Overview and experiences of different cane-management models in different countries

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Abstract Sugarcane is grown under varied agro-climatic, eco-geographic as well as socio-economic, conditions across the world and consequently cane management remains a complex activity that is largely situational and conditioned by local needs and requirements. In South Asia, where availability of land is limited and size of holdings small, sugarcane cultivation and supply to sugar mills mostly follow an out-grower model, while in much of the rest of the world cane production and supply are largely based on an estate model where large plantations are owned and managed either by the mills or by planters. There is also a third model where small land holdings are consolidated to form block farms or contract farms to achieve operational efficiency and economy in cane production. These three models are described and reviewed using the practices in India, Guyana and the Philippines as examples. India, the second largest sugar-producing country has 60 million out-growers supplying cane to 560 sugar mills. Cane production is through registered farmers facilitated by various subsidies and technological support by the mills. Cultivation practices, cane procurement practices, harvest and transport management and cane pricing differ in different parts of the country. In most mills in the private sector, an IT-based cane-management system is in place to manage and regulate cane production and supply. In Guyana, cane management follows an estate model, although outgrowers also contribute to cane supply to a lesser extent. There are critical issues in cane cultivation in these countries in terms of farm operations, input supply, burnt cane, harvesting operations and delivery to mills. Block/contract farming in the Philippines involves conversion of the consolidated farms into agribusiness centres through professionalized farm management and mechanized farming, with provisions for logistical, financial, technical, marketing and production support services from government agencies, banking and financial institutions and private sector. Such farms, of 200-300 ha size, are shown to have potential to increase cane yield and cane quality and reduce cost of cultivation. The future of cane growing hinges upon a mix of all three models to suit prevailing situations to make sugar industries socially relevant and economically competent. The paper outlines the merits and demerits and the likely approaches to improve farm productivity, economic viability and supply management under these models.

Key words Outgrower model, contract farming, estate cane management, cane management system

INTRODUCTION

Sugar industries play an important role in economic development and employment generation in many rural areas. The sugarcane supply to a sugar mill is from farmers or cane growers or through estate cane. The issues of cane supply vary and are different in an outgrowers’ model and a nucleus estate cane model. With the growth of the world sugar industry from 52 Mt of sugar production in 1963 to 173.8 Mt of sugar production in 2011-12 (Jha 2012), the methods adopted for growing of cane and logistics have undergone considerable changes. Mechanization and information technology interventions have changed the way sugarcane is grown and supplied to the factories.

Sugar industries in India, Philippines and Guyana follow distinctly different models for sugarcane production. Here, we apply our experiences to three different models, viz., outgrowers’ cane in India, contract farming in Philippines and estate cane model in Guyana. These are discussed based on case studies from three sugar mills in India and one each from Philippines and Guyana.

India is the second-largest sugar producer in the world where 60 million farmers cultivate 5 Mha of sugarcane and supply 250 Mt of sugarcane to 560 sugar mills (Jha 2012). On average, each factory has about 20,000 sugarcane supplying farmers. In this paper the issues and challenges related to such large number of farmers who have small farms are discussed. This is the unique cane management model in the world where managing this numbers of cane growers is a challenging job. IT intervention has greatly helped to streamline seamless activities of cane growing through to harvesting and cane price payment.
Sugarcane growing in estates attached to sugar mills is common in non-Asian countries. Cane growing requires vast resources such as agricultural machines and equipment, irrigation infrastructure and skilled manpower etc. Maintenance of agricultural equipment and harvesting occupies prime importance in sugarcane estate management. Since manual operations such as sugarcane harvesting are almost impossible at an economical scale. Sugarcane estate management at Guyana is unique as cane is cultivated in low-lying areas and is transported through waterways to a cane carrier. We describe our experience in sugarcane estate management at Guyana Sugar Corporation, Guyana.

In the Philippines, cane management is a mixture of the estate management model and outgrowers’ cane management model. The absentee ownership of farms in the Philippines and because sugarcane farms are attached to sugar mills has led to a situation where contract farming and/or block farming is a necessity. For the first time we have established contract farming in a Cagayan valley at Carsumco Sugar Mill area where cane supply is severely impacted by absentee farmers. In this paper, the problems and prospects of contract farming are discussed.

Our paper deals with all three models of cane management prevalent in the world with specific case studies for each model.

**OUTGROWERS SUGARCANE MODEL**

India is the second largest sugar-producing country in the world. There are 560 operating sugar mills with 60 million farmers supplying sugarcane. On average each sugar mill has 20,000-50,000 farmers supplying sugarcane. The average land holding of a sugarcane farm is 0.5-2 ha. The sugarcane cultivation practices from land preparation to intercultural operations are semi-mechanised, while harvesting is mostly done manually. Mechanised harvesting of sugarcane is just picking up in India (Chellaswamy and Revathi 2013).

The farmer/grower is the centre of outgrowers’ sugarcane model and the government interventions, as well as the factory, functions around it (Fig. 1).

![Fig. 1. Factors in cane management – Indian scenario.](image-url)
Sugar is an essential commodity in India and sugarcane is a politically sensitive crop as many people are involved in sugarcane cultivation. Since the sugarcane farmers are small to medium cane suppliers, the government fixes the cane price, monitors that their cane is not left in the field and also ensures cane payment to farmers.

Sugarcane is supplied by farmers in animal-driven carts, tractors-trailers and trucks. The harvesting of sugarcane is done on the basis of age of the crop (date of planting/ratooning) or on the basis of variety in tropical India. In sub-tropical India the supply of cane is based on principles of equitable distribution. In this system, the harvesting campaign is divided into 2-week periods and in each harvesting orders are given in such a way that every farmer gets harvesting orders at least once each 2 weeks. The basic minimum quantity of each harvesting order is 1.5 tons. There is a statutory government order that this system has to be strictly implemented by all factories (Sugarcane Control Order 1966). The cane price is paid on a weight basis over all India.

The in-field challenges for an outgrowers' sugar industry are:

1. Timely availability of basic inputs such as seed, fertilisers, pesticides, etc, in sufficient quantity is one of the major factors influencing sugarcane cultivation.
2. New varieties do not reach the farmers immediately on release due to technical as well as operational reasons. New varieties are tested by the factories for potential yield, quality and adaptation before they are passed on to farmers. While this ensures that only potentially good varieties suited for the particular mill zone are grown by the farmers, it also delays the adoption of improved varieties in time to exploit their potential. In addition, farmers are generally reluctant to replace an established variety with a new variety in view of the perceived risks.
3. In subtropical India seed production practices are grossly inadequate to meet the industry requirements as there is no organised or established system. Consequently, farmers use farm-grown seed year after year resulting in varietal degeneration and yield loss. In addition, the adoption of new varieties also is slow due to the absence of a proper seed-production system for faster multiplication and distribution.
4. Ratoons are poorly managed and often considered as a bonus crop and not given proper attention. This results in poor ratoon yields and, consequently, fewer ratoons.
5. Sugarcane is a long duration crop and needs a high amount of water. However, water is scarce in the canals and the tube-wells, which badly affects the yield of the crop. Power shortages also affect crop irrigation.
6. Late fixation of the support price of sugarcane by the Government creates a situation of uncertainty for millers and farmers. The fixation of the support price of sugarcane has remained a point of contention between the sugar mills and the farmers for years. The sugarcane price fixed by the central and state governments often does not match the prevailing sugar prices and leads to discard between the sugar mills and the farmers, often resulting in reduced availability of cane.
7. Competition from other profitable short-duration crops such as rice, wheat, oil seeds etc. results in less area planted to cane. The returns from these crops from unit area are higher and the prices are realised immediately, unlike sugarcane where the cane price is settled late.
8. A short crushing season because of late start and early closing of mills has been a serious issue in India. The delayed start of the crushing season affects the farmers in two ways: (a) loss in cane weight; and (b) delay in growing the subsequent crop on the land vacated by the sugarcane crop.
9. Late payment to the farmers by the sugar mills is a serious issue, with the result that the latter are unable to purchase inputs for the following crops.
10. Acquiring loans from the banks/other lending agencies remains a difficult task that needs to be made easy to enable the farmers to procure the inputs in time.
11. The harvest and postharvest management of cane in major parts of subtropical India remains unsystematic. The harvesting schedules are not based on maturity of the cane and, most often, cane are delivered to the mill 48-72 hours after harvest resulting in inversion and low recovery.

Given the above scenario, the outgrowers’ Cane Management System (CMS) of India is unique (Hassan et al. 2010). CMS has been developed over the years to take into consideration the prevailing practices in cane cultivation and cane delivery/procurement mechanisms. The system is a very efficient tool to record and monitor the complex multi-factor production system that prevails in India. It assists decision makers on the availability of cane, planning the maturity and harvesting calendar and organizing sugarcane transportation to minimize postharvest losses.

Typical aspects of the outgrowers’ CMS model are:

1. Cane crop management is primarily done by farmers as sustenance farming. Therefore, any technology input is advisory in nature in Indian outgrowers’ model.
2. For the sugar mill, it is management of cane growers rather than cane crop management.
3. Cultural practices have to be typically tailor-made to suit small and medium farmers that are heavily dependent on availability of:
   i. Agricultural equipment for land preparation, planting, intercultural operations and harvesting of the sugarcane crop.
   ii. Suggestions of the appropriate varieties for the location and availability of healthy seed material.
   iii. Fertilizers and chemicals made available on credit or at subsidised rates.
   iv. Arranging harvesting labour for manual harvesting.
   v. Arranging harvesters (wherever applicable) on rent, contract, etc.
   vi. Arranging cane transport vehicles to bring cane to sugar mills.

4. In CMS, from planting to harvesting, the following activities are monitored for each planter/farmer/grower:
   i. Geographical information of plant or ratoon crop through GPS surveys
   ii. Consolidation of area/fields for each farmer with plant and ratoon, variety, age grouping for each farmer and each village and then to zone. All the activities are done through computerised programs especially developed for individual factories.
   iii. Through IT interventions, the cane management staff of the factory keeps in touch with farmers from planting to harvesting of the crop via different modes of communication such as websites, text messages, personal visits to their farm etc. The dos and don’ts of crop cultivation are communicated through various extension activities.
   iv. Monitoring crop husbandry schedules such as crop growth, pests and disease, surveillance, intercultural operations, fertilizer application.
   v. Pre-harvest maturity surveys.
   vi. Preparation of calendar (scheduling) for each farmer for harvesting of cane.
   vii. Cane weighment management.
   viii. Cane price payment directly into bank account of farmers and accounting.

All the activities are monitored through IT interventions and customised software. The entire cane management is carried out seamlessly in the mills using this software. In India, sugar mills are socially relevant as they involve large numbers of farmers. Hence, the cane procurement system has to be efficient and flawless. Any deviation from the system will affect the day-to-day cane supply to the mill. It also affects overall cane availability to mills and can lead to loss of goodwill with farmers.

The above aspects of cane management at Simbhaoli Sugars Ltd, Units Simbhaoli and Chilwaria in Northern India have been implemented with the following outcomes:
   a) Increased production leading to overall cane availability for the factory.
   b) High-sugar varieties Co238, Co239 and Co118 were introduced, where recovery % cane increased by 1 unit over a period of 3 years from 2012-13 to 2014-15.
   c) The sugarcane area in the Chilwaria unit has increased from 2,000 ha in 2001 to 30,000 ha in 2011-12.

BLOCK/CONTRACT FARMING MODEL IN THE PHILIPPINES

CARSUMCO sugar mill is located at Cagayan Valley in northern Luzon, Philippines. The installed cane-crushing capacity of the mill is 4000 t cane/day, or 600,000 t of cane for a 150-day crushing. The crushing record shows that CARSUMCO has never achieved 100% capacity utilization. The highest capacity ever reached was only 55% of installed capacity (Sugar Regulatory Authority, Philippines). Underutilization of installed capacity has affected the profitability of the CARSUMCO mill.

The CARSUMCO mill management was keen to increase the sugarcane production and introduced the contract farming model. They engaged us to introduce contract farming in the mill district to increase the overall sugarcane availability.

The agro-climatic conditions are suitable for cultivation of sugarcane crop with average annual rainfall of 1600 mm and sandy loam soils, except few dry spells during summer season. Sugarcane is generally grown as a rain-fed crop in the area.

Although agro-climatically suitable for sugarcane cultivation, due to absentee land owners and competition from alternative crops such as rice and corn, sugarcane cultivation is the last priority of local farmers. Although enough labour is available for sugarcane cultivation, harvesting of cane remains an issue. Cane burning before harvesting is common, while the cane transportation through trucks is also a concern for the planters.
Fluctuating sugar prices are also deterrents for planters. The cane price payment is based on a sharing formula that gives farmers low returns when the sugar price is low.

The size of the land holdings under the factory command area ranges from 5-20 ha per family. Although farmers are not interested in sugarcane cultivation, they are willing to lease out their farms for sugarcane cultivation on a short-term contractual basis.

To introduce contract farming, GCS initially contracted 130 ha of land adding more areas in subsequent years and applying all recommended practices. Average cane production in the surrounding area was 30 t/ha. The plant crop yield was 90 t/ha (Table 1). The crop was ratooned during the subsequent year, and yields dropped as the ratoon area increased to 89% by the fifth year. Yield stabilised at about 65 t/ha by the fifth year. The maximum cane yield recorded for a plant crop was 135 t/ha, while the maximum yield recorded for a ratoon crop was 110 t/ha with a sugar content of 120 kg sugar/t cane) under the rainfed conditions. By the fifth year, the cane area had increased to 210 ha and cane production to 13,650 t.

<table>
<thead>
<tr>
<th>Year</th>
<th>Area contracted (ha)</th>
<th>Cane production (t)</th>
<th>Cane yield (t/ha)</th>
<th>Sugar content kg sugar/t cane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Ratoon</td>
<td>Plant to 4th ratoon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010-11</td>
<td>130</td>
<td>0</td>
<td>11,700</td>
<td>90*</td>
</tr>
<tr>
<td>2012-13</td>
<td>63</td>
<td>130</td>
<td>15,054</td>
<td>78</td>
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<tr>
<td>2013-14</td>
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<tr>
<td>2015-16</td>
<td>22</td>
<td>188</td>
<td>13,850</td>
<td>65</td>
</tr>
</tbody>
</table>

Data source: CARSUMCO Sugar Mill

The practices followed by GCS in the leased farms were:
1. Contour mapping and minor land levelling (wherever required).
2. Chisel ploughing followed by land preparation.
3. Planting of sugarcane with suitable varieties and seed treatments.
4. Timely intercultural operations based on available moisture.
5. Automated fertilizer application in a minimum of three splits.
6. Chemical application for weed, pest and disease control.
7. Supplementary irrigation to the young crop by sprinklers in dry months.
8. Manually harvesting of cane as a green cane and 0% trash cane.
9. Arrangement of trucks for cane transportation to sugar mill.

Due to the intensive cultivation practices, GCS grew crop to the fifth ratoon without any significant loss in yield. The average sugar content (kg sugar/t cane) of the mill district was 98.5 whereas GCS achieved 105 kg/t on the contracted farms due to good quality, clean and green-harvested cane.

By adopting improved cultural practices and timely field operations cane production was stabilised to approximately 12500 t from 200 ha of land over the five years. The effect of sustained cane cultivation in these contracted farms ensured a regular supply of cane to CARSUMCO Sugar Mill.

In view of the success of contract farming the CARSUMCO management extended support for acquiring more cane areas by offering assistance in terms of long-term loans for capital expenses and providing working capital for growing the crop. Consequently the block/contract farming area has increased to 350 ha over the six years.

Contract farming has the following advantages:
1. Land owners/ lessee gets assured income.
2. Semi mechanized sugarcane farming generates rural employment and provides a farming solution.
3. Intensive cultivation practices improve cane production and quality.
4. Sugar mill gets an assured cane supply of quality cane.

The success of contract farming has been noticed in other areas of the Philippines, and other sugar mills in Negros, Panay and Luzon have shown interest in the contract farming model.
ESTATE CANE MANAGEMENT IN GUYANA

Guyana is one of the major sugar producers in the Caribbean Community. Sugarcane is grown in several areas near the coast and temperature is moderate to high year round with about 2000 mm of annual rainfall. There are two rainy seasons and two dry spells, allowing two sugarcane harvests per year. Sugarcane is grown during the wetter periods and harvested during the dry season (Merrill 1992).

The soil near the coast is deep and fertile and ideally suited for sugarcane. Most of Guyana's population lives on the narrow coastal plain, providing the sugar estates with an adequate supply of unskilled, as well as skilled labour. The main road runs along the coast and makes estates easily accessible and provides the estates with access to other areas.

Guyana Sugar Corporation has seven sugar mills and produces around 300,000 t of sugar annually. Every factory has its own sugarcane estates and there are few outgrowers that account for 8-10% of the total cane supply (Guyana Sugar Corporation). In the estate managed sugarcane farms, the farming operations are mechanised, but the output was very low. Sugarcane is burned and harvested manually. Cane is transported from field to factory through waterways by boats (punts), each carrying 6-8 t of cane. Nearly 60 to 80 punts are pulled by a tractor to the cane unloader. Accumulation of large numbers of punts and their loading, coupled with factory stoppages, leads to a long burn-to-grind interval.

We identified short-comings in the existing operations and proposed solutions:

1. A general fertilizer recommendation policy was followed by all seven estates irrespective of soil type and nutrient requirement.
2. All the fertilizers were applied in single dose 6-8 weeks after planting or 2-4 weeks after ratooning.
3. Very poor weed control existed as the weedicide applications were generalized. Only a single dose of pre-emergent herbicide followed by a single dose of post-emergent herbicide was applied to control the weeds. There were hardly any mechanical or manual weed control measures taken.
4. No practices of intercultural operations were followed to loosen the soil and control the weeds.
5. The sugarcane was burned 14-18 hours before actual harvesting.
6. Cane transportation was through waterways/drainage canals with average transit times of 6-10 h.
7. The burn-to-grind time often exceeded 48 h which affected the sugar yield in the factory.

We were assigned two estates (East Demerara Estate and Skeldon Estate) to supervise the cultivation practices and improve the cane logistics. The following steps were taken to improve practices at both the estates:

1. Land preparation, planting and seed treatment were planned.
2. Intercultural operations for weed control were introduced.
3. Fertilizers were applied in split doses.
4. A combination of chemical, mechanical and manual methods for weeds control was introduced.
5. Proper scheduling of sugarcane harvesting orders based on age and variety were implemented.
6. Timely arrangement of punts and coordination for efficient sugarcane transportation reduced burn-to-grind time to 24-36 h.
7. Cane management systems for scheduling and management of farming activities were introduced.

Further improvements that were suggested included: (i) a switch from burning of cane to green-cane harvesting; (ii) surface transport of cane by road through tractor-pulled trolleys to reduce postharvest deterioration.

DISCUSSION AND CONCLUSIONS

The cane production and supply systems under consideration were categorised into three models: (i) outgrowers’ cane with small and marginal farmers; (ii) large planters individually or by contract farming; and (iii) estate cane. These different models exist in different countries depending on local conditions and each one has its own merits and demerits. Sugar mills are adopting all three models or any one of them or any two of them depending on their needs.

In countries such as India, the social engineering resulted in a land ceiling and the land holding is limited to 12.5 ha for each farmer. Therefore only small and medium farms (0.5-2 ha) are being used for sugarcane cultivation. The country has various Provinces (States) growing sugar cane and, hence, factories are located in these provinces. The agro-climatic conditions are quite wide and vary significantly from region to region. Sugarcane varieties are developed basically by the Sugar Cane Breeding Institute, Coimbatore and the State Sugarcane Research Stations and tested in different locations before their release for cultivation. Pests and diseases differ in each province, as do harvesting criteria and methods.
Therefore to manage such a large number of farmers, IT interventions are necessities. The sugar mills that have introduced and practised CMS through computerization have been benefitted by it and it has also helped to increase the cane area and productivity. The sugar industry in the country has grown from 100,000 t of sugar production in 1933 to 28 Mt of sugar production in 2014-15 (Solomon 2014). This was possible because of the research support by way of well-adapted varieties and superior crop-production technologies, extension activities by the development departments and the sugar industry, and the investment in infrastructure development. Adoption of IT tools and cane-management systems by the sugar factories have also contributed to the growth of the sugar industry in a significant way.

In the Philippines, absentee land ownership is a problem in some provinces. The low yield and lack of a CMS contribute to low sugar contents and unpredictable cane supplies. Lack of a systems approach and apathy towards cane development programs by factories have led to a situation where factories are short of cane. As a result, sugar production is almost stagnant and in fact decreases in some years. In the contract farming concept, absentee land owners can lease out their vacant lands and can leave sugarcane farming to professional agricompanies/planters. The results of such contract farming that we outline in this paper suggest that, in countries such as the Philippines, contract farming or leased sugarcane farming is a feasible solution to increase cane productivity and sugar production.

In countries such as Guyana, the estates were well managed when they were under the management of professional companies, but deteriorated due to poor management and lack of investment. Farming was not modernised over time. Acquiring new machines without maintenance and replacement with faulty spare parts and lack of professional skills has not helped them to increase cane productivity. An absence of IT interventions for system management and communications has contributed to the poor management of estates. Simple activities that improve cane yield and quality are lacking because the mill management has yet to experience the benefits. Adopting these tools is extremely important for the Guyanese sugar industry to turn it into a profitable entity. Hence, continuous efforts for improvements in estate management are required while short-term improvements may not work.

In conclusion, our observations on the three models suggest that each model is situational and location specific. In a country such as India where farm sizes are very small cane management relies on extension and IT interventions, while in the Philippines contract farming or block farming is essential to improve cane production and cane quality. In a Guyana-like situation, adoption of modern methods of mechanisation backed by spare parts supply and skilled manpower is essential. It is also essential to change and modernise cane cultivation and logistics over time rather than adhering to old inefficient practices.

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Un aperçu et les expériences acquises des différents modèles de gestion de canne à sucre dans différents pays

Résumé. La canne à sucre est cultivée à travers le monde dans diverses conditions agro-climatiques, éco-géographiques et socio-économiques, et de ce fait, sa gestion demeure une activité complexe, et en grande partie conjoncturelle, conditionnée par les exigences et besoins locaux. Dans le sud de l’Asie, où la disponibilité des terres est limitée et les exploitations de petite taille, la culture de la canne à sucre et l’approvisionnement des sucreries suivent plus le modèle paysan (outgrower), tandis que dans la plupart des autres pays sucriers, le modèle de propriété privée est privilégié, les usines ou les agriculteurs possèdent et gèrent des grandes cultures. Il y a aussi un troisième modèle, où les petites exploitations sont regroupées en des grands blocs ou exploitations contractuelles pour atteindre une efficience opérationnelle et une économie dans la production cannière. Ces trois modèles sont décrits et évalués en utilisant les pratiques adoptées en Inde, Guyane et Philippines comme exemple. En Inde, le deuxième pays plus grand producteur de sucre, 560 sucreries sont approvisionnées par 60 millions de petits agriculteurs. La production de la canne est par le biais des agriculteurs enregistrés et qui bénéficient de diverses subsides et soutiens technologiques apportés par les sucreries. Les pratiques culturelles, les méthodes d’approvisionnement en canne, la gestion de récolte et transport et le système de paiement de la canne diffèrent dans les différentes
visión de conjunto y experiencias de diferentes modelos de administración cañera en diferentes países

Resumen. La caña de azúcar se cultiva en diferentes condiciones agro-climáticas, eco-geográficas, así como socio-económicas alrededor del mundo y por consecuencia la administración cañera sigue siendo una actividad compleja que es mucho de contexto y condicionada por las necesidades y requisitos locales. En Asia del Sur, donde la disponibilidad de tierras es limitada y el tamaño de las propiedades es pequeño, el cultivo de la caña y la entrega a los ingenios la mayoría sigue el modelo de cañero independiente, mientras que en la mayoría del resto del mundo la producción de caña y suministro están mayormente basados en el modelo en donde grandes extensiones pertenecen y son administradas sea por los ingenios o por los cañeros. Tenemos también un tercer modelo en donde pequeñas propiedades de tierra están consolidadas para formar bloques de caña bajo contrato para lograr eficiencia y economía operacional en la producción de caña. Estos tres modelos están descritos y revisados usando las prácticas en Filipinas como ejemplos. En la mayoría de los ingenios del sector privado, un sistema de administración de caña basado en internet esta instalado para administrar y regular la producción y suministro de caña. En Guyana, la administración de la caña sigue el modelo dos de grandes extensiones, aunque cañeros independientes también contribuyen con el suministro de caña pero en menor escala. Hay temas críticos en el cultivo de la caña en estos países en términos de operaciones agrícolas, suministro de insumos, caña quemada, operaciones de cosecha y entrega a los ingenios. En Filipinas el cultivo en tierras bajo contrato en bloque implica la transformación de las tierras consolidadas en centros de agronegocios a través de la administración profesional y la mecanización agrícola, con el apoyo logístico, financiero, tecnico, de marketing y de produccion por parte de las agencias de gobierno, los bancos y las instituciones financieras y el sector privado. Estos campos, de 200-300 ha, demuestran tener el potencial para incrementar el rendimiento y la calidad de caña y reducir los costos de produccion agrícola. El futuro del crecimiento del cultivo de la caña gira en torno a un mezcla de los tres modelos para adaptarse a las situaciones predominantes que hagan a la industria azucarera socialmente relevante y economicamente competente. Esta presentacion describe los meritos y las carencias y los probables enfoques para mejorar la productividad de las granjas, la viabilidad economica y la administracion de suministro bajo estos modelos.

Palabras clave: Modelo del cañero independiente, cosecha bajo contrato, administracion de grandes propiedades de caña, sistema de administracion de caña