

SUGARCANE MECHANISATION FOR PROFITABILITY AND SUSTAINABILITY UNDER ENVIRONMENTAL CONSERVATION

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KEYWORDS: Sugarcane, Mechanisation,
Green Cane Harvesting, Small Growers, Sustainability.

Abstract

THE PAPER summarises the findings compiled from contributions of the committee members and from the proceedings of the International Society of Sugar Cane Technologists (ISSCT) Agricultural Engineering Section Workshop held between 3rd and 5th of March 2009 at The University Centre, Kamphaeng Saen Campus at Nakhon Pathom of the Kaestart University, Thailand. The opening addresses gave an excellent overview of the Thailand Industry, which globally is the second largest exporter of sugar, and has over 80% of its farms of less than 20 ha in size. The industry is in a stage of rapid development, with appropriate mechanisation for small growers being a significant issue. The demand for by-products such as ethanol is a significant catalyst for the growth of the industry. The presentations were grouped under the general headings of Machinery and Mechanisation and Management and Logistics, with a focus on mechanisation associated with smaller operations. The field visits associated with the workshop focused on the very significant development which is occurring in appropriate mechanisation for small and medium size growers, as well as the integration of rotation crops with sugarcane and irrigation systems used. In the workshopping sessions, a wide range of issues were discussed, ranging from Crop Production to the Environment. Miller-Grower 'Politics' and Health & Safety issues were also seen as issues which could be addressed, with discussion on the potential of ISSCT sanctioning various training courses. Overall, the most significant issue seen to be facing the industry was logistics and cost of cane transport from the field to the mill. Thailand represented an excellent venue for the workshop, because of its rapid growth and the market driven development of appropriate mechanisation for small growers.

Introduction

The Thailand industry consists of a US\$2.1b pa industry with a Sugar Act which provides some regulation, which the industry believes is a constraint on progress and requires reviewing. The area under cane is 0.99 Mha, there are 47 mills, and 170 000 growers. Only 10% of the area is Miller Cum Planter, 80% of the growers are very small with farms of less than 20 ha and only a few farmers have up to 100 ha. Thailand currently grows 72 Mt of sugarcane which is harvested annually and 7.57 Mt of sugar is produced, 2 Mt of which is for local consumption. Thailand is the world's 2nd largest exporter of sugar (5.7 Mt), mainly to Asia. Only 5% of the crop is mechanically harvested and the labour for crop production is mainly from neighbouring countries. Where water is available, they use surface irrigation and some surface type drip irrigation.

The industry strategy is to increase the area under cane by 30% and increase production from 72 Mt to 95 Mt; however, there are threats from other crops and trade barriers. The growers move in and out of cane depending on the price of other commodities.

The 9th ISSCT Agricultural Engineering Workshop was held from Tuesday 3rd March and Thursday 5th of March 2009.

The pre-workshop tour on the 2nd March focused on the area around the Capital, and visited Ayudhaya, Thailand's world-famous former capital (from AD 1350 to 1767) and now a World Heritage Site. The tour included the ruins which have survived from this once magnificent city, as well as the ruins of Phra Maha That temple, followed by a short elephant ride around the old ruins to Wat Phra Si Sanphet, the major temple in the old Royal Palace compound. Lunch was enjoyed at a local restaurant by the river, after which Wat Yai Chaimongkol and others were visited before returning to Bangkok. The welcome dinner was a very enjoyable Chao Pra Ya river dinner cruise.

The workshop sessions were held at Kamphaeng Saen Campus of Kaestart University, which is at Nakhon Pathom, approximately 90 km West of Bangkok. The workshop included a very well organised field trip to the University farm where machinery for all facets of the industry were presented in excellent static and operating displays. The second field visit was to Chokpradit Farm, Kanchanaburi, with the final workshop session being held there. The delegates then visited the famous Bridge over the Kwai, where lunch was enjoyed before returning to Bangkok.

Workshop theme

The workshop addressed the topic: 'Sugarcane Mechanisation for Profitability and Sustainability Under Environmental Conservation' with major subject areas addressed including:

- Tillage and land preparation equipment and strategies in Thailand and other countries.
- Mechanisation of crop husbandry operations for smaller growers
- Comparative performance of irrigation strategies
- Harvesting strategies, ranging from developments in cane knife design to issues relating to cane loaders and also performance and cost of chopper harvesting.
- Transport system scheduling, and broader issues such as the role of sugarcane as an energy crop and the impact of this on harvesting and transport systems.
- Alternative uses for sugarcane by small growers.

A workshop session and a plenary session were also held. The focus of the workshop was on the issues facing the Thai Industry.

Workshop attendance

The workshop was attended by 40 delegates from nine countries including 17 from Thailand, 6 from Indonesia, 5 from Mauritius, 3 from each of India and Sudan, 2 from each of Uganda and Japan, 1 from Australia and 1 from South Africa. There were also 23 observers and guests from Thailand.

Program

Relevant and interesting issues to many industries were raised in the Machinery and Mechanisation presentation sessions.

There has been significant adoption of the New Farming System with mechanical green cane harvesting in Mauritius; however, they are keen to incorporate the trash blanket into the soil. V. Riviere discussed the success they had by using a shredder type topper on the harvester and then using what they call a Flail disc harrow to incorporate the organic matter. Experiments have shown that, although not statistically significant, there was an increase in yield for the plant and each

ratoon up to the 4th with an accumulated increase of 21 t/ha. Just as significant has been the significant increase in soil organic matter which has been observed. Further work reported from Mauritius covered the work at Belle Vue, where equipment for pulverising rocks is being used with a combination of GPS guidance and permanent beds to make a mechanisation-friendly farming system. B. Vandalall described the success being achieved by an integrated approach and the adoption of the principles of 'New Farming Systems'.

Mechanisation in Thailand was discussed by T. Indrambarya. It was indicated that more than 80% of farms are less than 20 ha in size. They believe that mechanisation is the way to improve productivity, and machinery has been developed to be used with small conventional tractors (<40 kW) and the two-wheel walk behind type tractor. 90% of the cane is harvested manually. Depending on the area, up to 100% of the cane may be harvested as green cane. Many of the practices being developed may be relevant in countries other than Thailand.

The presentation by R. Karoonboonyanan on the development of a vibratory type Subsoiler focused on the issue of undertaking relatively heavy land preparation operations with 'lighter' tractors. While there was no advantage in terms of work rate or fuel consumption, the advantage of the vibratory action was that a tractor of a given weight could pull either a wider machine or a narrow machine deeper than would normally be possible, given the tractor weight.

The cane knives in Thailand have traditionally been of a short and straight design. This makes it difficult to cut the stalk close to the ground, as well as having health and safety issues. Work was thus carried out to improve the effectiveness of the knives used to manually cut cane. N. Sokudlor reported on nine different designs which were tested, and a new design known as 'Phuvieng 4' was found to be the most effective.

The data from field trials indicated that 41 percent of workers were satisfied with Phuvieng 4 because less cane was left in the field. Cane stalk height after harvesting was reduced from 9.5 cm to 2 cm in height and the benefit was an additional 2 t/ha, resulting in an added income of US\$46/ha. This indicates that it may be possible to design an even more ergonomically acceptable knife that enables a higher productivity.

In Thailand, juice is squeezed from cane stalks to provide fresh drinking juice, which provides some small growers a higher value for their cane; however, to make the taste acceptable, the rind is removed to remove the wax. The peeling process to achieve this is labour intensive and slow. A system described by P. Pruengam was developed to grind away the outer surface of the rind before the juice was squeezed out. The simple electrically driven grinder increased a labourer's productivity by a factor of four and 20% less juice was lost than in the peeling process.

C. Norris gave a presentation entitled 'Sugarcane; Reconsidering Harvesting Strategies for Cost-Effective Energy Recovery'. The traditional use of sugarcane captures less than half of the recoverable energy of the crop, often with less than optimal environmental stewardship.

The increased energy costs of recent times caused many paradigms to change in sugar industries around the globe, with sugarcane trash being considered as a viable replacement for fossil fuels in many applications. He discussed an analysis of a number of different sugarcane trash recovery strategies, investigating the costs associated with each, as well as a broad range of issues including agronomic cost or benefit, the quality of the fuel delivered, and the technology requirement and availability. He argued that, while systems where trash is delivered with the cane and separated at the mill are likely to be the most viable strategy into the future, further technology development is required.

P. Lyne presented their work relating to scheduling of vehicles for the road transport of sugarcane. The paper illustrated the very significant gains which can be made with respect to total investment and cost of sugarcane transport to the mill. This work has significant relevance in a wide range of industries.

Poster session

A. Boontham showed a mechanical system that was used to detrash cane prior to manual harvesting. The cane trash extractor consisted of two cages with cable strings attached to each cage for removing the old leaves. The cane detrasher is attached to a two-wheel walk behind tractor.

There was also a concern in Thailand about fires with cane trash on the surface. There is now considerable emphasis on the development of systems to incorporate the trash after harvest. Trash incorporators can be based on a range of machines including disc harrows with notched blade discs, rotavators or disc ploughs. This technology will undoubtedly increase in relevance for other countries as they move towards green cane harvesting

N. Sokudlor presented work on the development of various tools to be used for detraging in place of using the knives to remove trash. The cutters could change activities during the day and there was less injury due to the continuous conventional method of cutting and trashing cane. Leaf trash in the delivered product reduced from 6.9 to 2.9 percent. The equipment was also tested in farmers' fields. About 95 percent of cutters were satisfied with the equipment because it eased their workload; however, the remainder still complained of additional work. With the detraging tool, cutters increased daily productivity by 20 – 25 bundles/day (each bundle is 10 sticks of cane) resulting in an additional income. The operation of pre-stripping can be carried out up to 2 weeks prior to harvesting.

Y. Tarumoto from Japan described a Regional Simulation Approach for Evaluating New Sugarcane Varieties Using System Dynamics. Because the sugar industry is a very complex system, it is difficult to quantify or predict the outcome of changes. Different traits in different varieties is one example. Therefore, a System Dynamics simulation model was developed using the software Vensim to examine consequences. The steps involved included simulation of the weekly changes in sucrose for different crops, and the development of appropriate harvest quotas to maximise sucrose production and minimise industry costs. The model shows not only an industry wide effect but also detailed analysis on a field by field basis. This is useful to assist the discussion between stakeholders on issues such as crush dates or adoption of new varieties.

Chopper harvesters are used for approximately 5% of the Thailand crop, with about 250 harvesters involved. S. Khawprateep carried out a study involving 30 machines, differentiated into one of two groups by engine power, i.e., high power models with typical engine power of 240 kW, and lower power models fitted with engines of approximately 177 kW. The study was conducted over a period of 5 years, and determined productivity and fuel consumption of the different machines.

The result showed that the average sugarcane cut was 9769 tonnes/year and the average rate of fuel consumption was 2.60 litres/tonne. Analysis of the work capacity and fuel consumption between two engine sizes showed an average productivity of 8219 and 11 319 tonnes/year with the average fuel consumption at 2.53 and 2.68 litres/tonne, respectively for the low power and high power units.

Even given the average season length of 13 weeks for machine harvesting, this is considered to be a very low productivity, with small fields considered a major factor. The authors noted the target for Australian operators over this period would be 50 000 tonnes and a fuel consumption of 1 litre/tonne.

Field visits

The field demonstration at the university farm included an impressive array of machinery, ranging from tractor-drawn equipment for larger growers and contractors to equipment based on small tractors and also equipment fitted to walk-behind tractors. Each display was well organised and the accompanying posters gave very useful information.

The coverage of different systems was comprehensive yet in very useful detail. Considerable time had obviously been spent ensuring appropriate conditions were in place for each of the very wide range of machines to be demonstrated to their maximum advantage.

The field visit to Chokpradit Farm, Kanchanaburi allowed delegates to see the planting and post-planting irrigation being undertaken on a larger farm, which was also of significant interest.

Acknowledgements

The Agricultural Engineering Section Committee thanks all formal delegates and observers who participated in the Workshop, with special thanks to those who prepared and presented papers.

The committee gratefully acknowledges the enormous time input by Mr Borpit Tangwongkit and his team at the Farm Mechanisation section of the Kasetsart University, for organisation of the workshop.

The committee also acknowledges the very generous support of the major and minor sponsors of the Workshop. The Council of the ISSCT is thanked for entrusting the Agricultural Engineering Section Committee with the task of organising the Workshop and for providing necessary support.

MECANISATION POUR UNE PRODUCTION DE CANNE A SUCRE PROFITABLE ET DURABLE DANS LA CONSERVATION DE L'ENVIRONNEMENT

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MOTS CLES: Canne à Sucre, Mécanisation, Récolte en Vert, Petits Producteurs, Agriculture Durable.

Résumé

LE PAPIER résume les conclusions compilées à partir des contributions des membres du comité et du rapport du workshop de la Section de Mécanisation Agricole de l'ISSCT tenu entre les 3 et 5 mars 2009 au Centre Universitaire, Campus de Kamphaeng Saen à at Nakhon Pathom de l'Université de Kaestar, Thaïlande. Les discours d'ouverture donnèrent un excellent survol the l'Industrie thaïlandaise, qui au niveau global est le deuxième plus grand exportateur de sucre, avec 80% des unités de production d'une taille inférieure à 20 ha. L'industrie est à un stade de développement rapide, avec la mécanisation appropriée pour les petits producteurs comme problématique importante. La demande pour les sous-produits, tel l'éthanol est un catalyseur significatif pour la croissance de l'industrie. Les présentations étaient regroupées sous des rubriques générales de Machines et Mécanisation et Gestion et Logistiques, avec une emphase sur la mécanisation associée aux plus petites opérations. Les visites aux champs, associées au workshop, se sont concentrées sur le développement significatif de la mécanisation qui est actuellement en cours pour les petits producteurs et ceux de taille moyenne, aussi bien que sur l'intégration des cultures en rotation avec la canne à sucre et les systèmes d'irrigation utilisés. Dans les sessions de discussion, une large gamme de sujets variant entre la production agricole et l'environnement, ont été débattus. Les 'politiques' des usiniers-planteurs et les questions sur la santé et sécurité ont été considérées comme

des problèmes à être débattus, avec des discussions sur le potentiel de l'ISSCT pour approuver différents programmes de formation. En général, le problème le plus important ayant à faire face l'industrie sont la logistique et le coût du transport de canne entre les champs et l'usine. La Thaïlande, avec sa croissance rapide et le développement piloté par le marché d'une mécanisation appropriée aux petits producteurs, constituait un lieu excellent pour le workshop.

MECANIZACIÓN DE LA CAÑA DE AZÚCAR PARA RENTABILIDAD Y SOSTENIBILIDAD BAJO EL ESQUEMA DE CONSERVACION AMBIENTAL

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PALABRAS CLAVE: Caña de Azúcar, Mecanización, Cosecha de Caña Verde, Pequeños Productores, Sostenibilidad.

Resumen

EL DOCUMENTO resume los resultados compilados de las contribuciones de los miembros del comité y las memorias del Seminario de la Sociedad Internacional de Tecnólogos de la Caña de Azúcar (ISSCT) Sección de Ingeniería Agrícola, celebrado entre el 3 y 5 de marzo 2009 en el Centro Universitario, Kamphaeng Saen Campus en Nakhon Pathom, de la Universidad Kaestart, Tailandia. Los discursos de apertura dieron un excelente panorama de la Industria de Tailandia, que a nivel mundial es el segundo mayor exportador de azúcar, y tiene más del 80% de las explotaciones de un tamaño menor de 20 ha. La industria está en una etapa de rápido desarrollo, pero un problema importante es la falta de mecanización apropiada para los pequeños productores. La demanda de productos derivados como el etanol es un catalizador importante del crecimiento de la industria. Las presentaciones fueron agrupadas bajo los encabezados generales de Maquinaria y Mecanización, y Manejo y Logística, con especial atención a la mecanización asociada con la operación en pequeña escala. Las visitas de campo relacionadas con el taller se enfocaron en el muy importante desarrollo que está ocurriendo en la mecanización apropiada para pequeños y medianos productores, así como en la integración de cultivos de rotación con caña de azúcar y los sistemas de riego utilizados. En las sesiones de taller, fue discutida una amplia gama de temas, cubriendo desde producción agrícola hasta consideraciones ambientales. Otros puntos que se consideró podrían ser tratados fueron, la 'Política' de Miller para los cultivadores, y problemas de Salud y Seguridad. También se debatió sobre el potencial de ISSCT para implementar diversos cursos de capacitación. En general, se identificaron la logística y el costo de transporte de la caña desde el campo hasta la fábrica como los problemas más importantes que está enfrentando la industria. Tailandia fue un lugar excelente para el taller, debido a su crecimiento rápido y al desarrollo del mercado de la mecanización apropiada para cultivadores pequeños.