Improved performance in sugarcane production and factories of the Co-operative Sector through better management strategies: appraisal of sugar factories located in Uttar Pradesh, India

BK Yadav and Sunil Kumar Ohri

Abstract The Indian sugar industry plays a vital role in strengthening the socio-economic condition of the rural population. Sugar factories, especially in the co-operative sector, have a duty to safeguard the interests of cane growers by ensuring timely payment of the Government-approved cane price. The UP Co-operative Sugar Factories Federation Ltd pays around USD300 million per year to cane farmers for supply of sugarcane. In the province of Uttar Pradesh in north India, 24 co-operative sugar mills and 7 distilleries operate in different districts, linking about 0.5 million cane farmers. These sugar mills have a total cane crushing capacity of 64,375 tonnes cane per day, approximately 10% of the total capacity of the state. The total alcohol production capacity of associated distilleries is 210,000 L of rectified spirit per day in addition to 80,000 L of motor fuel grade ethanol per day. The UP Co-operative Sugar Factories Federation Ltd is an apex body that controls the functioning of all co-operative sugar mills and distilleries in the state and also provides technical and financial guidance/assistance, cane development work and support in setting-up new projects. These co-operative sugar mills show considerable variation in terms of varietal profile, sugarcane productivity, technical efficiency and sugar recovery. In 2011-12, a systematic management program was launched in the sugarcane production area and factories to improve production and production efficiency of different operations at cane field and factory level – this has started to give results in the 2015/16 harvesting/crushing season. In 2011-12, about 9% of the total sugarcane area was growing under early maturing improved varieties having pol% cane more than 12% at about 9 months of crop age. This percentage of the area under early maturing improved varieties increased up to about 24% in season 2015-16. The projected area under these varieties in 2017-18 will be about 40%, as the result of a vigorous seed-production programme. During the last four years, the technical efficiency of sugar factories has been improved - crushing capacity utilization has improved to 88% in 2015-16 as compared to 84% in t 2011-12 and, consequently, sugar losses were down from 2.29 to 2.09% on total cane crushed. The overall efficiency of the mills are gradually improving, resulting in enhancement in sugar recovery% cane of around 1.25% on total cane crushed in the crushing season 2015-16 as compared to 2011-12.

Key words improved varieties, seed production, mill efficiency, sugar recovery

INTRODUCTION

The sugar industry is the second largest agro-based industry in India and contributes significantly to the socio-economic development of the rural population. Sugarcane is cultivated in an area of over 5.0 Mha with an average yield of about 70 t/ha. This supports 6 million farmers and their families and provides direct employment to over 0.5 million skilled and semi-skilled people in sugar mills and integrated industries throughout the country. The Indian sugar industry plays a leading role in the global sugar market being the world’s second-largest producer after Brazil, producing nearly 15% and 25% of global sugar and sugarcane, respectively. The sugar industry encompasses 516 operating sugar mills, 356 distilleries and 270 cogeneration plants and numerous pulp, paper and chemical making units and is supported by four leading sugarcane research institutions, 22 state sugarcane research stations, world-class sugar machinery manufacturers, suppliers and technical experts. The industry produces about 340-360 Mt of sugarcane, 24-28 Mt of white sugar and 6-8 Mt of jaggery and khandasri every year to meet the domestic consumption of sweeteners. It also produces 2.0 GL of alcohol, 4700 MW of power and many chemicals (Solomon 2011).

There are 10 major sugarcane producing states in India (Table 1), with Uttar Pradesh the largest area of sugarcane and contributing 26% to the country total sugarcane production. Of the 516 sugar mills in the country, 118 sugar mills operated in the province of Uttar Pradesh during crushing season 2015-16, with total crushing capacity of approximately 0.75 million tonnes of cane per day.
Table 1. Major sugarcane producing states in India.

<table>
<thead>
<tr>
<th>Province</th>
<th>Area (in '000 ha)</th>
<th>Production of sugarcane (in '000 t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uttar Pradesh</td>
<td>2160</td>
<td>133203</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>987</td>
<td>75087</td>
</tr>
<tr>
<td>Karnataka</td>
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<td>34200</td>
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<tr>
<td>Tamilnadu</td>
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<td>27615</td>
</tr>
<tr>
<td>Bihar</td>
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<td>14240</td>
</tr>
<tr>
<td>Gujrat</td>
<td>185</td>
<td>13040</td>
</tr>
<tr>
<td>Andhra Pradesh and Telengana</td>
<td>157</td>
<td>12460</td>
</tr>
<tr>
<td>Haryana</td>
<td>113</td>
<td>8588</td>
</tr>
<tr>
<td>Punjab</td>
<td>99</td>
<td>7131</td>
</tr>
<tr>
<td>Uttrakhand</td>
<td>98</td>
<td>6047</td>
</tr>
</tbody>
</table>

Sugarcane is the major cash crop for Uttar Pradesh, providing livelihood opportunities to a large segment of the population directly or indirectly. It is the largest agro-based industry and a driving force to uplift the socio-economic condition of the rural population. The co-operative movement in the sugar industry plays a vital role in strengthening bonds between cane growers and the remaining industry. The Co-operative movement focuses on the socio-economic development of most backward area of the society, so was given priority over the other sectors. Due to involvement of farmers from its inception, the sugar mills were never looked upon as merely processing units of sugarcane, but, through the medium of the mills, they endeavoured to improve the socio-economic, educational and cultural development of the entire surrounding area. The U.P. Co-operative Sugar Factories Federation Ltd., Lucknow, is the apex body for governing the functioning of 24 co-operative sugar mills and 7 distilleries in different districts of Uttar Pradesh.

MAJOR PROBLEMS IN CO-OPERATIVE SUGAR FACTORIES OF UTTAR PRADESH: SITUATION IN 2011-12

During 2011-12, most of the Co-operative Sugar factories were facing problems of:

- Low cane productivity: The average cane yield in the farmers’ fields in mill area was 55 t/ha, 15 t/ha below the national average (70 t/ha).
- Low sugar recovery: The co-operative sugar factories were plagued with problems of low recovery - average sugar recovery % cane was 8.13%, about 2 units below the national average.
- Higher processing losses: The cumulative processing losses% cane crushed was about 2.30%, 0.30% higher than the national average (2.00%).

ACTION PLAN OF THE UP CO-OPERATIVE SUGAR FACTORIES FEDERATION LTD TO IMPROVE PRODUCTIVITY AND EFFICIENCY

The co-operative sugar factories of Uttar Pradesh were incurring recurring financial losses due to very low sugar recovery% cane, lower capacity utilisation and higher sugar losses% cane. Under the directions of the Government, management of The UP Co-operative Sugar Factories Federation Ltd decided to introduce both a massive cane development programme in their sugarcane production area and measures to improve technical efficiency in factories after crushing season 2011-12 in all the three zones - Western, Central and Eastern part of Uttar Pradesh. It aimed to achieve average cane productivity, sugar recovery% cane and sugar losses% cane of 70 t/ha, 10% and 2.0%, respectively, in the following 5 years. The following management interventions were introduced in all the co-operative sugar factories from spring/ autumn planting starting in 2011-12:

(1) Cane Development Program
   (a) Increasing the proportion of early maturing high sucrose sugarcane varieties attaining a sucrose content of more than 12% at 9 months after planting to around 35-40% in all zones.
   (b) Encouraging autumn planting.
   (c) Soil test analysis to assess N, P, K and micro-nutrient level of soil.
   (d) Ratoon management practises in northern India.
   (e) Seed production using the Indian standardized three-tier seed programme.
(f) Mechanical planting in deep trenches.
(g) Surveillance for pests and diseases and timely application of plant-protection chemicals.
(h) Timely purchase, distribution and application of crop inputs (NPK).
(i) Farmers’ Training and Awareness programs.

(2) Harvesting and Supply Management
(a) Harvesting based on the age of the crop.
(b) Computerization of harvesting slips weight and payment of cane price for quick disposal of cane and payment to the growers.
(c) Reducing the harvest to crush delay (<72 hours).
(d) Analysing the titrable acidity index in primary juice with respect to fresh field cane juice to detect consignments of stale cane.
(e) Constant monitoring of the cane centre and mill yard for faster clearance and more uniform rate of crush.

(3) Milling and Technical Efficiency parameters
(a) Sanitation inside the mills using steam.
(b) Technical Efficiency norms guidelines issued by the Federation.

In order to implement the above programmes, a team consisting of senior officers from the cane and technical wing visited sugar factories frequently and recorded observations with the help of local staff. The impact analysis was carried out based on these observations.

RESULTS AND DISCUSSION

The results of various management interventions were reviewed monthly, and their impact was assessed during the 2015-16 harvesting/ crushing season.

Impact of the Cane Development Program

*Increase in the area of early maturing varieties*

In view of the early start of milling season (November) and to attain better sugar recovery% cane; use of early maturing high sugar (EMV) varieties was promoted. These varieties attain 16-17% sucrose in juice and 82-85% purity within 9-10 months after planting. The proportion of EMV during 2011-12 was nearly 9% in the entire varietal planning scenario. It was aimed to increase the area under EMV to 35-40% in the next 5 years through rapid seed multiplication of EMVs, eg Co238, Co239, CoLk94184, Co9801 and Co0118. Farmers were encouraged to replace old and rejected varieties and plant EMVs for higher profits and sustainability.

![Early Maturing Cane Varieties %](image)

*Fig. 1.* Proportion of early maturing varieties in the Federation area of the three zones of Uttar Pradesh.
Cane seed of early varieties was made available to progressive growers in addition to subsidy on transport. This has resulted in an increase in the area of early maturing varieties in each zone (Fig. 1), with nearly 24% of the area now growing EMVs as compared to about 9% in 2011-2012. This has made a significant impact on sugar recovery in co-operative sugar factories. Furthermore, our farmers are also content with better and timely payment of cane prices due to the supply of EMVs. The cane development department of the Federation is all set to achieve the target of about 40% EMVs by 2017-18.

### Autumn planting of sugarcane

In Uttar Pradesh, nearly 93% of planting is done in February/March – the remaining crop is planted in autumn and late spring (May). Spring-planting of sugarcane is in vogue in northern India and these growers plant their fields in February/March. Normally, sugar mills in north India start crushing operations after 15 October, but due to non-availability of enough ratoon cane, some mills start crushing plant cane of 9-10 months maturity; this results in low recovery early in the season. This is one of the main reasons for low sugar recovery% cane in northern part of the country as compared to national average. Autumn-planted crops are therefore advantageous as they are fully mature and give better yield and sugar recoveries. To increase the crop growth duration in order to get better sugar recovery % cane and relatively higher cane yield, we created awareness amongst farmers to adopt autumn planting, which was almost negligible especially in Western part of the state. This has resulted in an increase in autumn planting in each zone, highest in Eastern zone at 11%. (Fig. 2). Autumn planting is increasing rapidly due to better cane yields, at the same time they are able to grow vegetables and legumes as intercrops, which gives them additional income.

![Autumn Planting Increase](image)

**Fig. 2.** Autumn planting in the Federation area of the three zones of Uttar Pradesh.

### Ratoon management

For good ratoon management, a package recommended for northern India by the Indian Institute of Sugarcane Research, Lucknow (IISR) was followed in our cooperative sugar factories (Sah et al. 2014).

### Soil test analysis

Soil test analysis facilities were established at some of the sugar factories. These aimed to determine the soil organic carbon, and macro- and micro-nutrient status of sugarcane soils. A laminated soil health card showing the status of nutrients in the soil was issued to the sugarcane growers.
Seed production of improved sugarcane varieties through three-tier seed programme

The three-tier seed programme developed at IISR provides disease-free healthy seed to growers (Solomon et al. 2014a, b). Seed procured from other places was also treated with moist-hot-air/hot water (MHAT). This was recommended in all areas of the co-operative sugar factories.

Mechanical planting of sugarcane

To plant sugarcane mechanically, the tractor-drawn trench planters that perform operations such as furrow opening, cutting and placing of setts, dispensing fertilizers, fungicides and insecticides in furrows, and covering setts with soil in a single pass were made available to the farmers through a custom-hire service. This ensured timely planting of sugarcane and reduced dependency on labourers. Currently, about 40-45% of the area is under mechanized planting.

Management practices and essential inputs for healthy sugarcane crop

Some of the productivity enhancement options and cost-effective technologies developed by research institutes such as IISR, Lucknow, SBI, Coimbatore, and UP Council of Sugarcane Research, Shahjahanpur, were introduced in the co-operative sugar mills. Some important and location specific technologies introduced by the cane-development wing were:

- Use of high yielding EMVs that require low inputs.
- Water-use-efficient methodologies, such as furrow irrigated raised bed (FIRB) method in Western Uttar Pradesh, and trash mulching.
- Use of bio-agents such as Trichogramma for the control of borers.
- Application of recommended plant-protection chemicals. Currently, popular high-sucrose early maturing varieties such as Co238 are highly susceptible to borers. To prevent the crop from large-scale damage, insecticides such as Coragen46 were made available to farmers at the correct time.

Farmers’ training and awareness programs

To make sugarcane cultivation simple, affordable and profitable for both small and large farmers and the industry, the Federation arranged many on-farm training/group discussions opportunities for sugarcane farmers. The cane development staffs, in collaboration with the scientists of research institutes, conducts regular training on different aspect of sugarcane agriculture and production technology.

Harvesting and supply management

Introduction of hand-held computers

With the use of hand-held computers (HHC), the cane purchase centres of sugar mills have been connected with the main server of the sugar mill via a GPRS connection. Now the sugarcane farmers get computerized weight slips in place of hand-written slips. This system allows the main server of a sugar mill to register online details of sugarcane purchased at out centres. The HHC system is also being used in sugarcane surveys (identification of variety, area under plant and ratoon crops of each farmer) of the farmer field because it is enabled with GPS device.

Cane harvesting based on crop maturity

The Cane department was directed to take following measures for supply of fresh and mature cane:

- Cane harvested at maturity level and a supply schedule (Table 2). This schedule is normally followed in northern India for getting consistently better sugar recovery% cane. This scheme ensures the supply of sugarcane having higher sucrose % cane for crushing in the factory.
- Proper cleaning of cane, i.e. removing the maximum amount of extraneous matter.
- Quick disposal of harvested cane to mill for crushing.
- Constant monitoring of cane centres and mill yard, monitoring of cane indenting.
- Better transport facility to lift cane from the out centres cane as early as possible to avoid become stale.
- Synchronisation between cane indenting and crushing.
Maintaining the cane yard level at mill gate about 20% of crushing capacity.
Availability of cane supply ticket to farmers before 72 hours of supply of cane.
Regular analysis in the mill laboratory for quality parameters such as the percentage rise of titrable acidity from field fresh cane juice to primary juice to access the staleness in the cane coming to factory for crushing.

All above measures resulted in crushing of gate area cane, which is within about 7 km radius of the factory in less than 24 hours and out-centres cane within 24-36 hours.

Table 2. Sugarcane harvesting and supply schedule in northern India.

<table>
<thead>
<tr>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autumn-planted</td>
<td>Spring-planted</td>
<td>Autumn-planted</td>
<td>Spring-planted</td>
<td>Spring-planted plant crops</td>
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<tr>
<td>ratoons (Early)</td>
<td>ratoons (Early)</td>
<td>ratoons (Mid-late)</td>
<td>ratoons (Mid-late)</td>
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<td></td>
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<tr>
<td>Spring-planted</td>
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<td>Late-planted and late-maturing ratoons</td>
<td>Late-planted and late-maturing plant crops</td>
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<td>ratoons (Early)</td>
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<td>Spring-planted</td>
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<td>plant crops</td>
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<td>(Early)</td>
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</table>

Milling and technical efficiency parameters

Sanitation inside the mills using steam

The amount of sugar loss % cane in mills due to microbial action does not figure in the reports nor is it recorded. The Federation was averse to use of costly biocides. To check the biological sugar losses, steaming at inter-carriers, DSM screen, dead pockets and boiler feed water washing was ensured in each shift in the co-operative sugar factories. This has resulted in maintaining the almost same level of reducing sugars in mixed juice as in primary juice.

Technical Efficiency norms guidelines issued by the Federation

The Federation issued guidelines and monitored the performance in the mills on following major key areas:

(a) Juice extraction
- Preparatory index (PI) increase by 3-4 units.
- Maceration % fibre targeted at 250% maceration on fibre.
- Primary extraction improved from 64-65 level to 68-70 level.
- Moisture of last mill bagasse to be kept below 50% and pol% bagasse around 2%.

(b) Processing house
- Reducing sugar level analysed at each stage to avoid its destruction by maintaining proper temperature and pH at each stage.
- Maintaining juice flow rate as per designed capacity of equipment in the processing house with an aim to keep retention times as low as possible.
- Clear juice pH maintained at pH 7.0 levels with a special check of un-sulphured syrup pH, maintaining not below pH 6.6.
- The decrease in filtrate juice purity from clear juice purity maintained in the range of 3-4 unis.
- Syrup brix maintained at +58 levels with proper bleeding arrangements at evaporator stations.
- pH of sulphured syrup maintained not below pH 5.2 level.
- Mainly three massecuite schemes maintained at pan boiling with proper control of brixes of dropping massecuite. At higher purities of primary juice, three and half massecuite scheme preferred to control loss in final molasses.
- Proper purity control maintained at the pan and centrifugal station with aim to minimum recirculation of non-sugars.
- Strict control on weighing the molasses produced to judge the actual molasses % cane with respect to theoretical molasses % cane.
Training programme for cane and technical staff

Various training programmes were conducted for cane and technical staff to upgrade the knowledge and to provide the platform for discussion regarding on-ground problems in the industry. National experts in individual field invited for knowledge-sharing sessions and workshops.

Overall impact assessment

The overall impact assessment of the development work in sugarcane production area and improvement in factory technical efficiency of co-operative sugar factories in Uttar Pradesh during the 2015-16 season is summarized below:

Average yields of sugarcane increased from 55 t/ha to 65 t/ha during the last 4 years of the development program (Fig. 3).

![Average Cane Yield (Tonnes/Hectare)](chart)

**Fig. 3.** Improvement in cane yield in the Federation area of the three zones of Uttar Pradesh - sugar content and sugar recovery.

![Pol % Cane](chart)

**Fig. 4.** Improvement in pol% cane in the Federation area of the three zones of Uttar Pradesh.
The overall improvement of 1.25% in sugar recovery % cane during 2015-16 with respect to 2011-12 is shown in Figure 5. There was an improvement of pol% cane due to introduction of high-sucrose improved early maturing varieties (EMVs) and other cane development practices (Fig. 4) and factory efficiency was improved to extract maximum sugar from the cane. Enhancement in sugar recover% cane due to increased pol% cane from the high proportion of EMVs and the improved practices has undoubtedly improved the economic viability of the Federation mills. The impact of this improvement can be seen on the overall sugar losses that have reduced substantially during last 4-5 years (Fig. 6).

**Fig. 5.** Improvement in sugar recovery in sugar mills in the Federation area of the three zones of Uttar Pradesh.

**Fig. 6.** Reduction in processing losses in mills in the Federation area of the three zones of Uttar Pradesh.

**CONCLUSIONS**

The UP Co-operative Sugar Factories Federation Ltd has an extensive network of 24 sugar mills and 7 distilleries across Uttar Pradesh. The low cane productivity, sugar recovery% cane and dwindling profitability compared to national average were always the major concerns of the co-operative sugar factories. A pragmatic development program by the Federation was initiated in 2012 to boost sugar productivity in co-operative sugar factories in Uttar Pradesh. Interventions introduced in sugarcane agriculture, namely high sugar varieties, autumn planting, timely application of inputs, better ratoon management, maturity based harvesting, supply of fresh cane and other technical improvements in factory resulted in
better cane productivity and sugar recovery % cane. Mid-term evaluation carried out in 2015-16 showed improvement in cane yield by 10 t/ha, sugar recovery% cane improvement by 1.25%, decline in processing losses% cane by 0.20% and improvement in crushing capacity utilisation from 84 to 88%.

ACKNOWLEDGEMENTS

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REFERENCES


Amelioration dans la production cannières et la performance des usines sucrières du secteur coopératif par le biais de meilleures stratégies de gestion: une evaluation des sucreries de l’Uttar Pradesh, Inde

Résumé. L’industrie sucrière indienne joue un rôle essentiel dans le renforcement de la situation socioéconomique de la population rurale. Les sucreries, surtout dans le secteur coopératif, ont le devoir de sauvegarder les intérêts des producteurs de canne en garantissant le versement du prix canne approuvé par le gouvernement dans les délais. La UP Co-operative Sugar Factories Fédération Ltd paie autour de USD 300 millions par an aux agriculteurs pour la fourniture de canne à sucre. Dans la province d’Uttar Pradesh en Inde du Nord, 24 coopératives de sucreries et 7 distilleries fonctionnent dans les différents districts, qui regroupent 0,5 millions de planteurs de canne. Ces sucreries ont une capacité de broyage de 64 375 tonnes de cannes par jour, environ 10% de la capacité totale de l’État. La capacité de production journalière des distilleries est de 210 000 L alcool rectifié et de 80 000 L alcool carburant. La UP Co-operative Sugar Factories Federation Ltd est un organisme qui contrôle le fonctionnement de toutes les coopératives de sucreries et distilleries dans l’État. Elle fournit également des conseils/assistance technique et financière, travaille pour le développement de secteur cannier et apporte un soutien dans la mise en place de nouveaux projets. Ces sucreries coopératives montrent des variations considérables en termes de profil variétal, productivité de canne à sucre, l’efficacité technique et récupération de sucre. En 2011-12, un programme de gestion systématique a été lancé dans la zone de production de canne à sucre et les usines ainsi améliorées la production et l’efficacité de la production des différentes opérations au niveau du champ et de l’usine– cela a commencé à donner des résultats lors de la saison de récolte/broyage 2015/16. En 2011-12, environ 9% de la superficie totale sous culture de canne à sucre comprenait des variétés améliorées à maturation précoces ayant un pol canne% de plus de 12% à environ 9 mois. Ce pourcentage de la superficie cultivée avec des variétés améliorées à maturation précoces a augmenté jusqu’à environ 24% dans la saison 2015-16. La surface projetée sous ces variétés en 2017-18 serait d’environ 40%, suite à un vigoureux programme de production de semences. Au cours des quatre dernières années, l’efficacité technique des sucreries a été améliorée - la capacité de broyage a atteint 88% en 2015-16, comparativement à 84% en 2011-12 et, par conséquent, des pertes en sucre ont été réduite de 2,29 à 2,09% sur la totalité de canne broyée. La performance générale des usines s’améliore progressivement, avec pour résultat une amélioration dans la récupération du sucre de l’ordre d’environ 1,25% au cours de la saison 2015-16 par rapport à celle de 2011-12.

Mots-clés: Variétés améliorées, production de semences, efficience de l’usine, récupération de saccharose

Desempeño mejorado en la produccion de caña de azucar e ingenios del sector cooperativa a traves de mejores estrategias de gerenciales: evaluacion de los ingenios localizados en Uttar Pradesh, India

Resumen. La industria azucarera de India juega un papel vital en el fortalecimiento de las condiciones socio-económicas de la población rural. Los ingenios, especialmente en el sector de las cooperativas, tienen el deber de salvaguardar los intereses de los cañeros garantizando el pago oportuno del precio de la cana aprobado por el gobierno. La Federacion de Cooperativas Azucareras de Uttar Pradesh paga alrededor de 300 millones de dolares por aho a los cañeros por el suministro de cana. En la provincia de Uttar Pradesh, en el norte de India, 24 ingenios cooperativa y 7 destilerias funcionan en diferentes distritos, abastecidos por cerca de medio millon de
cañeros. Estos ingenios tienen en total una capacidad de molienda de 64.375 toneladas de caña por día, aproximadamente 10% del total de la capacidad de molienda en el estado. La capacidad total de producción de alcohol en las destilerías asociadas es de 210.000 litros de alcohol rectificado por día además de 80.000 litros de etanol por día. La Federación de Cooperativas Azucareras de Uttar Pradesh es una entidad que controla el funcionamiento de todas las cooperativas azucareras y destilerías en el estado y además provee asistencia técnica y financiera, trabajo de desarrollo de caña y apoyo para montar nuevos proyectos. Estas cooperativas azucareras muestran considerables variaciones en términos de perfil varietal, productividad en caña, eficiencia técnica y recobrado de azúcar. En 2011-12, un programa sistemático de administración gerencial fue lanzado en las áreas de producción cañera e ingenios para mejorar la producción y la eficiencia de producción de diferentes operaciones en los niveles de campo cañero y fábrica, esto comenzó a dar resultados en la zafra 2015/2016. En 2011-12, cerca del 9% del total del área de caña estaba sembrada con variedades de caña temprana mejorada con pol % caña arriba del 12% y aproximadamente 9 meses de madurez. Este porcentaje del área con variedades de caña temprana mejorada incrementó hasta cerca de 24% en la zafra 2015/16. El área sembrada con esta variedad proyectada para 2017/18 será cerca de 40%, como resultado de un vigoroso programa de producción de semilla. Durante los últimos 4 años, la eficiencia técnica de los ingenios ha mejorado – la eficiencia en la capacidad de molienda ha mejorado hasta 88% en 2015-16 comparado con 84% en 2011-12 y, por consiguiente, las pérdidas en azúcar bajaron de 2.29 a 2.09% en el total de caña molida. La eficiencia total de los ingenios está gradualmente mejorando, incrementando el recobrado de azúcar % caña en aproximadamente 1.25% del total de caña molida en la zafra 2015-16 comparada con 2011-12.

**Palabras clave:** Variedades mejoradas, producción de semilla, eficiencia en molinos, azúcar recuperada