Catalyst Project Report

Grower Information	
Grower Name:	Steve Young
Entity Name:	Casey Zarb Pty Ltd
Trial Farm No/Name:	4202A
Mill Area:	Mackay Sugar
Total Farm Area ha:	240
No. Years Farming:	20
Trial Subdistrict:	Sandy Creek/Homebush
Area under Cane ha:	200

Background Information

Aim: To use low cost sensors on haul-out vehicles to produce cane yield maps to further improve the availability and accuracy of VR maps to growers

Background: (Rationale for why this might work)

Using harvester yield data would greatly improve the accuracy of remote sensing data and give growers the added confidence to apply variable rate nutrients. However, the development of accurate and reliable harvester yield monitors has been plagued with false hopes and high expense with very little uptake from the general growing community.

This project seeks to explore opportunities to develop low cost and reliable yield monitors to be installed onto haulout vehicles. Data will be collated and analysed to produce effective yield maps that growers can utilise to develop variable rate nutrient maps.

Potential Water Quality Benefit:

The application of variable rate nutrients that coincide with yield variability has shown to significantly improve Nitrogen Use Efficiency (NUE) without suffering yield decline. The improved NUE results in the plant taking up and storing Nitrogen (N) therefore reducing the amount of N that is in the soil which is subjected to loss pathways.

Expected Outcome of Trial:

It is expected that this project will provide data from the haulout vehicles that can be converted to show yield variability. The data will be used in conjunction with satellite derived yield variability information to produce variable rate nutrient maps with improved accuracy.

Service provider contact: Farmacist – John Markley

Where did this idea come from: Farmacist and grower

Plan - Project Activities	Date: (mth/year to be undertaken)	Activities :(breakdown of each activity for each stage)
Stage 1	**Dec 2016**	• Install logger and electronics onto selected haulout vehicle • Gather data, assess calibration of sensors, develop protocols for algorithm development to calculate cane yield • Assess suitability of device, make suggested changes
Stage 2	**June 2017**	Install required hardware onto all haulout vehicles in harvesting group
Stage 3	**Nov 2017**	Analyse collected data, create yield variation maps Develop Variable rate nutrient maps Select trial site location Instigate trial to compare VR application against standard practice
Stage 4	**Nov 2018**	Harvest trial location, compare cane yields Collect yield monitor data Develop Variable rate nutrient maps Select trial site location/s Instigate trial comparing VR to grower standard
Stage 5	**June 2019**	Final testing of harvester generated yield maps
Stage 6	**December 2019**	Final testing

Project Trial site details	
Trial Crop:	N/A
Variety: **Rat/Plt:**	N/A
Trial Block No/Name:	N/A
Trial Block Size Ha:	N/A
Trial Block Position (GPS):	N/A
Soil Type:	N/A

Block History, Trial Design:

Sensors and Tracking Device

The sensors are 0-10 bar Pressure transducers with a 4-20mA output (Figure 1) and were installed onto the airbags of the haulout vehicles in September 2016. The output of the pressure transducers feed into an Agtrix 380i which is an integrated GPS, GSM modem and data logger (Figure 2).

Figure 1 - 0-10 bar pressure transducer

Figure 2 - Agtrix 380i Data Logger.

Date from the loggers is sent via the mobile phone network to a purpose-built database. An example of the type of data sent is shown in Table 1.

Table 1 - Example of transmitted data from data logger

Report Id	ReportTime	Lat	Long	Spd	Dir	Input1	Input2	Ma Speed	Distance
596480400	4:04:30 AM	21.26269	149.092093	0	333	171	304	0	0
596480401	4:04:32 AM	21.26268	149.09208	0	335	171	304	0	1
596480415	4:04:43 AM	21.262388	149.0919958	0	240	171	316	0	31
596480513	4:05:33 AM	21.26237	149.091958	0	240	175	317	0	1
596480522	4:05:44 AM	21.26251	149.0916928	0	61	175	317	0	30
596480583	4:06:34 AM	21.26251	149.0916928	0	61	175	318	0	0
596480620	4:06:45 AM	21.26251	149.0916928	0	61	174	318	0	0
596480769	4:07:34 AM	21.26251	149.0916928	0	61	173	318	0	0
596480803	4:07:45 AM	21.26251	149.0916928	0	61	173	318	0	0
596480977	4:08:35 AM	21.26251	149.0916928	0	61	232	310	0	0
596481034	4:08:44 AM	21.26251	149.0916928	0	61	249	295	0	0
596481221	4:09:34 AM	21.26251	149.0916928	0	61	279	310	0	0
596481322	4:09:44 AM	21.26251	149.0916928	0	61	266	311	0	0
596481407	4:10:34 AM	21.26251	149.0916928	0	61	230	334	0	0
596481413	4:10:45 AM	21.26251	149.0916928	0	61	230	339	0	0
596481443	4:11:06 AM	21.26233	149.091431	8.89	286	210	344	8.89	36
596481502	4:11:35 AM	21.26192	149.0904978	15.93	304	205	350	15.93	96
596481504	4:11:35 AM	21.2619	149.09046	15.93	302	205	350	15.93	4
596481531	4:11:46 AM	21.26178	149.089988	18.89	274	205	350	18.89	45
596481554	4:11:55 AM	21.26174	149.089413	21.85	274	203	350	21.85	56

Treatments:

Results:

A plot of air bag pressure versus time (Figure 3) clearly shows the pressure within the airbags increasing as haulout bins are being filled during harvest operations. Figure 4 shows the variation in airbag pressure as an individual bin is being filled indicating more or less weight being added to the haulout vehicle as the yield fluctuates.

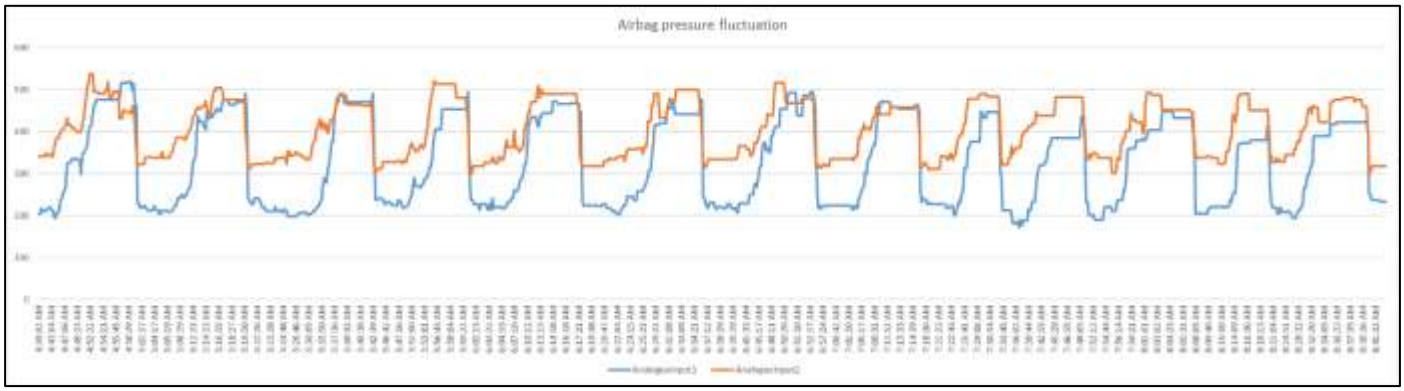

Figure 3 Fluctuation in airbag pressure over time

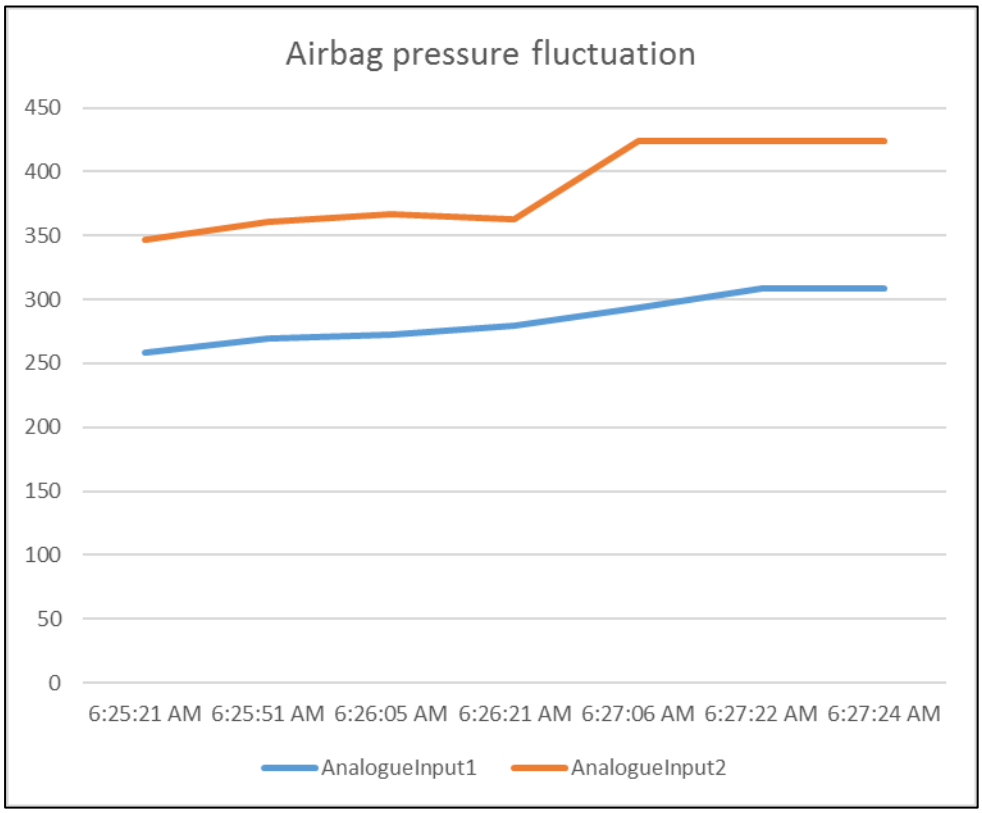

Figure 4 - Fluctuations in air bag pressure for an individual bin.

There is considerable fluctuations in the sensor values due to a variety of reasons but predominately the rough terrain inside a cane paddock causes highly variable pressures in the air bags as the vehicle travels over the ground. These fluctuations are very difficult to assess as either weight increase in cane in the bin or air bags being pressurised from the travel over rough terrain.

In 2018, rather than monitoring the haulout vehicles and airbag sensors, the trial monitored harvest position on a daily basis. From these position reports area of harvest was created that were matched to the cane supplied from the harvest date to create a daily area yield map (Figure 5).

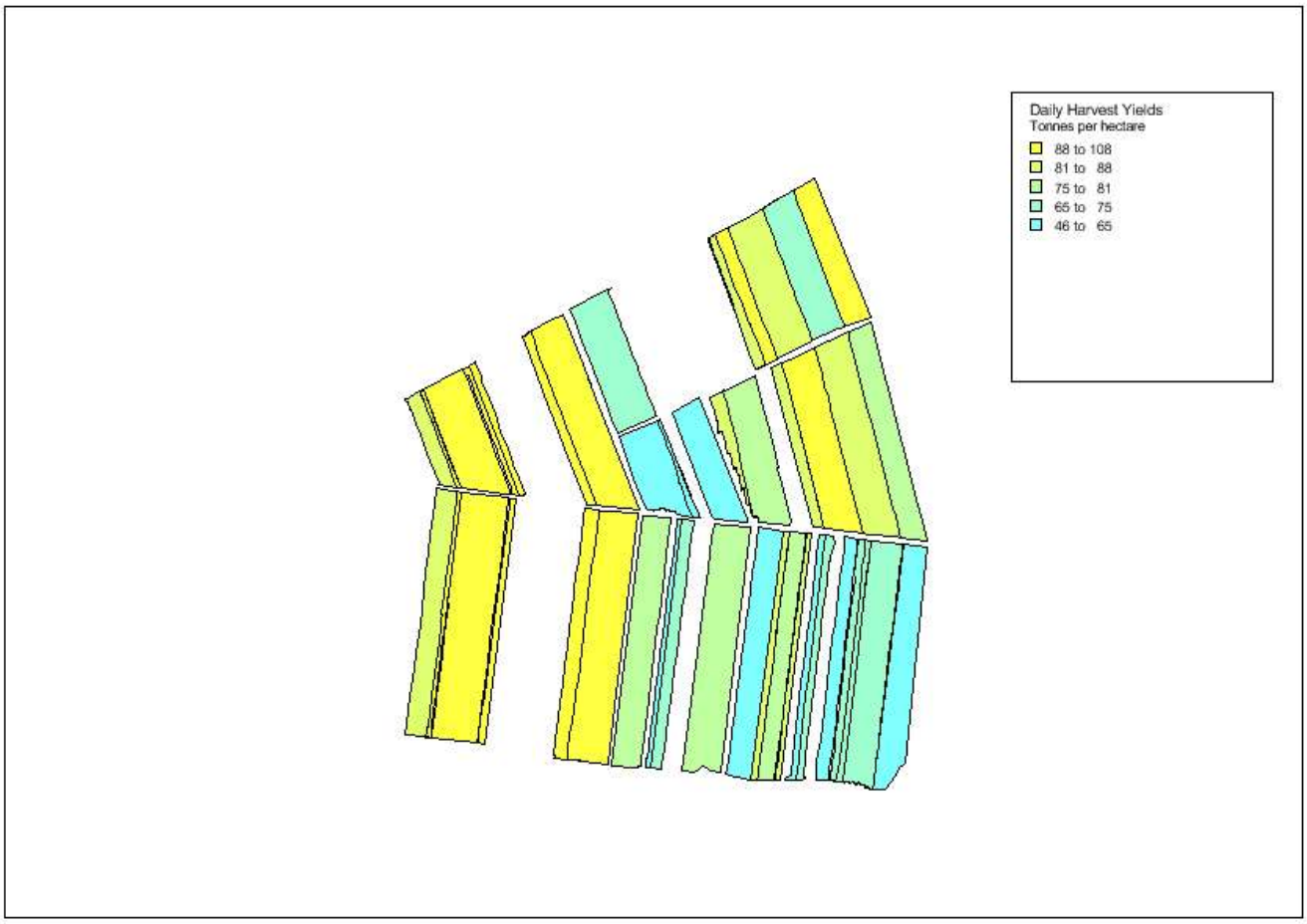

Figure 5 - Daily harvest yield map

A 10 metre Spot multispectral satellite image aquired prior to the start of the 2018 harvest is analysed to indicate the variability in vigour using Normalised Differential Vegetation Index (NDVI) algorithms. The satellite data is overlayed onto the daily harvest map (Figure 6) that associates the satellite data directly onto the harvest data. Data from the daily harvest map is used to convert the variations in NDVI values from the satellite image into a yield variation map (Figure 7).

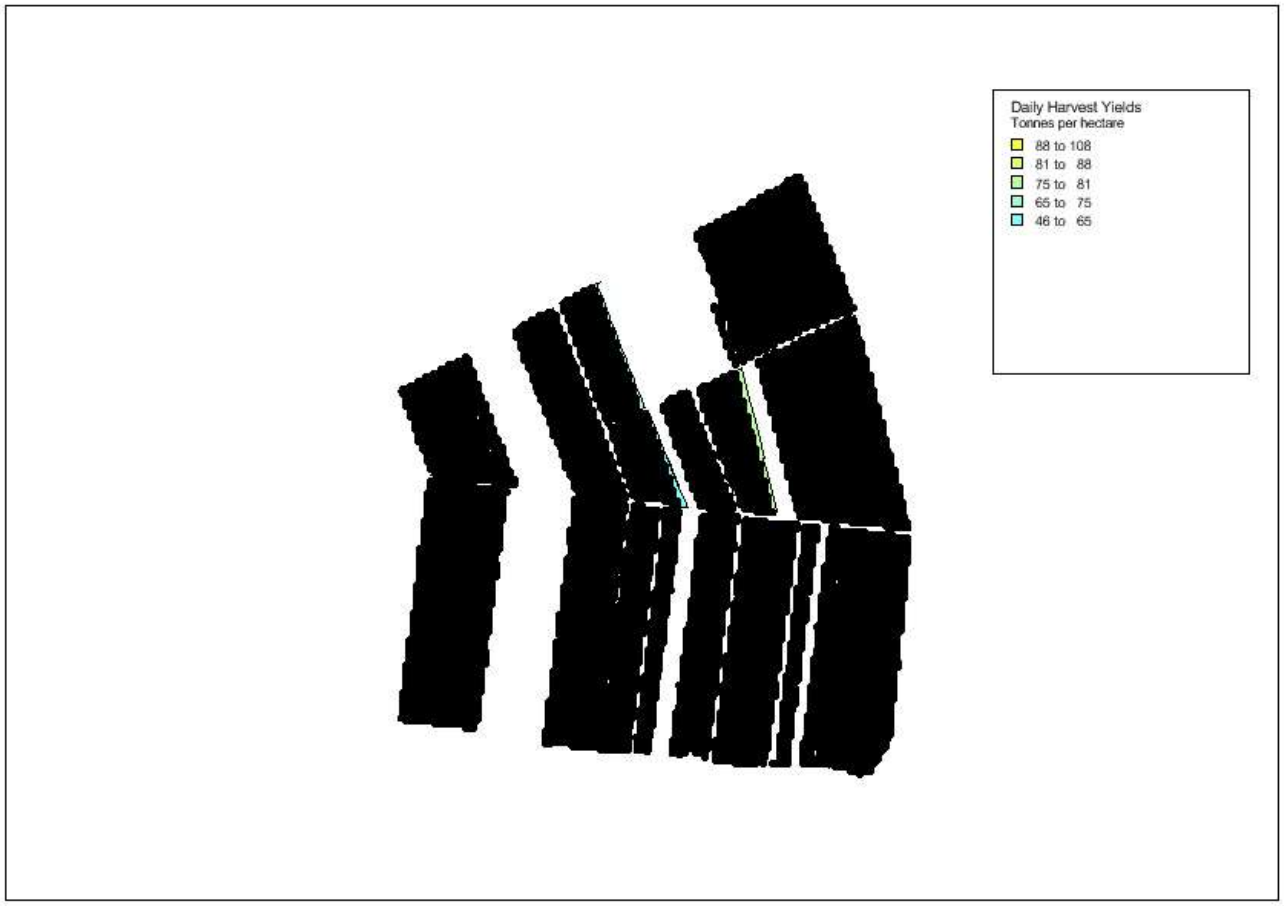

Figure 6 - Daily harvest map with points from the satellite image

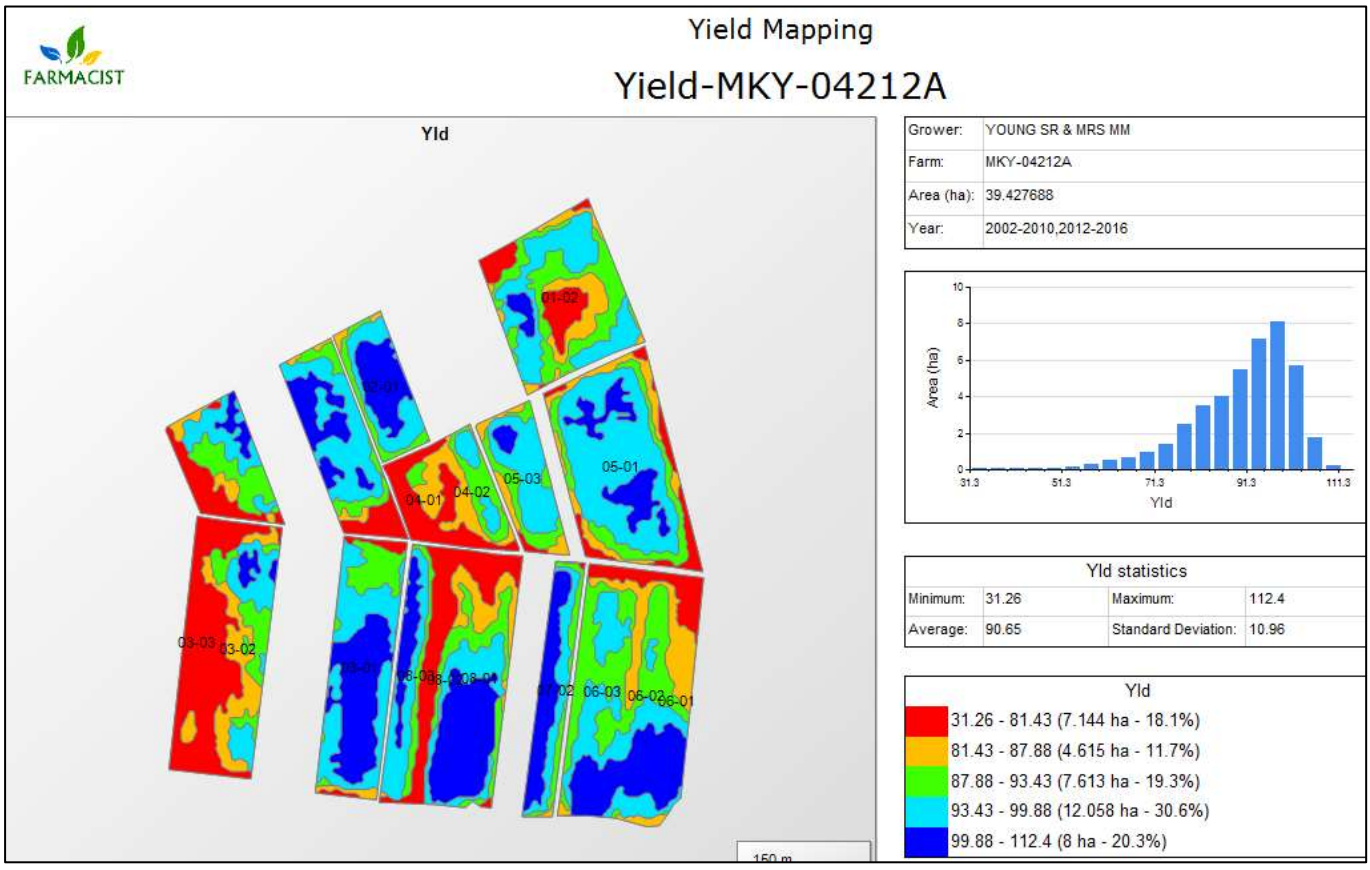

Figure 7 - Yield variation map

2019 Data

Harvester position reports from early in the 2019 harvest season combined with daily delivery data from the farm were used to create a daily harvest yield map (Figure 8). This shows a wide variation in average cane yields for each harvested are within the block ranging from less than 82 to more than 111 tonnes per hectare within ths 16 hectare block.

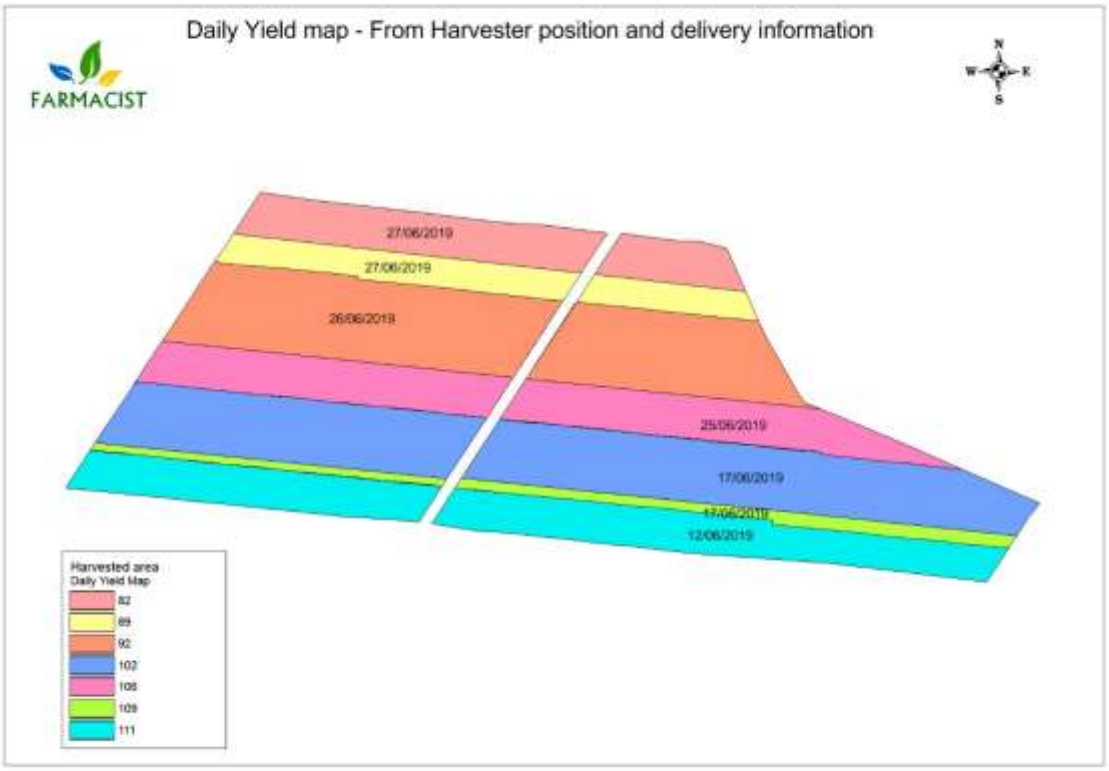

Figure 8 - 2019 harvested area daily yield map

A satellite image captured in April 2019 has been overlayed onto the daily yield map. The variability of the pixels in the satellite imagery is then translated into yield producing a yield variation map (Figure 9). The map shows large variation exist in yields within this block ranging from a low of 47 tonnes per hectare to a high of 131 tonnes per hectare. Overall , the block averaged 100 tonnes per hectare.

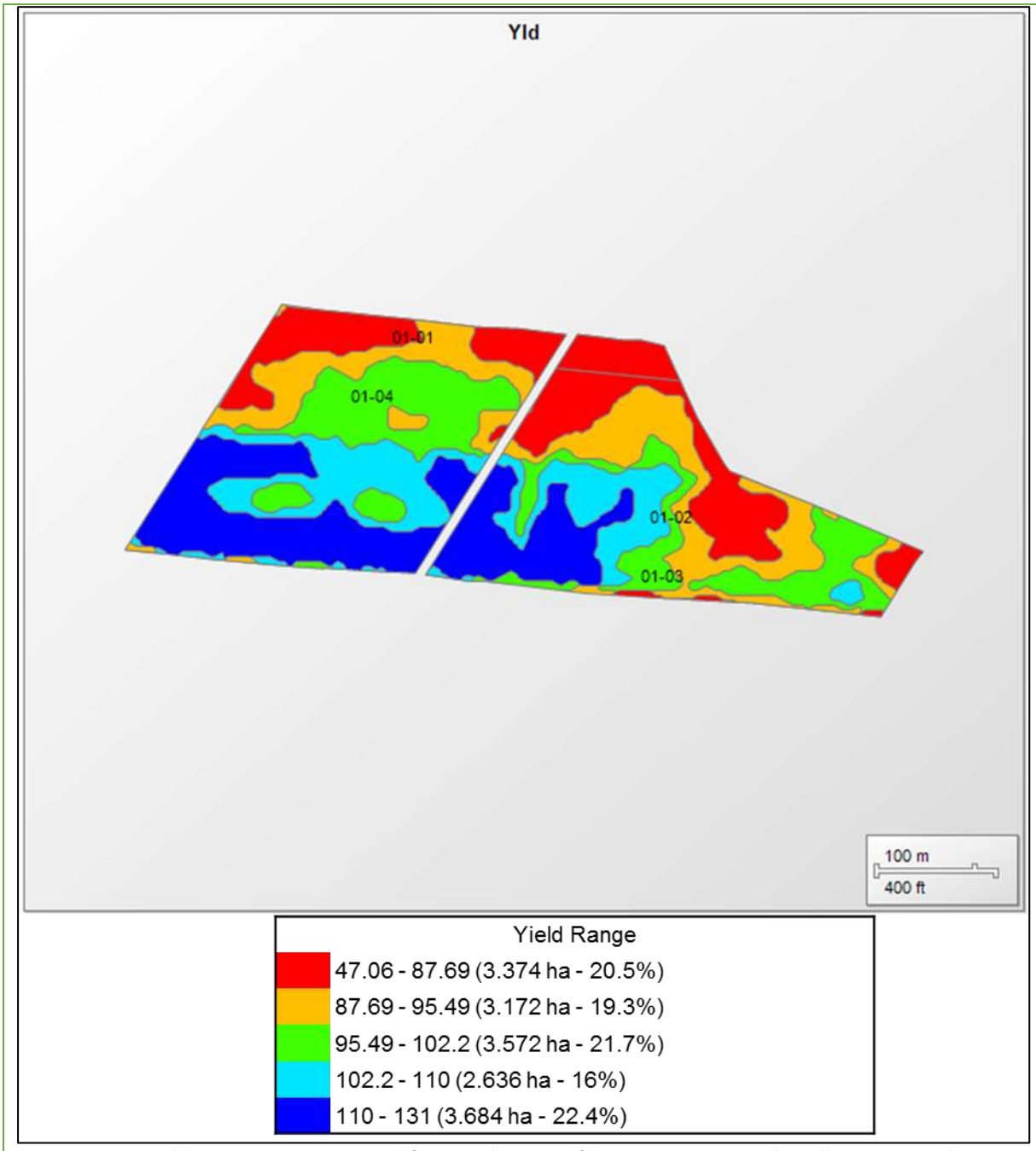

Figure 9 - 2019 yield variation map generated from combination of harvester position and satellite image analysis

Conclusions and comments

Early indications that measuring airbag pressure in a haulout vehicle would provide data that can be used to measure yield variation within a cane paddock were proven unsuccessful due to the extreme fluctuations in pressure caused from travelling over rough terrain. The fluctuations created excessive 'noise' in the data signals making it difficult to process with any great confidence.

A change in direction in 2018 has seen harvester GPS position reports used to create area harvested polygons that can be directly matched to daily farm delivery information. This in turn creates daily yield maps and when overlayed with satellite data acquired in the pre-season creates yield variability maps with a high degree of accuracy.

Advantages of this Practice Change:
Disadvantages of this Practice Change:
Will you be using this practice in the future:
% of farm you would be confident to use this practice:
Project site is continuing in 2019