusively to reducing the energy used in refining. Improving energy efficiency will always have a substantial effect. But in addition the GHG emissions associated with the source of the energy are most important. For instance electric power sourced from hydroelectric generation would be associated with very low emissions. The choice of natural gas instead of coal as illustrated above also has a significant effect.

The carbon footprint of sugar produced in a white end refinery will therefore always have a substantial advantage relative to a stand-alone refinery. Emissions due to potential longer transport distances to markets are in most cases likely to be lower than those associated with energy use.

More important is the choice of raw sugar supplier with low emissions in the production of the raws; the way in which raw sugar is produced should become of greater interest to the refiner. The use of high quality raws which reduces the intensity of energy requirements can also have a significant impact.

Results of other studies

Raw sugar

Renouf and Wegener (2007) report high values in the range of 500 to 800 kg CO_2eq / t raw sugar. These values are inflated by high estimates of nitrogen emissions from fertilizer, by irrigation and emissions from energy embedded in agricultural capital equipment. This is considerably higher than other estimates. Hattori *et al.* (2008) report calculated carbon footprints for raw sugar produced in Thailand and Japan as 203 and 311 kg CO_2eq/t sugar respectively. The lower value in Thailand is largely achieved through the sale of electric power.

The carbon footprint for average conditions in the South African sugar industry was estimated by Mashoko *et al.* (2010). They found that emissions of 364 kg CO_2eq were associated with one tonne of raw sugar produced, at the factory gate. Cane farming was shown to be the major contributor to GHG emissions, and that a reduction in fertilizer use and the phasing out of cane burning would most significantly reduce GHG emissions.

Florida Crystals market “carbon-free” sugar, achieved through the cogeneration and sale of electric power. Their power generation facility can produce 80 MW from 103 bar steam, using the mill bagasse as well as 900 000 tons of wood waste/year diverted from landfill as the fuel sources.

Refining

Tate & Lyle report a figure for white cane sugar of 380 kg CO_2eq / t sugar in a 1 kg consumer pack. Previously they had reported a value of 500 kg CO_2eq / t sugar, taking into account refining, packing and transport, and recycling and disposing of packaging waste (Houghton-Dodd 2008). The growing and milling activities are responsible for 190 kg CO_2eq / t sugar. The figure reported by Tate & Lyle for beet sugar in the same study is almost 1000 kg CO_2eq / t sugar.

Hattori *et al.* (2008) calculated the emissions in refining raw sugar to be 314 kg CO_2eq/t sugar, 94 % of which is derived from the energy required for refining. Combining this with raw sugar produced in Thailand gives 528 kg CO_2eq/t refined sugar.

The best case for refined cane sugar is an annexed refinery. Plassmann *et al.* (2010) report a figure of 400 kg CO_2eq/t white sugar produced in Mauritius and landed in Europe. The comparison between beet and cane sugar largely revolves around how energy is produced and used. In the US it appears that beet sugar has a considerably larger carbon footprint than cane sugar (Taylor and Koo 2010), while in Europe the carbon footprint can be lower than refined cane sugar sourced from Africa, where cane is irrigated and burnt before harvesting.

Taylor and Koo (2010) looked at the impact of possible emissions regulations on the cane and beet industries in the US. They used emission figures of 1160 kg CO_2eq/t sugar for beet sugar and 570 kg CO_2eq/t sugar for refined cane sugar. The net effect of a cap and trade or carbon tax system would be to reduce the amount of beet sugar relative to cane sugar, and lead to increased imports. They did not consider the effect of carbon taxes on inducing changes in the operation of sugar producing facilities in the US, which would be the intention of the system.

British Sugar used the procedure of PAS 2050 to arrive at a figure of 600 kg CO_2eq / t beet sugar. This is the B2B figure, as provided to the industrial user. About 60 % of the emissions are due to fuel use at the factory (pers. comm. P Watson 2009). Use of cogeneration in the manufacture of ethanol from wheat particularly in combination with a gas-fired turbine can significantly improve energy and emission improvements relative to gasoline (Concawe 2007). This strategy is put to good use in British Sugar’s operations.

Other foods

The implications of the magnitude of the numbers generated can be appreciated by comparison with other foodstuffs. The very low carbon footprint of sugar is illustrated by Nordic Sugar's work (Anon. 2009), which yields the following results for emissions associated with foods:

Beet sugar	675 kg CO_2eq/t
Cheese	10 800 kg CO_2eq/t
Beef	14 000 kg CO_2eq/t

Milk in Holland is shown to have a carbon footprint of 1600 kg CO_2eq/t product. Hattori *et al.* (2008) compared the carbon footprint of refined sugar of about 500 kg/t sugar with the carbon footprints of other foods, 520 for flour, 746 for bread, 430 for cleaned rice and 1420 for soybean oil, all in kg CO_2eq/t product.

DEVELOPMENT OF SUSTAINABILITY STANDARDS

Current Status

Over the past few years, various initiatives have been developed to address the impacts associated with the production of biofuels. These initiatives include regulatory frameworks, voluntary standards/certification schemes and scorecards. Some of them cover the entire supply chain while others deal with only parts of it.

All countries have their own sets of regulations and laws governing environmental and social issues. Internationally recognized standards may be seen as a prescription by one country or customs union of the standards that a supplying country must meet as a condition for access to their markets. In some respects it levels the playing fields amongst producers, e.g. developed nations presently consider that they have to meet harsher environmental and labor standards than some of the developing world's standards. Others may question whether linking such standards to trade is motivated by altruism or protectionism.

Requirements

The requirements of the standards depend on the use to which they will be put. Reporting frameworks such as those proposed by the Global Reporting Initiative (GRI 2008) and the Institution of Chemical Engineers (IChemE 2002) cover the three legs of economic, environmental and social elements.

The International Social and Environmental Accreditation and Labeling (ISEAL) Alliance has developed a Code of Good Practice for Setting Social and Environmental Standards to evaluate and strengthen voluntary standards, and to demonstrate their credibility on the basis of how they are developed (www.isealalliance.org). Adhering to procedures that constitute good practices for setting standards ensures that the application of the standard results in measurable progress towards social and environmental objectives, without creating unnecessary hurdles to international trade.

The first step is the establishment of Principles, which are universal statements about sustainability and define the objectives. From the Principles flow the Criteria and Indicators. Criteria are the conditions to be met in order to adhere to a Principle. Indicators are measurable states that indicate whether or not associated criteria are being met. This is shown schematically in Figure 1.

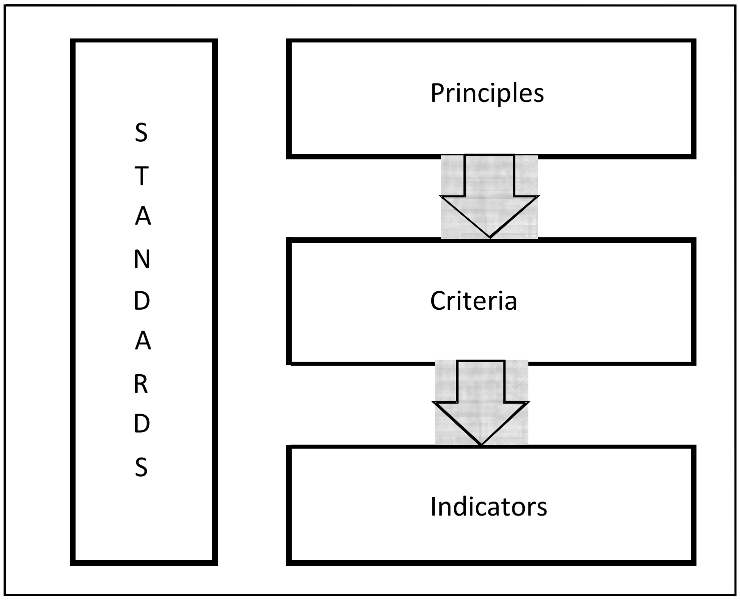

Figure 1. Nomenclature used in standards.

The process of developing standards and indicators must be entirely transparent and inclusive involving a multi-stakeholder process. This is vital if the standards developed are to have international credibility. Thus it is necessary to engage widely with the stakeholders in all spheres of operation and to encourage participation through comments, suggestions and input of any kind. Only then can it be claimed that the system of certification is not open to abuse.

If certification is required, it is also necessary to incorporate a system of traceability, to ensure that consignments of product are identified throughout the process of transport and distribution.

Bonsucro

Bonsucro is specifically focused on sugar and ethanol from sugarcane. It is a collaboration of sugar retailers, investors, traders, producers and NGOs who are committed to sustainable sugar production by establishing principles and criteria that can be applied in the sugarcane growing regions of the world. Bonsucro is funded by members, among whom are consumer companies (e.g. Coca Cola, Kraft), commodity traders (e.g. ED & F Man, Cargill), NGOs (e.g. WWF, Solidaridad), producers (e.g. Cosan, Mitr Phol), producer associations (e.g. UNICA, ASSOCANA) and oil companies (e.g. Shell, BP). The Bonsucro web site explains its activities in more detail (www.bonsucro.com).

Bonsucro has developed a Certification Protocol for members and auditors that lists the process and procedures for certification against the Bonsucro standards. This includes:

- rules and requirements for Certification Bodies to audit against the Bonsucro standards,
- certification requirements for economic operators to demonstrate compliance with the Bonsucro standards
- audit procedures for Certification Bodies to verify compliance with the Bonsucro standards.

Bonsucro has developed 2 standards:

- The *Production Standard* contains principles and criteria for achieving sustainable production of sugarcane and all sugarcane derived products in respect of economic, social and environmental elements.
- The *Mass Balance Chain of Custody Standard* contains a set of technical and administrative requirements for enabling the tracking of claims on the sustainable production of Bonsucro sugarcane derived products along the entire supply chain after the mill; through production, warehousing, transportation and trade to the use of sugarcane derived products.

This is illustrated in Figure 2.

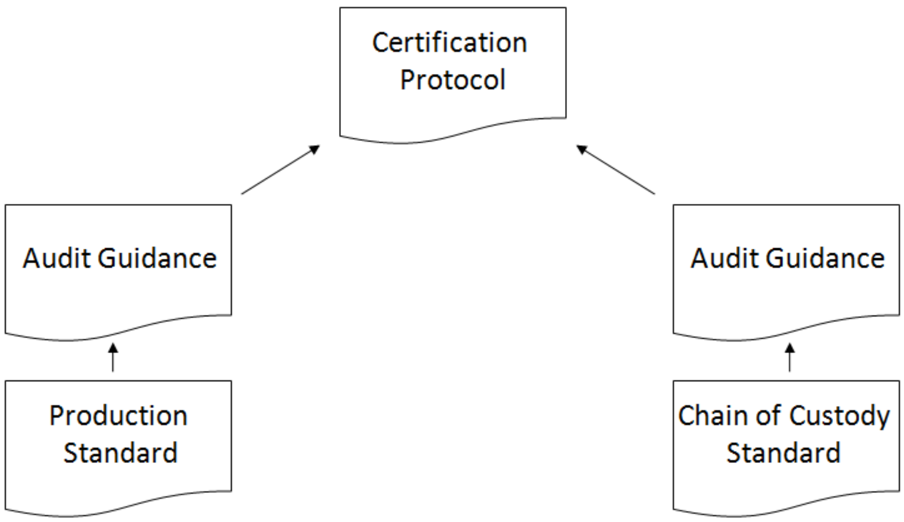

Figure 2. Bonsucro Certification Standards.

The standards are intended to be auditable according to ISO 65 and not only a reporting framework. For certification, third party certification will be necessary, particularly if the scheme bestows additional value on the certified product. This requires verification by an assessor or inspector, certification as a result of the assessment, and accreditation based on the demonstrated competence of the certification body.

The Principles of the Production Standard accepted by Bonsucro members are:

1.) Obey the Law
2.) Respect human rights and labor standards
3.) Manage input, production and processing efficiencies to enhance sustainability
4.) Actively manage biodiversity and ecosystem services
5.) Commit to continuous improvement in key areas of the business

The principles are broken down into 23 criteria and 50 indicators. The ISEAL Alliance comments as follows on standards: “A good standard is equally applicable anywhere within its geographic scope and focuses on achieving outcomes rather than prescribing methods for reaching these outcomes”. It is for this reason that Bonsucro has attempted to set indicators which measure outcomes, the impacts of their activities, rather than recording the existence of good practices. It is hoped that the values of the indicators will be universally applicable, with a minimum of regional variation required by local circumstances. The development of Bonsucro Standards is described elsewhere (Rein 2009).

It is important to differentiate between the Standards and Best Management Practices (BMPs). BMPs are a means to an end and not an end in itself. BMPs have been drawn up in many parts of the sugarcane world, which are valuable and useful, but they do not identify the impact on the environment of the activity considered. They will also be different in different cane growing areas. In addition, today's BMPs are likely to be superseded by tomorrow's better ones. It has been suggested that the term BMP should therefore refer to Better Management Practices (Clay 2008). ISO 14001 standards are also available to guide sustainable practices, but focus on organizational processes and not products or impacts.

An advantage of the use of metrics is that they can be used as a means of assessing ongoing improvement, by monitoring how the values of the metrics change over time. It also facilitates comparisons and benchmarking with other producers. Setting baseline values represents an on-going challenge. It is not intended to be an "elitist" initiative intended to discriminate against certain industries. The standards should not be "best achievable" but true reflections of what experts define as a minimum acceptable level that can realistically be achieved by responsible operators. Baseline values are set following experience with application of the standards in the sugarcane industries in a number of different regions of the world.

Branding or labeling can be used to generate income, which it is hoped will cover the cost of accreditation, the on-going costs of the standard setting body, and still return money to producers, to provide incentives for them to cover the cost of improved performance. It is certainly one of the objectives of Bonsucro to achieve a system of standards which result in benefits to producers which outweigh any costs.

CONCLUSIONS

It is already evident that awareness of sustainability issues is influencing business decisions, to the benefit of the environment and sustainable production into the future. Pressure to produce sugar in a sustainable way is mounting on all parts of the value chain, from producers through to consumers. This is likely to impact the decisions that sugar producers make in regard to design and operation of their production processes within their companies.

In terms of GHG emissions, energy usage is a major contributor to the carbon footprint of sugar. The raw sugar producer has a huge advantage in being able to operate in most instances without the use of supplementary fuels and can produce raw sugar with a small carbon footprint. The refiner needs to look to energy efficiency and the source of its energy input to reduce his emissions. Fundamentally however the carbon footprint of sugar is low by comparison with most other foodstuffs.

A means of measuring and monitoring sustainable production of sugar is being driven by a number of factors, including legislative requirements, investor expectations, consumer/market advantage and reputation and brand image. Bonsucro has developed a system of measuring sustainability, incorporated in a set of standards against which producers can be certified, a process expected to start formally in 2011. It is anticipated that this process will contribute to efficient management of the triple bottom line components of environmental responsibility, economic return and social development.

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