THE REVOLUTION OF RESOURCE MANAGEMENT IN THE AUSTRALIAN SUGARCANE INDUSTRY

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Abstract
Since the 1960's the Queensland sugar industry has implemented a range of soil conservation techniques in high risk areas. These techniques have included contour banks, grassed waterways and since the mid 1980's green cane trash blanketing. Mixed uptake of these practices has occurred due in part to farming layout, stabilisation of waterways and waterlogging. Research conducted by the Queensland Department of Primary Industries (QDPI) revealed the major contributor to soil erosion was cultivation with limited influence from ground cover, in part due to the soil types and high intensity rainfall. Green cane trash blanketing was seen as a saviour in high risk soil erosion areas in the ratoon cane phase. However, the plant cane and fallow phases remained vulnerable. A new farming system was needed to combine soil conservation with drainage, harvesting, crop agronomy and overall production efficiency. This paper reports the progress of five Mackay district farmers who formed a group called 'Back on Track'. Their aim was to develop a new farming system which addressed a range of issues, including stagnant production and the need to coordinate agronomic/natural resource management issues at a farm and sub catchment scale. The Back on Track group have demonstrated a controlled traffic farming system that deals with production, water use efficiency, crop monoculture, soil conservation and soil health, farming efficiencies and reduced production costs. In essence, they have packaged many of the best practices and designed a system to produce a result greater than the sum of the individual parts. The 5 farmers are 100% committed to adoption of their farms to the new farming system.

Additional Keywords: soil, erosion, conservation, sugarcane, controlled traffic farming, group participation

Introduction

Soil is the medium on which many civilizations rise and fall. Great civilizations have become extinct or significantly receded because they failed to manage their most valuable resource, their land. This paper covers the developments of soil erosion awareness, soil erosion management and soil health management over the last 40 years in the Australian sugar industry. The sugar industry does value their natural resources and is implementing techniques to ensure these resources are here for future generations.

The location of the sugar cane industry means it is exposed to some of the most intense rainfall conditions within Australia. The management of soil erosion has evolved from

- virtually no management in the very early days;
- soil structural controls (1950's onward);
- trash retention (1980's onward);
- controlled traffic systems, minimum-tillage and trash retention (late 1990's onward).

The industry endured high levels of erosion as rain forest was cleared for agriculture, but as farming practices were adjusted this level of erosion was reduced. Today's technology has the potential to manage erosion risk keeping it to historical low levels through a complete sugarcane farming system change. This farming system comprises Controlled traffic Farming (CTF), trash retention, minimum tillage and cover/break crops to suppress soil pathogen build-up, caused by mono-culture.

Soil Erosion

Early cultural practices of the sugar industry exposed the soil to high risk of erosion, as many of the practices failed to consider the potential weather variation. Dawson *et al*. (1983) drew the sugar industry's attention to the high risk of soil erosion and implied that if appropriate land management practices were not utilised the future of the whole industry would be jeopardized.

In the early establishment days of the sugar industry, land was predominantly selected on is proximity to the sugar factory and inherent soil fertility. As a result both steep and flood prone areas were planted to cane. The Isis Land Use Scheme, which started in the 1960's, was the first to highlight the yield reductions on steep slopes due to soil erosion (Anon, 1971). As a result steep slopes in many mill areas were de-assigned as cane production areas, also due in part to the advent of mechanical harvesting.

From the 1950's growers looked toward soil conservation works to control erosion, mostly in the form of contour banks, with the bulk adoption in the southern regions. Contour banks greatly reduce soil erosion in sugarcane fields, but their design often greatly reduced other farming practice efficiencies (Sullivan and Sallaway, 1994). Therefore adoption was restricted or designs altered, which reduced the contour banks ability to suppress erosion (Sullivan, *pers comm*). Soil conservation measures did reduce erosion, but their adoption was low and slow. Of the area requiring soil conservation works, in the 1980's, only 12% had work conducted (Hyde, 1983). The sugar industry went through expansion phases in the 1980's onto increasing marginal lands. It was the view of Dawson *et al.* (1983) that these marginal lands could not sustain long term sugar production without altering practices to address soil erosion.

Soil losses under conventional cultivation practices have been measured at 42 to 227 t ha^{-1} yr^{-1} for the Mackay region by Sallaway (1979), with the generally accepted sustainable level of soil loss 10 t ha^{-1} yr^{-1} (Wischmeier and Smith, 1978) indicating conventional cultivation practices needed modification.

Prior to the early 1970's farmers could only grow cane on 75-85% of their assigned land, due to cane assignment agreements. These conditions resulted in good soil health management by causing farmers to fallow around 20% of their land each year, but also exposed the fallow to high erosion risk which was reduced where cowpea cover crops were planted. Tropical soils, due to higher nutrient storage in vegetation, have demonstrated improved fertility when fallowed (Capelin and Prove, 1983), so the practice was considered beneficial for the soils if the erosion risk could be reduced. The practice of harvesting cane green and leaving the leaves and tops on the ground, called Green Cane Trash Blanketing, was seen as the solution to removing the erosion risk during the ratoon phase, but did not fully address the fallow period.

Green Cane Trash Blanket

The value of a green cane trash blanket (GCTB) for soil erosion control was clearly demonstrated by Titmarsh *et al.* (1996) with erosion levels of 0.1 t ha^{-1} on trash blanketed areas and 11 t ha^{-1} from conventional cultivation. Trash blanketing provided many other advantages including that there was no longer the need to burn fields prior to harvest, weed suppression, soil moisture conservation and nutrient recycling. It is accepted these issue drove the adoption of trash blanketing and soil conservation was generally a secondary benefit.

The area in Mackay trash blanketed has been increasing from the late 1980's, the area trash blanketed today is close to optimum (Figure 1) as some locations and soil types don't respond or need trash blanketing.

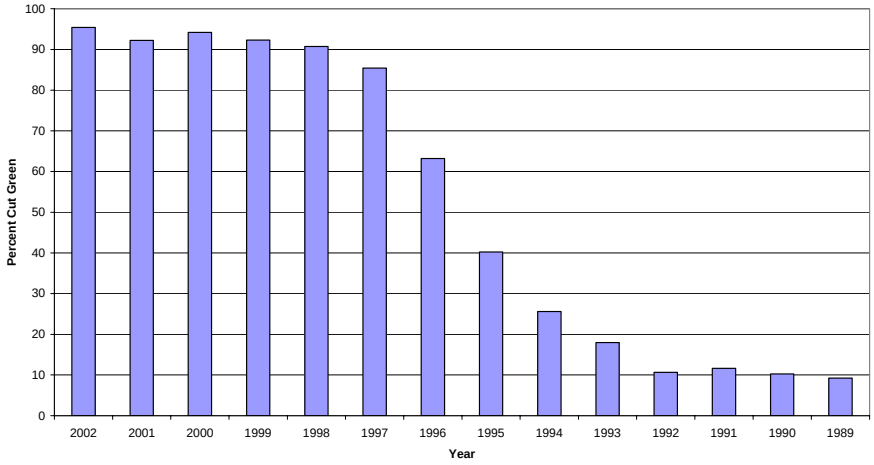

Figure 1. Increase in adoption of green cane harvesting in Mackay region, since 1989.

The adoption of GCTB by growers required adaptation of farming practices and equipment as the rate of implementation increased. The main obstacles were harvesting, fertilising and weed control. Increasing harvester capacity and changing design, developing stool-splitter and liquid fertiliser applicators and the greater range of herbicides all combined to assist in adoption of GCTB. The practice of trash blanketing has had a major influence on reducing stream sediment level in coastal catchments where sugarcane is more than 10% of the area of the catchment (Rayment and Neil, 1996).

The trash blanket has contributed greatly to environmental management in the Australian sugar industry through erosion control, increasing production on marginal soils, weed suppression, improved soil water capacity and increased soil health. However, there is a move toward increased use of renewable energy and sugarcane trash for production of renewable power needs to be evaluated against it's capacity to reduce erosion.

New Farming System

In the early 1980's, Dawson *et al.* (1983) noted the sugar industry was at a critical phase in managing soil erosion. Cane land was expanding into marginal soils and earth work design/implementation was unable to keep pace. The only way ahead that Dawson *et al.* (1983) saw for erosion controls to be addressed at a level higher than the individual grower (ie. catchment level). The level at which to address issues is still a problem 25 years on, as the main obstacle to adoption of guidance systems, CTF and min-tillage equipment is cost recovery (for individual grower) and system utilisation (over-capitalisation). The sugar industry proposed farming systems to address the issues covered by the Back on Track system as early as the mid 1980's (Hyde and Teske, 1987), but is was the advent of the Sugarcane Yield Decline Joint Venture (SYDJV) in 1993 that consolidated ideas and research to provide a clear direction for the sugar industry.

Five local growers, Mackay Sugar Cooperative Association (MSCA) and BSES Limited overcome these constraints to form the "Back on Track" project. The Back on Track project is grower driven and uses a participatory approach to address a complex technological change that entail controlled traffic, break crops (erosion control & soil health), minimum tillage and precision farming practices. The growers directly involved employ participatory learning techniques on their farms which serve as demonstration sites for other growers.

The sugar industry has proposed farming systems that started to address the issues covered by the Back on Track system as early as the mid 1980's (Hyde and Teske, 1987), but it was the development of the SYDJV in 1993 that consolidated ideas and research to provide a clear direction for the sugar industry. The Back on Track farming system restricts soil compaction to traffic lanes, providing a healthy zone for crops. Soil compaction has reduced yields in ratoon cane by 20 t ha^{-1} (Norris *et al.*, 2000) and growers are recognizing this devastating impact on yields. The system utilizes trash blanketing and minimum tillage, which greatly reduces erosion risk in ratoons. The fallow blocks are cultivated and beds are formed in the dry season, allowing bed consolidation and soil moisture accumulation. The beds are planted with a cover crop to improve soil health (Garside *et al.*, 1999; 2000), protect soil against erosion over the wet season and the crop is sprayed out prior to planting to sugarcane. Planting equipment uses double-disc openers which cause minimal soil disturbance, reducing erosion and weed germination. This system brings greater flexibility in regards to timing of farming tasks and spreads the workload over longer periods. The wider row spacing reduces the time taken for each task. This allows individual growers to farm larger areas improving their financial sustainability.

The Back on Track farming system is the compilation of many of the beneficial farming practices. It has the potential to greatly influence the viability of the sugar industry; as it addresses environmental issues, improves long term sustainability, reduces fertilizer and herbicide inputs and lowers operating cost.

The Future

Agricultural production is going through a revolution. The perception that food needs to be "healthy and chemically free", the impact of agriculture on the environment, increased global trade, and the Genetically Modified Organisms are having an impact on consumer buying behaviour.

The sugar industry in Australia is not immune to changing consumer and community attitudes which are being reflected in legislation changes. In Queensland, Australia, recent announcements on banning the broadscale clearing of remnant vegetation, the Reef Protection Plan to reduce the offsite impact of land use in the Great Barrier Reef catchments (sugar cane predominantly grown in these catchments), Local Government Statutory Planning schemes that require change in land use approvals and Land and Water Management Plans under the *Water Act 2000* are just a few of the changes landholders who use natural resources to provide an income are facing.

Farming systems must respond to the changing consumer and Government legislation. The Back on Track Farming System for sugar cane production is currently in the development phase but offers solutions to this complex scenario. Key elements of the farming system for sugar cane production that will require on-going research and development include:

- Soil health issues such as organic matter, soil biota, crop rotation, tillage and pathogen management;

- Soil degradation issues such as erosion, surface and subsurface drainage and compaction;
- Efficiency and effectiveness of natural and purchased resources will be pivotal in terms of cost and impact from natural resource use. This will change the emphasis from productivity based assessment (t ha^{-1}) to tonnes per input (natural and or purchased);
- Timeliness of operations which will be facilitated by the use of zero tillage and controlled traffic farming;
- Use of technology such as remote sensing for crop management and yield forecasting, Global Positioning Systems which will allow precise machinery guidance and optimal crop inputs based on variable rate applications and crop genetics that will reduce crop protection chemicals and increase natural and purchased resource use efficiency;
- Maximum profitability through precise management actions; and
- Human resource issues associated with the increasing management/technology input, capital cost associated with change and economy of scale required will result in reduced labour input and revolutionary changes to the family farm as we currently know it.

The sugar industry does value the natural resources it utilises and is implementing techniques to ensure these resources are here for future generations. With the industry investigating and implementing more sustainable farming practices it is doing all it can to ensure it has a profitable future.

Acknowledgements

The trial work and demonstration sites would not be possible without the continuous support from the growers involved; G. Deguara, W. Jones, R. Lamb, T. Matsen & J. Pastega. Their enthusiasm toward new ideas and for constant improvement is a constant encouragement. The financial support from Mackay Sugar Cooperative Association and BSES have also been pivotal in progressing this work.

References

Anon (1971). Report on a land use study of the Isis District. Govt. Printer, Brisbane.

Capelin, M.A. and Prove, B.G. (1983). Soil conservation problems of the humid coastal tropics of North Queensland. *Proc. Aust. Soc. Sugar Cane Technologists*. 87-93.

Dawson, N.M., Berndt, R.D. & Venz, B. (1983). Land use planning – Queensland canelands. Proc. Aust. Soc. Sugar Cane Technologists. 43-52.

Garside, A.L, Bell. M.J., Cunningham, G., Berthelsen, J. and Halpin, N. (1999). Rotation and fumigation effects on the growth and yield of sugarcane. *Proc. Aust. Soc. Sugar Cane Technologists*. 69-78.

Garside, A.L, Bell. M.J., Berthelsen, J. and Halpin, N. (2000). Effect of breaks and nitrogen fertilizer on shoot development, maintenance and cane yield in an irrigated plant crop of Q117. *Proc. Aust. Soc. Sugar Cane Technologists*. 61-67.

Hyde, R.E. (1983). Erosion control in the central sugar cane district. *Proc. Aust. Soc. Sugar Cane Technologists*. 59-62.

Hyde, R.E. and Teske, L.H. (1987). Surface management systems in the central district canelends, QLD. *Proc. Aust. Soc. Sugar Cane Technologists*. 41-43.

Norris, C.P. Robotham, B.G. and Bull, T.A. (2000). High density planting as an economic production strategy: c) A farming system and equipment rfequirements. *Aust. Soc. Sugar Cane Technologists*. 113-118.

Rayment, G.E. and Neil, D.T. (1996). Sources of material in river discharge. *In* "The Great Barrier Reef-Science,Use and Management". Proceedings of a National Conference, Townsville 25-29 November. 42-58. Reef CRC,GBRMPA and James Cook Uni. Townsville.

Sallaway, M.M. (1979). Soil erosion studies in the Mackay District. *Proc. Aust. Soc. Sugar Cane Technologists*. 123-132.

Sullivan, D.J. and Sallaway, M.M., (1994). Development of soil conservation specifications in the costal Burnett District. *Proc. Aust. Soc. Sugar Cane Technologists.* 178-185.

Titmarsh, G., Sallaway, M., Mason, F., Glanville, T. and Gilley, J. (1996). Inter-drop furrow management for soil erosion control. *Conf. Eng. Ag. & Food Processing.*

Wischmeier, W and Smith, D. (1978). Predicting rainfall erosion losses. *Agriculture Handbook* 537, USDA.