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INTEGRATED TECHNOLOGIES - GIS DATA MANAGEMENT

Keynote address

The Coming Famine: the risks to global food security

Julian Cribb FTSE

Prof. Julian Cribb is the principal of Julian Cribb & Associates, specialists in science communication. He is Adjunct Professor of Science Communication at the University of Technology Sydney and a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE). He is founding editor of ScienceAlert, the leading Australasian science news site and of SciNews, Australia's specialist science media delivery service. His book 'The Coming Famine' will be published by the University of California Press in 2010.

In coming decades the world faces the risk of major regional food crises leading to conflicts and mass refugee movements. This is driven primarily by emerging scarcities of all the primary resources required to produce food. The paper outlines the key drivers of emerging global food insecurity and proposes some solutions.

CTF – the Proven Solution

Don Yule

Dr Don Yule trained in agricultural science and soil physics, and was a R&D leader for the Queensland Government for many years. Don led the LWA funded project in 1993-98 that developed Controlled Traffic Farming. Don formed CTF Solutions with Stew Cannon and Tim Neale in 2002 and led a GRDC funded project on managing variability in 2002-07. This project identified the value of spatial information and the synergies between CTF and Information Rich Agriculture (IRA). Don has been an Executive Member of the Australian Controlled Traffic Farming Association since its founding in 2006, and a member of the CRC for Spatial Information since 2007.

Julian Cribb has defined the mountain in front of us from a global perspective; it is a daunting prospect. My aim is to overview the contributions that cropping can make, as the CTF story. It is a short story, about 13 years. The first half deals with resource management issues, the second half with interactions with spatial technologies.

CTF is a farming system solution, and systems are driven by interactions. Systems performance indicators are efficiency, effectiveness, flexibility and common sense. Farming systems for cropping are driven by machinery and people – machinery does the work, people make the decisions. All farmers grow crops in soils within landscapes and CTF is developed on farms with farmers. It is a simple five point story. With those five points, CTF is the FOUNDATION for all cropping systems.

All cropping is mechanised. Controlled traffic is the solution for all mechanised cropping systems. Controlled traffic is specified wheel spacings and wheel track, and matched implements. Very many farmers grow a range of crops and standard wheel spacing across all crops would be a common sense solution.

Controlled traffic defines the spatial footprint. Implements do a perfect job every time, simply by staying on track. The footprint allows us to measure performance easily.

Controlled traffic builds soil health by managing soil compaction – compacted wheel tracks for machinery, non-compacted zones for optimum soil structure, crop establishment, and root growth.

Together, controlled traffic and no-till are efficient and effective for soil surface management, and further build soil health - improving soil structure and biology, and optimising the water balance.

The CTF solution for landscape health is designed CTF layouts to manage surface runoff and control both erosion and waterlogging. Layouts also ensure efficient farm operations, access and roads.

This has defined CTF - controlled traffic, no-till and designed layouts – a farming system solution. CTF achieves higher yields, better timeliness, lower costs and less chemicals, for all crops, for all seasons. CTF yield benefits have been 2 ½ times more and resilient across many seasons. Bowman (2008) reported large reductions in erosion, diesel use, N pollution of streams and GHG emissions; large reductions in labour requirement with benefits for labour availability, family life and community contributions; and large economic benefits from CTF adoption.

To summarise resource management, CTF is the proven FOUNDATION system for cropping. CTF and Spatial Technologies are a perfect match. I contend that spatial technologies will contribute much more to cropping productivity than all other technologies combined. Five technologies are examined. GNSS Guidance creates the spatial footprint and CTF uses it. Satellite imagery identifies that most paddock variability is caused by the farmers. Reducing variability is a new strategy for PA. For yield monitoring, CTF ensures quality data and easy processing. 2 cm RTK GNSS technology also provides topography data for designed layouts on CTF farms. CTF and automation provide auto-steer (where only CTF growers get the full benefits) and automated measurement and record keeping. The data are digital and spatial – computer ready, and ready for GIS analysis to identify causes. These support on-farm R&D and continuous improvement. Everything works better with CTF. CTF benefits the farm family and rural communities; it offers a future, and a clear path for change and progress.

In conclusion, I have shown that Controlled Traffic Farming is the proven solution for resource management, productivity, applicability to all crops, resilience to climate variability and change, use of spatial technology, and social benefits. Our frustration, and I speak for many growers too, is why then are 88% of crop growers using no CTF and why is CTF not recognised as the foundation of cropping by governments, agencies, Universities and most of our support services?

Cropping Systems for Climate Change

Jeff Tullberg

Dr Jeff Tullberg lectured in farm machinery management at the University of Queensland, Gatton for many years. He started research on the fuel energy effects of uncontrolled field traffic in the early 1980's, and subsequently led a series of projects to evaluate the practicability of controlling traffic. This included assessments of tillage/traffic impacts on soil physical and biological parameters, erosion and crop yield in Australia and China. He originally trained in agricultural engineering in UK and USA. Now with CTF Solutions, his interest in cropping energy requirements was the starting point for an evaluation of tillage/traffic effects on input-energy-related and soil emissions of greenhouse gasses. This presentation is based on his keynote paper to the 2009 ISTRO conference in Izmir, Turkey. Email: jeff@ctfsolutions.com.au

Greater concentrations of atmospheric greenhouse gasses (GHGs) are expected to reduce average annual rainfall and increase the frequency of climate extremes in most Australian cropping zones. Climate and certainty are words that don't go together, but model predictions are consistent with recent data, so we can reasonably anticipate the need for:

- Resilience under decreased rainfall, with extremes producing greater erosion hazards:
  Rainfall use efficiency and soil surface protection must be improved.
- Incentives or compulsion will be used to make all industries more 'climate-friendly':
  GHG balance of cropping must be improved.

Farm machine and system management decisions have a profound effect on each of these factors, These effects are illustrated here by comparing three generic systems:

<u>Mulch tillage</u> (or stubble mulching). 1-3 tillage, and 1-3 herbicide operations between crops. 100% soil disturbance (tillage); >60% area wheeled per crop; some residue retained.

<u>Zero tillage.</u> No soil disturbance except at planting, full herbicide weed control. Occasional tillage to deal with compaction, or ruts after wet harvests; ~50% soil wheeled/crop; most residue retained.

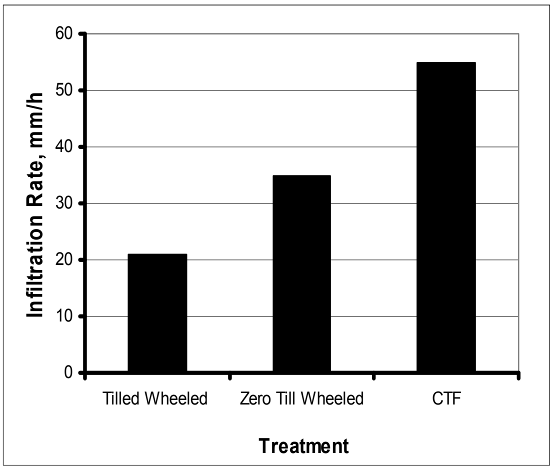
<u>Controlled traffic farming,</u> (CTF) Zero tillage with all heavy wheels restricted to precise permanent traffic lanes oriented to provide drainage and safe disposal of surface water. <15% soil disturbed at planting; <15% soil in permanent lanes; 100% residue retained.

The advantages of minimising tillage are now widely understood by farmers and their advisors, but wheel traffic effects are still often ignored, despite the evidence. One pass by a wheel carrying <1t has a major effect on porosity of the top 10cm of moist soil; common tractor and harvester wheels carrying 2-10t damage porosity to a much greater depth, where amelioration is much slower. Unless traffic is actively controlled >50% of crop area is wheeled in every cropping cycle even in zero tillage systems, and the effects last several seasons. The known, published and demonstrable consequences of uncontrolled field traffic vary with soil type and environment, but commonly:

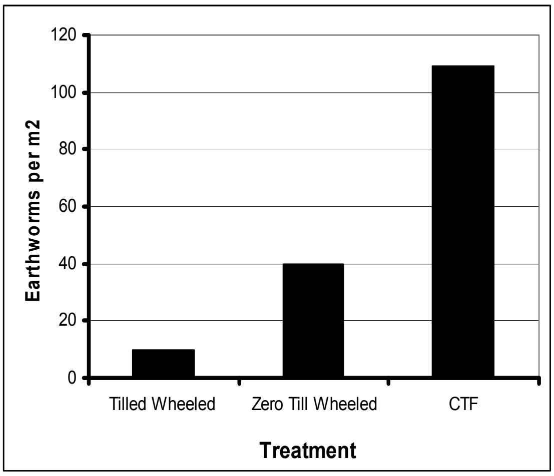
- Fuel requirements of crop production are increased by 60 --100% .
- Infiltration rate, plant available water capacity and soil biota are reduced by 40-50%.
- Fertiliser is placed in compacted soil, reducing N efficiency by 10-40%

Rainfall Use Efficiency and Soil Surface protection

Tillage and wheel traffic reduce infiltration rates by removing protection from surface soil, and damage to subsurface soil structure, respectively. Maximum infiltration occurs where both sources of degradation are controlled in CTF or permanent bed cropping. The same is true of soil biological activity. Both reflect tillage and traffic effects on porosity and continuity and explain the >40% increase in plant available water capacity in non-wheeled, non-tilled soil. This helps to support greater cropping frequency and biomass production in CTF.



a) Infiltration under >80 mm/hour rainfall.



b.) Mean earthworm numbers in surface 15cm.

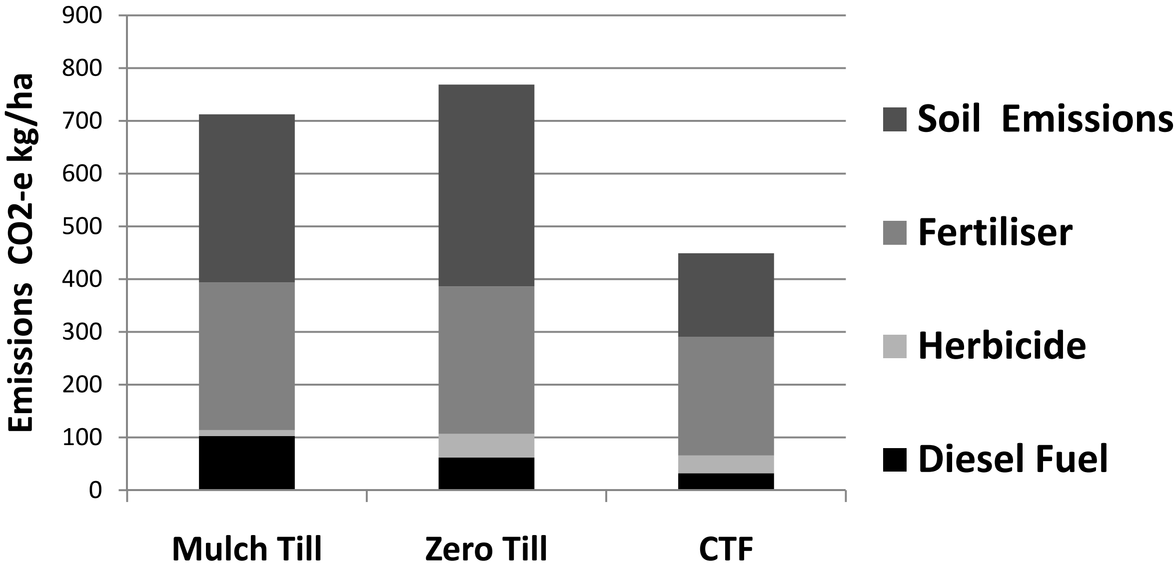
Figure 1. Tillage and wheeling effects on infiltration and earthworms in a vertosol. (CTF = no-wheels or tillage).
Adapted from Tullberg, Yule and McGarry (2007) Soil & Tillage Research 97 272–281)

Better rainfall use efficiency in CTF is also facilitated by the compacted permanent traffic lanes which provide more timely field access after rain and eliminate the problem of harvester wheel ruts. This means that CTF systems can be replanted directly after when harvest soil moisture is available. This might be only a cover crop, but it will still improve surface protection and the contribution to SOM.

Standing crop residue lasts longer in CTF because less is crushed by harvester and sprayer wheels, particularly when precise inter-row sowing is used to establish the following crop. Greater quantities of anchored, standing residue also improve soil surface protection. When combined with greater infiltration rates and cropping frequency (i.e. less runoff) this ensures that both water and wind erosion hazard is reduced.

Greenhouse Gas Balances

A simple spreadsheet approach has been used to compare emissions from mulch-till, zero till (both random traffic) and CTF (controlled traffic, zero till) systems. The results are illustrated in Figure 2.



Considering each emission component in turn:

Fuel requirements are less in zero tillage, and even smaller in CTF where equipment wheels always operate on firm soil, and only soft, non-wheeled soil is disturbed in seeding/fertilising operations.

Herbicide related emissions (the embedded energy of herbicide production) are greater from zero till, but improved precision, timeliness and cropping intensity in CTF reduces this by >25%.

Fertiliser nitrogen usually represents the largest single energy input to cropping, but the N efficiency of cereal production is usually <50%. Loss of unused nitrates (via runoff, leachate, and denitrification) is often associated with compaction, low SOM, and waterlogging. Zero tillage effects are mixed, but CTF reduces a number of loss vectors. 20% less N application is assumed here for CTF.

Soil Emissions are usually a substantial contributor to cropping GHG balances. If most N is applied at seeding, large nitrous oxide emissions occur when following rain increases water-filled porosity to the 60% - 80% range, a frequent occurrence in random traffic zero tillage, particularly on heavy soils. Limited testing of a partial CTF system (v. random traffic) has demonstrated 35-50% reductions in nitrous oxide emission and methane absorption instead of emission. The spreadsheet assumption is a 15% increase in emissions from zero till, and a 40% reduction for CTF (v. mulch till, in both cases).

No comprehensive assessment of CTF effects on emissions, accounting for both bed and traffic lane effects, has yet been completed. The present assessment indicates that GHG emissions from CTF must be >30% less than those from alternative systems, using assumptions that are conservative in terms of available system data and farmer experience, and supported by broad research evidence.

Conclusion

Precise CTF cropping systems minimise soil disturbance, reduce GHG emissions and improve rainfall use efficiency. Compact traffic lanes of CTF facilitate greater cropping frequency and biomass production, improving the prospect of soil carbon sequestration. Most GHG emissions are a consequence if inefficient application of expensive cropping inputs. CTF avoids the inefficiencies inherent in current systems, and is essential for more productive, climate change resilient cropping.

Spatial Information Research — New Opportunites for Agriculture Communities

Philip Collier

Dr Philip Collier gained his PhD in 1988 in the field of integrated geodesy, developing techniques to account for the influence of the gravity field on precise engineering and structural deformation surveys. Subsequently, he joined the Melbourne Water Corporation undertaking geodetic, deformation and GPS surveys as well as being engaged in the re-adjustment of Melbourne's very large urban survey control network. Phil joined the Department of Geomatics at the University of Melbourne in 1992 where he has been involved in teaching, research and consulting projects over many years. From 2004 to 2007, Phil worked part-time (50%) as a Senior Lecturer at the University and part-time (50%) as a Senior Research Fellow in the Cooperative Research Centre for Spatial Information. In 2008, he began his current position as full-time Assistant Research Director with CRC for Spatial Information (CRCSI), where he has been both conducting and managing a range of research and consulting projects. In the past twelve months, Phil has played a key role in preparing the positioning component of the recently successful re-bid for CRCSI-2.

Spatial Information (SI) is information about location. It is a critical element in an increasing array of leading edge technologies and applications. Familiar examples include on-line mapping tools like Google Maps and Bing Maps, in-car navigation systems, GPS enabled mobile phones and high accuracy real-time positioning for precision agriculture. Access to reliable, timely and fit-for-purpose spatial information has lead to significant efficiencies, economies, procedural improvements and productivity gains across a wide range of industry sectors. But the potential impacts and benefits of existing and emerging technologies in the spatial information arena are set to deliver even more benefits across a broader range of applications as we step into the second decade of the 21st century.

It is in the light of the potential for spatial information to deliver significant benefits to the nation that Senator Kim Carr recently announced that the new Cooperative Research Centre for Spatial Information (CRCSI-2) would receive funding of $32.2 million under the Federal Government's CRC Program. With a total budget (cash and in-kind) of $180 million and an eight year research program, CRCSI-2 brings together over 100 partner organisations across all sectors to deliver a user-driven research program with the stated objective of 'spatially enabling Australia'. The spatial information industry currently contributes an estimated $12.6 billion to national GDP. Direct outcomes from CRCSI-2 are expected to deliver a further $305 million to the nation if emerging developments can be leveraged for Australian industry.

Beginning in January 2010, the CRCSI-2 research program will be built around three core science themes in positioning, automated spatial information generation and spatial infrastructures and supports applied research outcomes and utilisation benefits in five key industry sectors. These include;

- health
- energy and utilities
- sustainable urban development

- defence
- agriculture, natural resources and climate change

In the sphere of a*griculture, natural resources and climate change,* farmers will benefit from research in spatial information that promises to deliver:

- access to a pervasive, ubiquitous, reliable, high accuracy positioning capability based on GNSS technology and a national CORS network to support a diverse range of on-farm activities, including the widespread adoption of current and emerging CTF practices
- the capacity to remotely measure and monitor crop and pasture responses to various activities such as irrigation, fertilizer application, weed spraying, pest and disease infiltration and grazing
- ready access to the vast stores of government held spatial information to aid in planning, decision support, emergency response and coordination

This paper will outline some of the key elements of the research program planned for CRCSI-2 with a view to motivating and challenging the CTF community to identify new and innovative ways that spatial technologies can support and promote improved farming practices and yield benefits for farmers in particular and rural communities more generally.

What has CTF / Zero-Till done for my farming operation?

Robert Ruwoldt

Glenvale Farms

Robert & Wendy Ruwoldt
Our farm is now a fourth generation family farm and is situated in the middle of Victoria (Australia) and in the heart of the Wimmera farming region. The farm consists of 7000 acres of cropping and strictly no livestock. We are lucky to have some of the best soils in Australia to farm, they consist of mainly heavy black clay soil types with good water holding capacity. Average rainfall is 16 inches a year of mainly winter rain and no reliable summer rain to count on. We grow wheat, barley, lentils, canola, beans and chickpeas in our continuous cropping rotation, this amount of options give us plenty of diversity in our system.

We started to direct seed our crops back in 1983 and have continued to advance the system ever since then. The changes continued at a very fast rate with many new herbicides coming onto the market as well as changing machinery and farming methods all at once. It was a struggle to keep up.
Every time we would change something in our system we would think that we had the game sown up, but when I look back now I have to laugh at myself and my ignorance (lack of knowledge) at that time of the development of the CTF No-Till system that we currently use today.

Change is the hardest thing for farmers to do as they have done it that way for so long and it worked most of the time, they are happy to keep getting the new tractor or truck but when change involves their farming practises they do not want to change.

Change will not happen until the pain of staying the same is greater than the pain of change.

There is always a better way to do things! The challenge is for us to work through the issues that come along to challenge our current system, we have to keep on top of these and continue to advance the art of CTF No-Till farming into the future.

Our current CTF No-Till farming system is setup on 30ft seeders and combines, 90ft SP boom spray and 30ft shrouded sprayer. All machines have 120inch wheel centres and we run them on a controlled traffic system every year. Row spacings are 15inch and 30 inch depending on the crops grown.
We have been using GPS (VRT) and auto steer systems for many years now and every crop is inter row seeded into last years standing crop residue. We are continually modifying machinery to do what we want it to do and to work with our soils and crops we grow.

What will the future hold for our system of crop production? When will we get to perfection? Who knows but I cannot wait to get there. Soil Compaction is holding world agriculture back from going to the next level!!

CTF/Zero-Till has transformed my agriculture into a profitable exciting way of crop production. We have learnt many things over the last 20 years of agriculture but none more than in the last few years.

By using modern technology we have been able to measure and record the information gathered to help make decisions to improve our management processes.

Since we have stopped our random traffic we have noticed reduced weed numbers, they seem to only grow in the tram lines, yes we still have some weeds but we can control then much easier and we do not get as much competition with the crops.

The continued low rainfall years have forced our hand to improve the way we have farmed which has been very good as we needed to lift our game. If we are not progressing we are going backwards!

The importance of improved water management is one of the most vital aspects to achieve if we are to stay farming successfully into the future.
Everyone seems to blame the lack of rain on their crop failures, but let me say that there is more to growing crops than rainfall.

We believe we have been doing that far better than in our old farming systems, and that is what has improved our water use efficiencies and produced higher crop yields. We have to grow more with less if we are to stay in business so let's get on with it. We use less fertilizer now than we have in the past.

The change in soil health has been one of the amazing things we have observed over time, it has made us look a lot harder at what we do and how it will affect the natural biology that exists in the soil and we continually look for ways to improve it. But you know the most important thing is to stop bashing the shit out of it and stop driving all over it.

These two seem very hard for people to accept and achieve and I do not understand. They seem to be looking for the magic pill or silver bullet that they can buy to fix everything in one day but that is not available, yet to change their farming system is the easiest thing to do and some people make it the hardest.

We have some consultants out there that do their best to stop the progression of agriculture and new technology, WHY ???

Where we go from here with our farming system I do not know but there is no doubt the system will change as the years go by. We need to keep an open mind to this potential change and continue to advance the art of Zero-Till farming.

The Farming Business – 1992-2009

Hugh Ball

'Oodnadatta' Moree. Email: hugh@ballfm.com.au

The Ball Family commenced farming at 'Gorian' Burren Junction NSW in 1992; this country was purchased in 1988 and developed from grazing to farming in 1992. Previously the family lived in the Hunter Valley running a crossbred cattle enterprise. In 2002 'Oodnadatta' a farming enterprise at, Moree NSW was purchased.

A total of 15,000 hect of arable cropping land is in the family business. A further 20,000 hect is under crop management and contract farming for external clients as Hugh's business, Ball Farm Management. This business is expanding rapidly.

The farming system is built around Zero till controlled traffic implemented in 1992. The system comprises of permanent 3 metre wheel centres using 12 meter planting and 36 – 48 meter Boom sprays. Machinery and labour efficiencies are challenges. Hugh and Duncan run the farming business with a strong emphasis on capable core staff and external expertise (agronomy, marketing and business management).A family Advisory board has been established.

Hugh is a director and shareholder in MAX Grains, a grain marketing business in Brisbane. A strong focus is to grow the business and align with like minded businesses too better achieve viable economical and sustainable results in what is a challenging but dynamic agricultural climate.

Rural R&D Response

Peter Reading

Going Straight – A Reporter's Run Down the Tramlines

Peter Lewis

Executive Producer, Landline, ABC-TV Brisbane

ABC-TV's Landline programme first heard about farmers putting permanent tracks or tramlines through their paddocks back in 1998 – and we were as intrigued as anyone. Thanks to the patience and professionalism of Doctors Tullberg and Yule we were able to explain it televisually to our audience in a way that made sense.

They had arranged a shooting schedule with a number of those early CTF pioneers in various parts of Queensland , as well as at the research hub at UQ's Gatton Campu . We borrowed heavily from an in-house training video they'd already produced as well as those original graphics which frankly are still hard to beat .

But it was the testimony of ordinary farmers that carried the yarn along. They spoke about the changes they had to make to paddock layouts, equipment and mostly mindset. There was an enthusiasm we find among those on the leading edge of innovation that always makes for interesting telly. The result was an informative, educational and entertaining segment that proved to be one of our most popular.

Five years later we hooked up again with the good doctors at a CTF conference at Gatton, where we were able to show just what sort of inroads the approach was having – particularly among manufacturers, who rolled out a remarkable variable wheel-base tractor for our benefit.

We work on the theory that an 'eyeful' is always better than an 'earful' – seeing is believing and watching some of the most progressive farmers in the country kicking this thing's tyres and checking out its satellite steering system was proof, for us, that CTF wasn't a passing fad.

Now CTF is mainstream and it's making a substantial difference across all sorts of farming enterprises, large and small. It's vindicated all that early work by Tullberg, Yule and like-minded souls and I'm delighted to be involved – even peripherally – in their journey.

Controlled Traffic Farming (CTF) Systems - Australian CTF Standard, Industry Proposal

KevinPlatz

A Contract Harvester Perspective of CTF

Peter Bradley

Contract grain harvester, National President of the Australian Grain Harvesters Association Inc.

The paramount issue is standardization of all equipment at 3 m wheel centres, particularly headers/combines. The most pressing problem is in relation to irrigation crops on 2 m beds. Some growers have changed to 1.5 m irrigation beds, to work in with 3 m wheel centres. There is a cost to growers to change, as there has been for 12 m fronts etc. I firmly believe the end result will outweigh the expense of the change to a sustainable and low emission cropping system.

The technology required for efficient CTF harvesting includes GPS devices, auto-steer, 12 m fronts, 3 m wheel centres on headers, tractors and chaser bins. Contract harvesters cannot be solely responsible for these costs. A class 7 header fitted with all the technologies required for efficient CTF costs approximately $62/ha for a 2.5 t/ha standing crop. Currently, farmers are paying contractors $37 - $48/ha harvested. Who is paying for CTF practices? Where does this leave the contact harvester? No business can be sustained under these conditions, and farmers could very easily lose an important service in professional 'Contract Harvesters'.

CTF practices give very clear monetary and farming practices benefits. We have shown 20% - 40% reductions in soil compaction, and a 25% reduction in fuel consumption. We average around 6% less actual time harvesting due to auto-steer.

However, greater productivity will be wasted if harvest scheduling does not allow for on the go unloading, there is insufficient storage in the field, not enough trucks, or if on-farm storage has not been planned for effective handling of grain quantities and quality. Farmers and harvesters need fully documented and understood breakdown contingency plans in place prior to harvest. Moisture control criteria need to be implemented and any other risk assessments and planning in place. Field planning must be in place for roads and unloading points etc.

Our business is considering commencing Farm Harvesting audits to give our clients a more accurate understanding of harvest costs and where more efficient CTF practices could be implemented to create better profit margins.

If a farmer wants a profitable and more sustainable harvest, my honest point of view is to go for it - create your CTF cropping system and you won't look back!!

Logistics and efficiency of grain harvest and transport systems

Greg Butler

SANTFA

Improvement of efficiencies, reduction of costs and optimum allocation of resources is becoming more important to grain growers in the face of climate change constraints. Australia has many areas where production is carried out under very marginal growing conditions and it is often the scale of farms that makes them profitable. A discrete event simulation was built upon the data collected during field trials to model some typical southern Australian harvesting systems and was compared to actual data collected in the field during harvesting. Simulation parameters included: harvester or header (in the Australian context) size/capacity, operating speed, turning time, unloading time and overall work rate efficiency. Field shape, size and location of temporary storage (field bins) along with the travel distance to the grain silo were recorded and monitored and investigated in a case study. The model was able to optimize the harvest pattern, the number and location of field bins and the number of road transport trucks to best match the harvester and grain transport. Example benefits for a 5000 ha wheat farm included a reduction of 9.5% in harvesting time and a fuel saving of 2100 kg (equivalent to 5.8 t/year reduction in CO_2 emissions). The validated model will form part of a decision support tool that farmers can use to optimise their investment patterns for the complete harvest system. This tool aims to minimise production costs, and maximise harvested yield and cropping income, in a strategy to reduce farming risks and improve sustainability.

The work was carried out as part of a collaboration between researchers from the Dept. of Agricultural, Forestry and Environmental Economics and Engineering at the University of Turin, Italy and Researchers from the Institute for Sustainable Systems and Technologies – Agricultural Machinery Research & Design at the University of South Australia.

Australian GNSS CORS networks – Status, Issues, Challenges, Future

Martin Hale

Operations Team leader, Vicmap™ Position - GPSnet™

The Australian precision agriculture sector currently relies on stand-alone RTK (Real Time Kinematic) GPS (Global Positioning System) base station technology. These base stations are established for local use or formed into small and often ad hoc proprietary 'arrays' to increase user coverage to support applications such as controlled traffic farming and inter-row farming etc.

Recently, Continuously Operating Reference Station (CORS) technology, delivering genuine networked satellite correction services (Network RTK—NRTK) has become available and has superseded single RTK base station solutions. CORS networks create significant utility which is leading to its application across many Global Navigation Satellite System (GNSS) user sectors—including agriculture. The primary advantages of CORS includes efficient station spacing (approximately 70 km) which can enable regional and even national access to uniform, sub 2 centimetre horizontal spatial accuracy for guidance, positioning and navigation applications.

Australian jurisdictions are at various stages in the coordination, establishment and expansion of multi-purpose CORS networks. These include Victoria's GPSnet™, New South Wales' CORSnet-NSW, Queensland's SunPoz and an embryonic network in the Northern Territory. The Australian Government, in partnership with jurisdictions, is also implementing the AuScope GNSS CORS network to support scientific and commercial applications.

This presentation will provide an update on Australian CORS networks and the benefits for low emissions cropping systems. It will detail the issues and challenges facing government and commercial organisations in the implementation of an appropriate CORS infrastructure for the nation.

GNSS and Agriculture: An alliance for economic competitiveness

Martin Nix

Managing Director, Navonix

Agriculture is one of the key contributing industries to Australia's economic health. Recent reports have shown a dramatic link between GNSS technology and economic benefits over the next 10 years. It advocates improvements to GNSS infrastructure to gain additional economic benefits. However, there is less information on the status of GNSS infrastructure improvements to support the Agriculture industry relative to other countries. The presentation will outline some of the issues relevant to GNSS infrastructure support for Agriculture?

- Economic aspects: contribution to economic competitiveness of GNSS systems and CORS in Agriculture
- Non economic benefits: environmental and social considerations
- CORS infrastructure in other countries with agriculture industries
- Some commentry about the Spatial Industry strategy for GNSS
    - Key 'take-outs' from ANZLICs policies for Agriculture
    - The Natural Resources Information Management Toolkit
    - CORS and the Australian Spatial Data Infrastructure (ASDI)
- Are other industries likely to use CORS corrections to leverage the infrastructure investment for Agriculture?
- Challenges to adoption of CORS by the agriculture industry
    - Cost benefit issues affecting price considerations
    - High accuracy versus low accuracy
    - Communications issues
    - Implications of improving the national broadband infrastructure
- Roles of public and private organizations in CORS infrastructure

Proximal Sensor Technologies

John Rochecouste

CEO, CAAANZ

Proximal Sensing Technology (PST) involves small sensor-target distances, especially when the sensor is in direct contact with the target - often referred to as on-ground sensing systems. The key aspect of PST is that it uses one or a number of instruments to provide a verifiable spatial data point. The addition of a GPS coordinate locates its surface position for comparison with large scale remote sensing technology. Having a large range of data points that can calibrate remote sensing data allows for comparative analysis with a certain degree of confidence using replications over large populations.

It can also be supported by an increasing range of objective measurement tools as simple as temperature probes to more complex gamma ray or NIS spectrophotometers. The question from landholders is relation to PST data such as yield monitors is '*So what*'? How does the information relate to what I doing? The presentation outlines examples of supporting PST in determining potential improvements in crop production efficiency, reduced emission and climate adaptation. The combining of proximal and remote sensing provides a new platform for future production research. However identifying the 'production issue' is still a precursor to the deployment of technology. The challenge is integrating the research question and available technology in simple workable formats.

The question for consideration is how do we most effectively use proximal and remote sensing technologies to improve agricultural and resource management efficiency? And possibly answer the question 'so what'?

Remote Sensor Technologies

Eileen Perry

Future Farming Systems Research, DPI, Horsham, VIC

There are many applications of remote sensing to generate information related to crop production, including information on soils, terrain, and climate. Assessment of crop health is key to supporting management that optimizes fertilizer applications. More efficient use of N fertilizers could reduce environmental impacts from run off, denitrification and volatilisation. Real-time DGPS guidance systems (Controlled Traffic) is the enabling technology that allows growers to fully utilize information from maps and other products developed from proximal and remote sensing. To develop crop assessments, we need to consider both the sensor and platform requirements when considering the best solution for the crop information requirements. Sensor requirements include which wavelengths are needed, the spatial resolution, and what sky conditions are required. Ground-based applications open up the use of active optical sensors, which are independent of sky conditions. Crop assessments generally utilize vegetation indices which are computed on some combination of wavebands. It's important to understand the basic differences between indices that characterize percent cover (such as NDVI) versus other indices that relate to plant N status. Future research areas include improving existing active optical sensing technology to take advantage of the improved vegetation indices, and evaluating complementary sources of data for crop information such as new satellite imagers designed for vegetation assessment.

GIS Data Management

Paul Slatter

Gathering Data for Variable Rate Technology is the Easiest Bit, Doing Something with it is the Challenge

Ed Cay

gps-Ag

The great stumbling block for the adoption of Variable Rate Technology (VRT) has been data management and how to use it for implementing management decisions. Gathering data still has many challenges for the average grower but the technology and service providers are making it easier and easier. The real challenge for growers who want to make sense of data produced by integrated technologies is to link the data, hardware and agronomic advice together.
Here are some examples of just a few of the many hurdles that growers face with data management for VRT management decisions:

- How do I get yield mapping on my header?
- What file format are my maps in?
- How do I get the maps into my software?
- How do I process the data so it accurately represents variation in my paddock?
- How do I convert zone maps into fertilizer recommendations?
- What hardware do I need to make my equipment Variable Rate compatible?
- What format does my airseeder controller need the prescription maps in?

Despite this, utilising data and increasing the adoption of VRT for making management decisions has become easier thanks to new developments such as remote data transfer, the growth of the service industry dedicated to VRT adoption and support from industry.