The Grower Baseline: Greenhouse Gas Emissions by Port Zone

This project is funded by the Australian Government's Agricultural Innovation Hubs Program, with support from Farmanco, and was initiated through the South-West WA Drought Resilience Adoption and Innovation Hub.

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Introduction

Farmanco

Farmanco Management Consultants is Western Australia's largest independent agricultural consulting firm, working with over 750 farm businesses based predominantly in Western Australia's Wheatbelt area, producing an annual average of 6.2 million tonnes of grain, 1.9 million sheep, producing 8.4 million kilograms of wool and 29,000 head of cattle from a farming asset base of $9.9 billion. For the past 25 years we have been collecting detailed, enterprise level financial and operational data from approximately 300, predominantly Western Australian, farm businesses. Originally this data was aggregated in a consolidated Excel spreadsheet and then used to produce a personalised, annual, benchmarking book for the participating businesses to support and help make ongoing improvements to their business.

Aglytica

In 2020 Farmanco launched their Profit Analyser Platform, through a subsidiary company: Aglytica. The Profit Analyser Platform enables non-Farmanco clients to add their data to the annual benchmarking (the Profit Series) knowing that their data is secure and enables them to compare their own financial and production numbers to the information in the overall dataset

Farmanco Research

Farmanco research was established in 2018 to undertake Research & Development projects that would ultimately benefit the agricultural industry. Since its inception Farmanco Research has had a strong focus on the calculation of On-Farm Greenhouse Gas Emissions, and how data gathered through these calculations can be leveraged to provide pathways to cleaner agricultural production methodologies and practises.

Innovation Grant

Farmanco applied for a South-West WA Drought Resilience Adoption and Innovation Hub grant to add further capability to its Agricultural Carbon Measurement and Benchmarking capabilities. The successful application will create, as an initial stage, a first of its kind, version-controlled, Online Carbon Calculator available for broad business use. The outputs of the calculator have been used to compile "The Grower Baseline Greenhouse Gas Emissions by Port Zone" report to provide a snapshot of Carbon emissions current within the database for season 2021.

The next phase of development, under the Innovation Grant, will see the current Benchmarking capabilities of the Aglytica Profit Analyser extended further than the current Enterprise Level data, to a more granular Individual Paddock Level view.

Executive Summary

Climate change, and in particular Carbon or Greenhouse Gas (GHG) Emissions, have become a hot topic as the world moves to lower carbon economies. Regardless of industry, it is inevitable that business activities will produce greenhouse gas emissions. Both State and Federal governments, as well as private enterprises, are supporting, undertaking, and funding research and development projects in this space. As a result, the space is rapidly evolving with updates coming in fast.

The combination of evolutionary pace and available funding has resulted in there being an abundance of information available for people to easily access, with various tools developed to assist businesses and individuals in determining their carbon footprint and identify where they may be able to make changes. On the back of this information boom there is a growing consulting industry to assist people in making sense of the natural capital space, how they fit into it and what changes they can make to positively impact their carbon footprint.

While there is mixed sentiment on the existence and level of contribution to climate change within the agricultural industry, the sentiment from the broader community is what will ultimately influence the outcomes for the industry. The broadly held view is that agriculture is a net contributor to increasing greenhouse gases in the atmosphere. In Australia, agricultural GHG emissions have remained relatively static since the national baseline was established in 2005. In this same timeframe other industries have made reductions to their emissions. This difference has led to there being an increased focus on agricultural practices and their emissions production.

Under the Paris Agreement, Australia is committed to lowering its GHG emissions by 43% below 2005 levels by 2030, with a broader commitment to achieving net zero emissions by 2050. The original commitment was a decrease of 26-28% below 2005 levels by 2030, but an updated Nationally Determined Contribution was lodged with the United Nations Framework Convention on Climate Change in June of 2022.

According to government statistics, some major sectors, including electricity and waste, have recorded declines in their level of emission output, compared to the emissions from agricultural production, which have remained relatively static. This lack of change in the agricultural sector is placing the industry under the spotlight.

When looking to identify why this may be occurring, a comparison point could be between agriculture and the coal industry. The mining of coal is typically completed by large multinationals, however businesses focused on agricultural commodity production are more commonly owned by family owner/operators. This difference in ownership may attribute to the perception that the agricultural industry is a relatively easy target for legislation. Based on this, there is a possibility that at some point in the future, the Government may seek to impose costs on individual farm businesses for their carbon emissions, with taxes and levies already being applied in other jurisdictions in this manner.

The perception of Australian farmers not making sufficient efforts to reduce their emissions footprint could be considered a key risk to Australian agriculture. If customers (either domestically or overseas) believe that Australian farmers are not taking steps to reduce GHG emissions, they may turn to producers from countries that they perceive are taking it more seriously. In addition to consumers moving away from Australian produce, international governments may start to impose tariffs on countries and/or individual enterprises that operate under a high carbon operating model or are unable to demonstrate the actions they are taking to tackle GHG emissions. As the industry continues working on developing pathways for growers to sell, and be rewarded for, delivering low carbon grain these perceptions may hinder their success. To establish these pathways, farmers will need to be proactive in the calculation of their GHG emissions, and their subsequent management.

It is without question that farmers in Australia produce GHG emissions through the operation of their business. The sources include crop residues breaking down in the soil, stubble burning, fertiliser use, livestock excrement, machinery powered by fuel, and pesticides. Some of the emissions are generated on-farm and others are generated off-farm during the production of farm inputs and considered “embedded” in the products used on farm.

Historic knowledge of GHG emission production from agriculture, comes primarily from combining production data with field-scale studies of individual emissions sources. It is thought that current data for agriculture is likely to be an over-estimation of emissions combined with an under-estimation of agriculture's contribution to carbon sequestration. The majority of individual farm businesses don't measure their emissions, making it difficult for them to determine how to reduce their impact.

It was identified that the calculation and analysis of GHG emissions was going to be a focal point for the agricultural industry, and subsequently individual farmers, in the future. With this in mind, Farmanco Research embarked on an R&D Project to provide a method for individual farms to collect and measure their overall carbon emissions and compare them to other farms of a similar enterprise makeup in similar geographical and rainfall conditions; in terms of:

- Identifying those enterprises (crop and livestock, initially) that lead to higher levels of carbon emissions
- Identify which enterprise mixes can provide a balance between business profitability and lower emissions
- Identify the impact of changes in enterprise mix and management decisions on GHG emissions over time; and
- Identify and measure how carbon sequestration might be used to counteract higher carbon emissions.

CBH Port Zone and Receival Site map

While there were existing carbon calculators for agriculture available, they had traditionally been used for a small scale, moment in time, research focused projects where the emissions data collected had not been combined with production data. This project differed to the existing projects in that the analysis was going to be completed on hundreds of farm businesses rather than 2-3, over the course of multiple years with the data being combined with other information to build a much larger picture. The collected data would also be diverse, covering various farming systems, rainfall zones, geographical regions, and farm managers. These differences meant that the existing calculators needed to be assessed to understand if they would be suitable to accurately manage the volume of businesses with the diversity in operation that would be required.

An assessment of the widely used Carbon Calculators was made, with four being identified as the main agricultural emissions calculators in Australia:

- The University of Melbourne Greenhouse Accounting Framework (GAF)
- CSIRO FarmPrint
- AFI FarmGAS
- Cool Farm Tools.

Each of these had been previously tested by other organisations including the Kondinin Group and Grain Growers. When tested across two farms, each calculator provided significantly different results of calculated t CO_2e/year from farm collated data. Based on this testing, the GAF calculator was selected as our initial choice due to its relative longevity in the market, as well as the consistent updates (although other calculators are likely to be included in the near to medium term).

The GAF calculators were developed and are maintained by the Primary Industries Climate Challenge Centre (PICCC) and the University of Melbourne. There are 12 individual calculators to assess cropping, horticulture, sugar, cotton, dairy, feed lotting and six individual types of livestock. These calculators align with the Australian National Greenhouse Gas Inventory (NGGI) method, to predict the magnitude and source of GHG emitted from a farm. `

Background – How we collect and analyse GHG Emissions Data

Farmanco

For the past 25 years Farmanco has been collecting detailed, enterprise-level, financial and operational data from approximately 300, predominantly Western Australian, farm businesses. Every year, Farmanco consultants gather approximately 50,000 pieces of data for each individual farm enterprise, during their management reviews, to assist the farm business owners establish what factors make a financial difference to their business. A lot of this data is used as part of the farm review, but only recently have we started to consolidate and benchmark more of this data.

Originally data from individual farm reviews was aggregated in a consolidated Excel spreadsheet and then used to produce a personalised, annual, benchmarking book for the participating businesses to support and help make ongoing improvements to their business.

In 2017, the decision was made to move away from an Excel spreadsheet to a secure, online database and at the same time develop an online platform with the intent of enabling individual farmers to add their data to the aggregated dataset so they can compare their individual performance across a range of over 70 key performance indicators. In addition to increasing grower usability, advanced graphing functionality was added to enable the automatic production of graphs.

Aglytica

In 2020 Farmanco launched their Analyser Platform, through a subsidiary company: Aglytica. The Platform enables non-Farmanco clients to add their own numbers to the Profit Series, knowing that their data is secure and enabling them to compare their numbers to the information in the dataset. Use of the Platform allows non-Farmanco clients that want to compare their results against the benchmark database, to add the required base data through the Platform and receive a benchmark report.

Farmanco Research

In 2018, Farmanco Research Pty Ltd (Farmanco Research) was primarily established with the goal to determine what constitutes a high performing farm combined with the lowest achievable levels of carbon emissions. When Farmanco Research commenced this project there had been significant of modelling of GHG emissions in agriculture, but the use of actual data had been lacking. Where actual data had been gathered as part of research projects, there was a tendency for it to have been collected over a very limited number of farms, with a focus on only the data directly related to the study, and over a limited amount of time (usually 1-2 years). It was determined that a high performing farm would need to display this in both production and profitability.

In conjunction with other data identified by the technical objectives of the research, information collected through farm business reviews and the production of the Profit Series would be analysed to determine these outcomes.

The major aims of the project were to:

- Measure Greenhouse Gas (GHG) emissions at an individual farm and enterprise level;
- Identify which enterprise mix (crops / livestock) produce the highest and lowest carbon emissions; and
- Determine the optimal enterprise mix for both total crop and mixed enterprise systems, that provides the best balance of profitability and low GHG emissions, whilst also taking into account other data such as rainfall, based on a range of carbon pricing.

Data Gathering and Carbon Audits

Over the last nine years, Farmanco's management consultants have been gathering the base data used to calculate GHG emissions from over 300 farm management clients as part of its management review process. More recently, the calculation of emissions on an annual basis has been introduced to the review process. In 2022, we started to include an analysis of the emissions outputs for all farm management businesses that we consult with, including an "emissions audit" using GAF calculators, integrated into our existing analysis software.

In the fast-moving carbon space, the state of the art is also changing, and it is a challenge for calculator developers to keep current. The challenge for Aglytica is remaining cognisant of any major changes. Professor Richard Eckard of the University of Melbourne is the developer and maintainer of the suite of GAF calculators. The establishment and ongoing relationship between Professor Eckard and Farmanco's Researchers have assisted with remaining ahead of the curve when it comes to the development and maintenance of the calculations for clients' completing an annual review. The Farmanco Research Team Members regularly test and provide feedback to Professor Eckard on the calculators, assisting with the ongoing development.

Farmanco were successful in obtaining a grant provided by Grower Group Alliance/South-West Drought Resilience and Innovation Hub, which would allow further development of the Profit Analyser Platform to incorporate a version controlled online GAF calculation tool. Further, the grant will also provide funding to develop a more granular approach to data gathered by focusing Benchmarking at an individual Paddock Level.

By integrating version controlled individual GAF calculators into the Profit Analyser, there were several identified gaps that were able to be addressed, e.g. the ability to assess a limited number of crop types or the inability to combine the crop and livestock outputs in one calculator. The algorithms in the calculators themselves are complicated and the Aglytica developers programming the integration had to be mindful of this when completing this step. Cross checking was completed between the Profit Analyser and the GAF calculators throughout the process to ensure that the integrity of the original calculators was retained.

Through receipt of the Innovation Grant, software development has been undertaken by Aglytica to further extend the reach of the GAF calculator embedded beyond Farm Management Consultants, to any business that wishes to measure and Benchmark their GHG emissions. The release of this software through the Profit Analyser went live in October 2022 and will be available through the Aglytica website (www.aglytica.com/carbon) moving forward.

Each participating Farm Management Consultancy, or stand-alone business can provide their data through the secure online platform (the Profit Analyser Platform), to a centralised database (the Profit Series database), where client data is anonymised and aggregated, as part of this process.

The anonymised data contained within the Profit Series database is then used to Benchmark results, and forms the portfolio of comparative graphs, creating a compelling data story to enable the individual grower to gain insight into their practises as they compare to their peers by Rainfall or Port Zone.

For the 2021 season the GHG emissions of the Farmanco clients were assessed using:

- Cropping GHG Accounting Framework (G-GAF) V10.7
- Sheep & Beef Accounting Framework (SB-GAF) V1.8

The reporting outputs follow the standard guideline of including the individual breakdown of carbon dioxide (CO_2), methane (CH_4) and Nitrous Oxide (N_2O) for each individual enterprise type before combining these for the summary page. In addition to this, the emissions are broken out into their relevant scopes to ensure that the full picture is presented to the client.

Accuracy of Data

Farmanco Research has access to large volumes of farm focused data through its partner company Aglytica. With this volume comes a high level of diversity, covering different farming systems, rainfall zones and geographical regions, as well as the farm managers who completed their review through their parent company, Farmanco Management Consultants. It can be appreciated that the sheer amount of data may bring into question the accuracy under a claim of "quality over quantity" that could be made by some.

It has been broadly acknowledged by farm business owners/managers and agricultural professionals alike that data collected by Government or educational institutions can contain information where businesses have been "economical" with the truth. In various parts of the agricultural industry there is deep seeded suspicion of the potential for institutions to communicate information collected between them and the potential for repercussions that may arise from this. This fear is particularly applicable to the Australian Bureau of Agricultural and Resource Economics (ABARES) and the Australian Taxation Office (ATO). It is the knowledge of this fear that can bring the data presented through ABARES into question when consulted. Based on this knowledge, private researchers are both wary and mindful of using ABARES data extensively for analysis or modelling purposes due to the risk that the accuracy may be called into question by those that the research is intended to benefit.

In contrast to the suspicion shown towards data collected by government or educational institutions, farm business advisors are one of the most trusted sources for farmers. The data that is collected from growers is accompanied by an extended in-person meeting between the consultant and the client, as well as additional meetings and consultations as required throughout the year.

The data collected by Aglytica is for commercial purposes with the primary intention of benefitting individual farm businesses. Taking this into consideration, farmers are far more likely to provide accurate information. With a view of "you only get out what you put in" the majority of farmers will not pay for a product or service that feel will not bring value to their business. Business consultancy services and products are no exception, especially given the cost to the farm business to engage with a consulting professional.

Aglytica is focused on building a database with integrity that can be confidently relied upon by consumers. In order to maintain the integrity of the dataset and continue to build consumer confidence, the data needed to be collected and collated to ensure an accurate starting point to identify what factors may have the most influence on emissions. Using existing data from various research organisations included a risk that the data or results could be considered unreliable by farmers and other researchers. There was also an additional risk that the figures selected to be used as the baseline were calculated differently than those used moving forward with the project. Without good quality data Farmanco Research, could not experiment and determine what factors may be important and what may be inconsequential to the emissions produced during the production of agricultural commodities.

Data collection at an individual enterprise level is standard operation for Aglytica. In 2016, Farmanco made the decision to collect and analyse data at an enterprise level in order to extend the depth of advice they were supplying to clients. This standard was then maintained by Aglytica upon the formation of the company in 2021. The company is the only company that has this level of analysis for this period of time as they were the first to implement data collection with this level of detail.

Analysis and Benchmarking on Aggregated Data

The Analyser platform provides the ability to complete intense analysis of the underlying, anonymised and aggregated Carbon dataset to identify data trends in agriculture from a variety of parameters including, but not limited to;

- farm size,
- farm enterprise mix,

- rainfall zone,
- location,

The ability to determine long term Carbon trends on paddock, enterprise and farm level from the collected data will continue to emerge as the input footprint of the database increases and matures from data seasonally added to the database.

Results from the analysis of the 2022 Aglytica Profit Series Carbon Benchmarking shows that while High Rainfall Zone growers produce a higher level of emissions on a per hectare basis than their Low Rainfall Zone counterparts, the rainfall zones produce similar levels on a per tonne basis for the cereal and oil seed crops analysed. The only anomaly was legumes that show an increase for both intensity and volume of GHG emission production.

Both varieties of canola had the highest intensity per tonne of production. The assumption can be made that this would be due to the significantly lower yield of canola when compared to cereal crops produced in the same conditions, as well as the tendency for growers to apply additional nitrogen to canola crops to boost production or oil content. Lupins and feed barley had the lowest intensity.

Auditing GHG Emissions at an individual grower level

For nine years the base data used to calculate GHG emissions has been collected from farm management clients. More recently, the calculation of emissions, at an individual farm level, on an annual basis has been introduced to the Farmanco review process. In 2022, Aglytica started to include an analysis of the emissions outputs for all farm management businesses that Farmanco consult with, including an “emissions audit” from the GAF calculators integrated into the existing analysis software. The aim of including this analysis was to familiarise our clients with the individual components that make up their emissions and their emission output.

The result of this focus is a dataset of approximately 250 individual client emission output measurements using the GAF calculators, which provide an easy way for individual farms to collect and measure their overall carbon emissions over time, and compare them to other farms of a similar enterprise makeup in similar geographical and rainfall conditions to:

- Identify those enterprises (crop and livestock, initially) that lead to higher levels of carbon emissions.
- Identify which enterprise mixes can provide a balance between business profitability and lower emissions.
- Identify the impact of changes in enterprise mix and management decisions on GHG emissions over time; and
- Identify and measure how carbon sequestration might be used to counteract higher carbon emissions.

Calculation Methodology

The GAF calculators were developed and are maintained by the Primary Industries Climate Challenge Centre (PICCC) and the University of Melbourne. There are 12 individual calculators to assess cropping, horticulture, sugar, cotton, dairy, feedlotting and six individual types of livestock. These calculators align with the Australian National Greenhouse Gas Inventory (NGGI) method, to predict the magnitude and source of GHG emitted from a farm.

Grains Greenhouse Accounting Tool

Crop	Wheat	Barley	Barley	Oats	Triticale	
Outputs	t CO_2e/farm	t CO_2e/farm	t CO_2e/farm	t CO_2e/farm	t CO_2e/farm	total t CO2e/farm
Scope 1 Emissions (on-farm)						
CO_2 - Fuel	255.2	53.3	16.6	18.8	0.0	343.9
CO_2 - Lime	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 - Urea	0.0	0.0	0.0	0.0	0.0	0.0
CH_4 - Field burning	0.0	0.0	0.0	0.0	0.0	0.0
CH_4 - Fuel	0.37	0.1	0.0	0.0	0.0	0.5
N_2O - Fertiliser	521.4	108.9	33.9	3.7	0.0	668.0
N_2O - Atmospheric Deposition	57.4	12.0	3.7	0.4	0.0	73.5
N_2O - Field Burning	0.0	0.0	0.0	0.0	0.0	0.0
N_2O - Crop Residues	525.5	103.7	27.2	37.2	0.0	693.5
N_2O - Leaching and Runoff	174.8	34.9	9.5	10.1	0.0	229.4
N_2O - Fuel	1.3	0.3	0.1	0.1	0.0	1.7
Scope 1 Total	**1,536**	**313**	**91**	**70**	**0**	**2,010**
Scope 2 Emissions (off-farm)						
Electricity	12.2	2.5	0.8	0.9	0.0	16.4
Scope 2 Total	**12.2**	**2.5**	**0.8**	**0.9**	**0.0**	**16.4**
Scope 3 Emissions (pre-farm)						
Fertiliser	537.9	112.4	35.0	3.8	0.0	689.1
Herbicides/pesticides	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	0.7	0.1	0.0	0.1	0.0	0.95
Fuel	13.1	2.7	0.9	1.0	0.0	17.7

Summary	t CO2e/farm
CO_2	1,019
CH_4	14
N_2O	1,667

Breakdown of GHGs

Data summary | Data input - crops | Data input - vegetation | Fertiliser | Urea Application | Leaching and runoff | Crop Residues | Atmospher ...

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The GAF calculators were integrated into the Farmanco Analysis program to enable consultants to complete the assessment of emissions using the data collected during the farm management review. In integrating the individual GAF calculators into the analysis program, there were several identified gaps that were able to be addressed, e.g. the ability to assess a limited number of crop types or the inability to combine the crop and livestock outputs in one calculator. The algorithms in the calculators themselves are complicated and the consultants completing the integration had to be mindful of this when completing this step. Cross checking was completed between the analysis program and the GAF calculators throughout the process to ensure that the integrity of the original calculators was retained.

Farmanco Test File 3		Carbon Data Analysis - Cropping Enterprise						Page 34
		Grains Greenhouse Accounting Framework						Jan-22
Farm Cropping Enterprise Details	**Units**	**Wheat**	**Feed Barley**	**Canola**	**Lupin**			**Units**
Average grain yield	t/ha	1.73	1.73	1.46	1.49			t/ha
Area sown	ha/farm	7,002	1,463	455	516			9,436 ha/farm
Annual diesel consumption	otal litres/year 215,000							215,000 crop litres/year
Annual electricity use	KWh/year 23,796							23,796 crop allocated KWh/year
Power source	State Grid							
Tier 1								
On-Farm Grain Production								
		kg/ha +/-	kg/ha +/-	kg/ha +/-	kg/ha	+/-		
Nitrogen Fertiliser Use	kg N/ha	21.04	21.04	21.04	2.04	-19	20.00 kg N/ha	189 total N (t)
Urea Application (included in the above)	kg Urea /ha						kg Urea /h	total Urea (t)
Fuel Use	l/ha	22.79	22.79	22.79	22.79		22.79 l/ha	
Residue to crop ratio	(kg crop residue/kg crop)	1.50	1.24	2.08	1.37			(kg crop residue/kg crop)
Below to above ground residue ratio	(kg /kg)	0.29	0.32	0.33	0.51			(kg /kg)
Dry matter content	lry weight/kg crop residue)	0.88	0.88	0.96	0.87			(kg dry weight/kg crop residue)
Nitrogen content of AG residue	(kg N/kg DM)	0.01	0.01	0.01	0.01			(kg N/kg DM)
Nitrogen content of BG residue	(kg N/kg DM)	0.01	0.01	0.01	0.01			(kg N/kg DM)
Carbon mass fraction in DM	Fraction	0.40	0.40	0.40	0.40			Fraction
CO_2								
CO_2 -Fuel	kg CO_2/ha	61.477	61.477	61.477	61.477		580.10	
CO_2 -Irrigation Electricity	kg CO_2/ha							
CO_2 -Lime	kg CO_2/ha							
CO_2 -Urea Application	kg CO_2/ha							
CO_2 -Total	**kg CO_2/ha**	**61.477**	**61.477**	**61.477**	**61.477**			

For the 2021 season the GHG emissions of the Farmanco clients were assessed using:

- Cropping GHG Accounting Framework (G-GAF) V10.7
- Sheep & Beef Accounting Framework (SB-GAF) V1.8

Identified Limitations

Within the analysis program, there is the ability to analyse thirty-one different crop types (including options for feed and malt barley, GM and non-GM canola and two varieties of hay), four sheep enterprises, three cattle enterprises, two pig enterprises and contracting enterprises. When integrating the GAF calculators into this tool, the ability to analyse the GHG emissions of each of these options individually needed to be as automated as possible to prevent double handling or measures being missed.

During the integration process there were multiple hurdles identified and addressed. The first hurdle that needed to be addressed was that cropping and sheep/beef analysis was completed in two separate GAF calculators. These single enterprise calculators needed to be combined into the analysis tool without there being an overlap of the calculations.

In addition to the two calculators needing to be combined into the single analysis tool, the Grains-GAF calculator only had the ability to calculate a maximum of five crops at one time. To address the shortfall of twenty-six crops, the calculations used to calculate each individual crop enterprise within the GAF calculator needed to be replicated for each of the individual crop types.

Along with the replication of calculations, there needed to be the ability to adjust the level of nutrients or specific fertilisers allocated to each individual crop type. A calculation was added to the pulse and legume enterprises to automatically adjust the nitrogen application to 95% of the remaining crop types. This adjustment was taken into consideration that growers don't apply nitrogen to legume and pulse crops as best practice, however they are likely to receive a small amount of nitrogen through the use of compound fertiliser during seeding. As well as this automatic adjustment, the ability to adjust the per hectare application for nitrogen, lime and urea was included for all crop types and a solver function was added to distribute the volume of fertiliser applied in accordance to the parameters set by the consultant or as a default of even distribution between the cropped hectares presented.

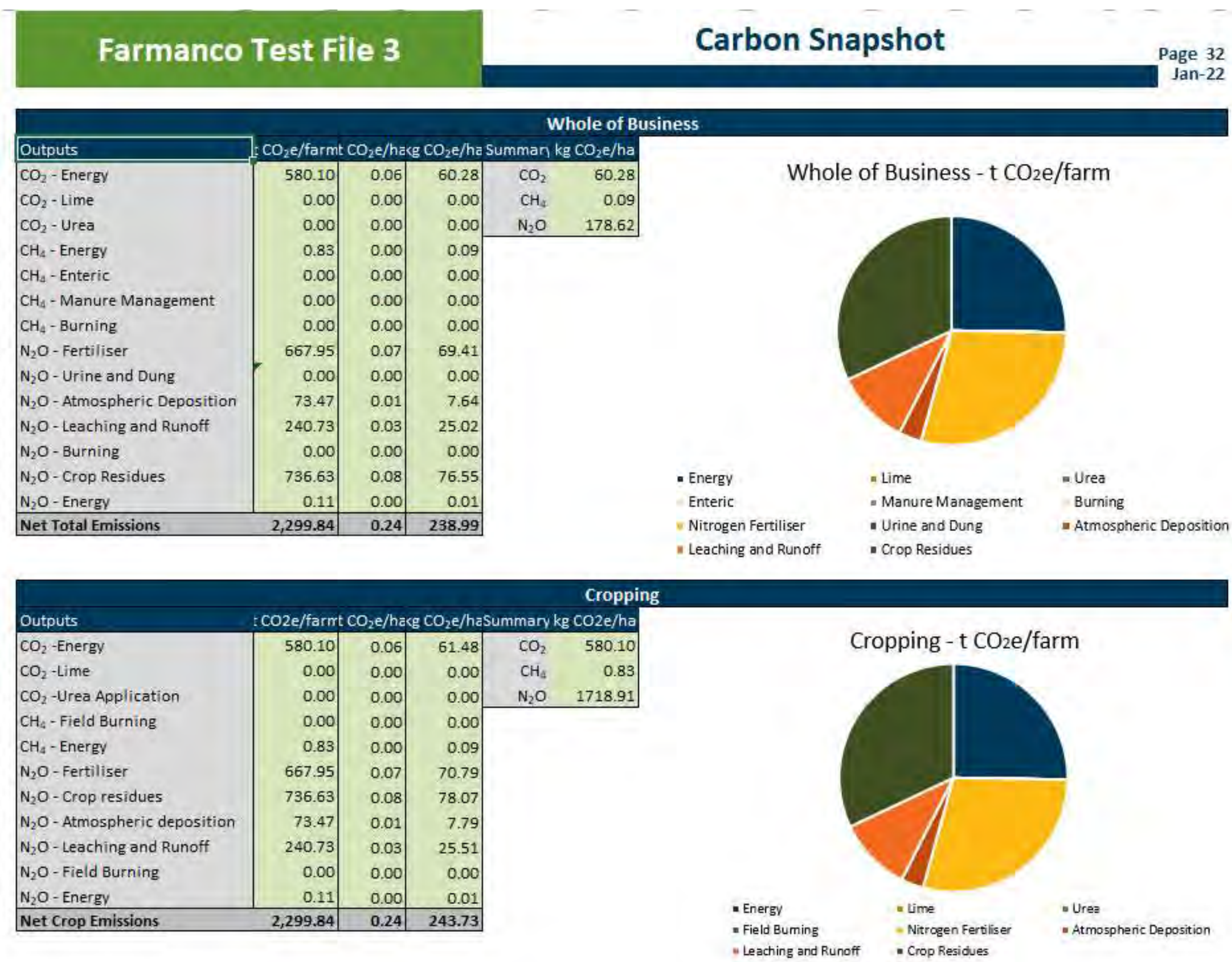
As the production, financial and carbon base data has been collected over an extended period of time, the ability to allocate the variable and overhead costs to the individual enterprises has been present in the analysis program for this same period of time. Based on the existing distribution by financial means, the electricity and fuel were able to be distributed between the enterprises.

While consulting with climate conscientious clients, the issue was raised of there not being the ability to calculate or consider the emissions produced using contractors. As a specific example, there is a large proportion of Farmanco clients that own road trains for primarily the purpose of efficiency at harvest. Based on the GAF calculations, the emissions are calculated from the volume of fuel that the business uses. A business that owns and operates its own trucks will have the fuel included in the analysis, but a business that uses contractors will have the ability to “off-set” these same emissions using contractors. Based on this, a series of calculations were developed to give an estimated volume of the potential fuel used and therefore the potential emissions that were produced from this reporting method.

At present, Aglytica has the largest dataset of Western Australian farm businesses analysed for their emission outputs using the GAF calculators. We have the existing relationship with Professor Richard Eckard of the University of Melbourne, as well as with Dr Rob Waterworth, the developer of the Farm Print emissions accounting tool and the Full Carbon Accounting Model (FullCAM) software. Access to information contained in this dataset is a key benefit of partnering with Aglytica to deliver carbon emissions projects.

Carbon Emission Audit

All clients who engaged a Farmanco farm management consultant for an annual review of their business commenced receiving an audit of their carbon emissions from the 2022 review season. The reporting is broken out into four separate sections consisting of a page specifically focused on the cropping enterprises and their analysis, a page



Farmanco Test File 3 — **Carbon Snapshot** — Page 32, Jan-22

Whole of Business

Outputs	t CO_2e/farm	t CO_2e/ha	kg CO_2e/ha	Summary	kg CO_2e/ha
CO_2 - Energy	580.10	0.06	60.28	CO_2	60.28
CO_2 - Lime	0.00	0.00	0.00	CH_4	0.09
CO_2 - Urea	0.00	0.00	0.00	N_2O	178.62
CH_4 - Energy	0.83	0.00	0.09		
CH_4 - Enteric	0.00	0.00	0.00		
CH_4 - Manure Management	0.00	0.00	0.00		
CH_4 - Burning	0.00	0.00	0.00		
N_2O - Fertiliser	667.95	0.07	69.41		
N_2O - Urine and Dung	0.00	0.00	0.00		
N_2O - Atmospheric Deposition	73.47	0.01	7.64		
N_2O - Leaching and Runoff	240.73	0.03	25.02		
N_2O - Burning	0.00	0.00	0.00		
N_2O - Crop Residues	736.63	0.08	76.55		
N_2O - Energy	0.11	0.00	0.01		
Net Total Emissions	**2,299.84**	**0.24**	**238.99**		

Cropping

Outputs	t CO_2e/farm	t CO_2e/ha	kg CO_2e/ha	Summary	kg CO_2e/ha
CO_2 -Energy	580.10	0.06	61.48	CO_2	580.10
CO_2 -Lime	0.00	0.00	0.00	CH_4	0.83
CO_2 -Urea Application	0.00	0.00	0.00	N_2O	1718.91
CH_4 - Field Burning	0.00	0.00	0.00		
CH_4 - Energy	0.83	0.00	0.09		
N_2O - Fertiliser	667.95	0.07	70.79		
N_2O - Crop residues	736.63	0.08	78.07		
N_2O - Atmospheric deposition	73.47	0.01	7.79		
N_2O - Leaching and Runoff	240.73	0.03	25.51		
N_2O - Field Burning	0.00	0.00	0.00		
N_2O - Energy	0.11	0.00	0.01		
Net Crop Emissions	**2,299.84**	**0.24**	**243.73**		

focused on the livestock enterprises and their analysis, a historic record of their emissions production from previous review seasons and a summary page breaking down their emissions and how they were produced by the business.

The reporting follows the standard guideline of including the individual breakdown of carbon dioxide (CO_2), methane (CH_4) and Nitrous Oxide (N_2O) for each individual enterprise type before combining these for the summary page. In addition to this, the emissions are broken out into their relevant scopes to ensure that the full picture is presented to the client.

The Gases

In agriculture there are three gases that are measured:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)

While these individual gases are measured, the results are displayed as a measure of "carbon dioxide equivalent" (CO_2e), allowing the impact of the gases to be compared. To calculate the CO_2e, the global warming potential (GWP) figures are multiplied with the CH_4 and N_2O figures to achieve the result.

A Global Warning Potential (GWP) figure expresses how many kilograms of carbon dioxide would be required to warm the climate equal to 1kg of another GHG over a set period of time. As an example, one tonne of methane released into the atmosphere will have the same impact to the climate as 28 tonnes of carbon dioxide. The GWP figures are reviewed and set by the United Nations Intergovernmental Panel on Climate Change (IPCC). The current figures were set in 2014 in the IPCC Fifth Assessment Report (AR5). Carbon dioxide, methane and nitrous oxide all have a different GWP.

1kg CO_2 = 1kg CO_2e
1kg CH_4 = 28kg CO_2e
1kg N_2O = 265kg CO_2e

Emissions Classification

The reporting of emissions follows the standards set out by all other calculators. The emissions produced by a business are classified into three categories, referred to as "Scopes".

Scope 1:

Scope 1 emissions are the direct result of a business activity or series of activity. They are sometimes referred to as "direct Emissions" as they are produced from resources owned or controlled by the business.

Scope 2:

Scope 2 emissions are the emissions released to the atmosphere from the indirect consumption of an energy commodity. For example, 'indirect emissions' come from the use of electricity produced by the burning of coal in .another facility. The primary activity that is classified as Scope 2 is the majority of emissions produced by electricity

Scope 3:

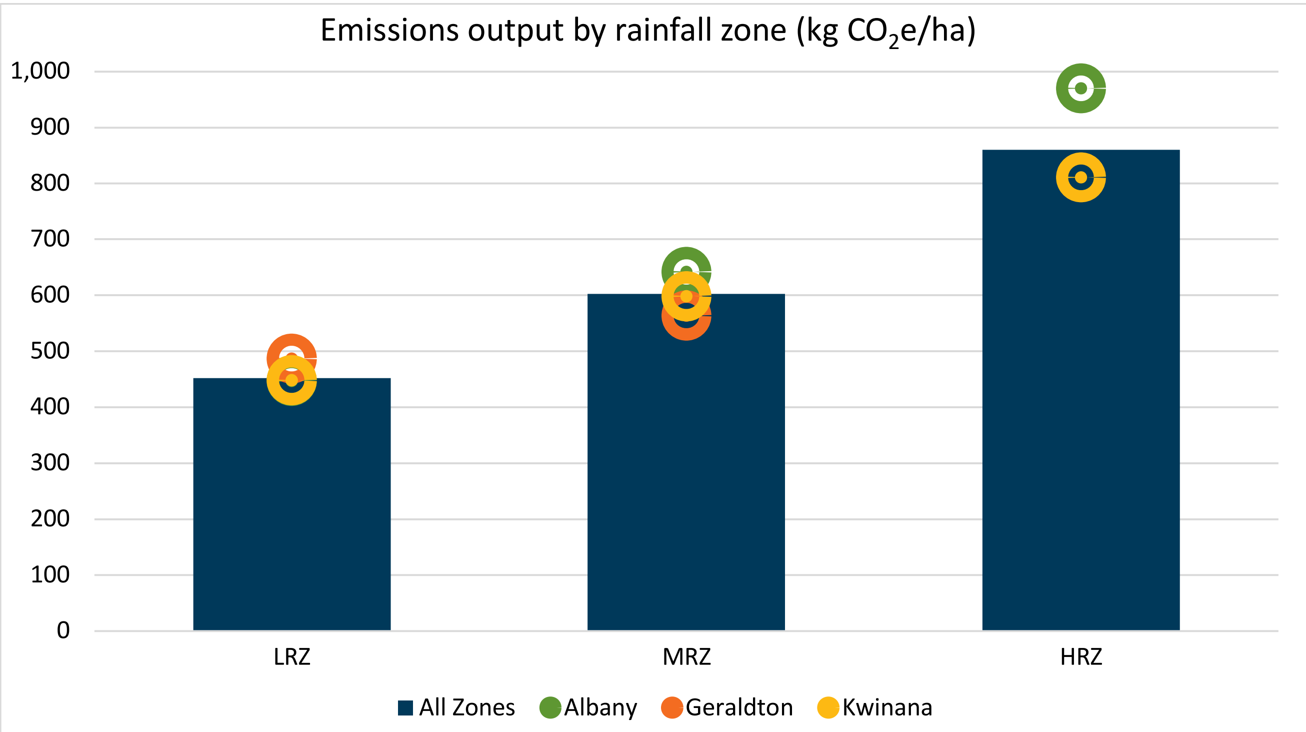
Scope 3 emissions are indirect greenhouse gas emissions, other than scope 2 emissions, that are generated as a consequence of the activities of a business, but not from sources owned or controlled by the business. These emissions include embedded emissions, which are produced by the production of fertilisers and pesticides.

An understandable topic of contention for growers is the allocation of Scope 3 emissions to their business as they are produced by off-farm means. With this in mind, it is worth noting that under the National Greenhouse and Energy Reporting (NGER) scheme, Scope 3 emissions are not reportable and under Australia's National Greenhouse Accounts are optional to report. Under both schemes the Scope 1 and Scope 2 emissions produced by business activities are reportable. The Australian National Greenhouse Gas Inventory is updated quarterly.

Pp;The 2022 Aglytica Profit Series Carbon Benchmarking Data

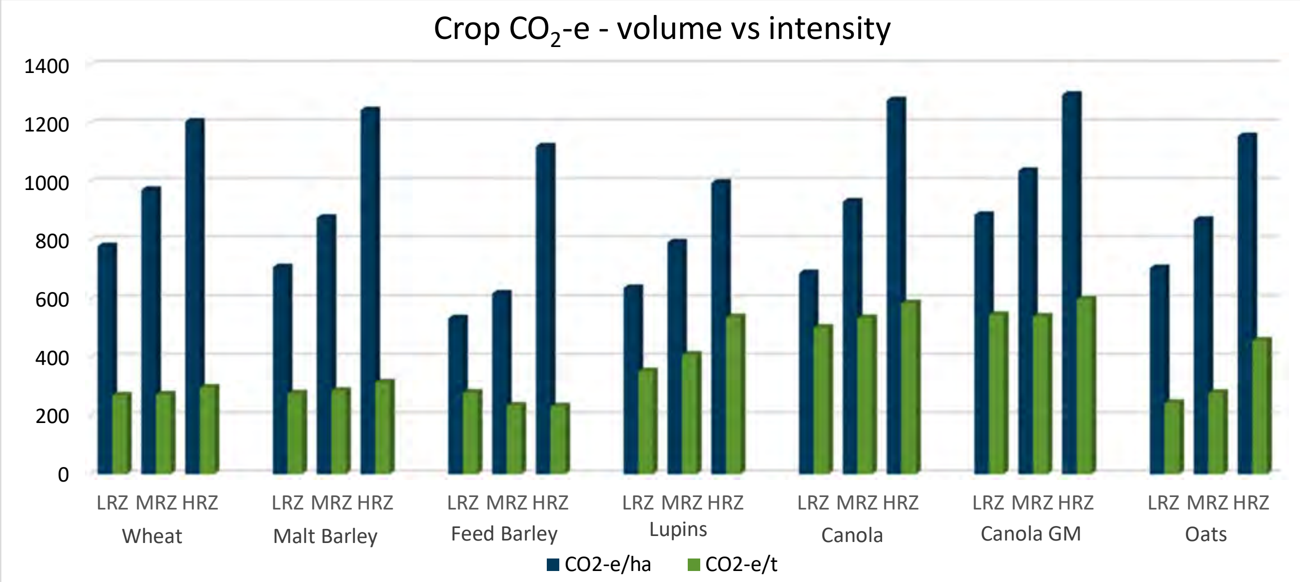
A key component of the Farmanco Research project was the development and testing of hypothesis related to carbon emissions and the businesses that produce them. Below is a discussion of the information presented in the tables and some of the findings of the Farmanco Research project that also apply to the Port Zone datasets.

One of the earliest hypothesis formed was that high rainfall growers produce more GHG emissions on a per hectare basis than their low rainfall counterparts. The theory behind this was that high rainfall growers are likely to apply a larger volume of inputs per hectare than their low rainfall counter-parts due to their higher level of production. Larger level of inputs, in particular fertiliser, as well as a greater volume of crop residues from the higher crop yields leads to an increase in GHG emissions. In addition to these factors influencing the cropping enterprise emissions, the higher rainfall zone has the ability to carry a greater DSE per hectare compared to growers in a lower rainfall zone, leading to an increase in GHG emissions for livestock. In the chart below, all Port Zones displayed follow this rule.

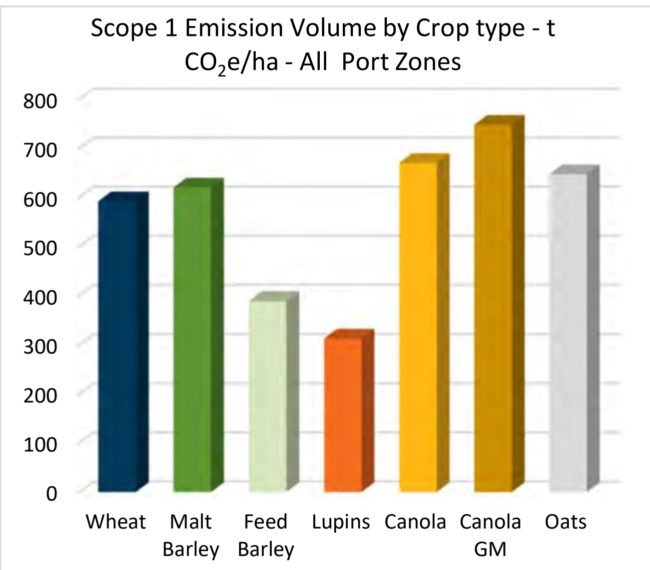


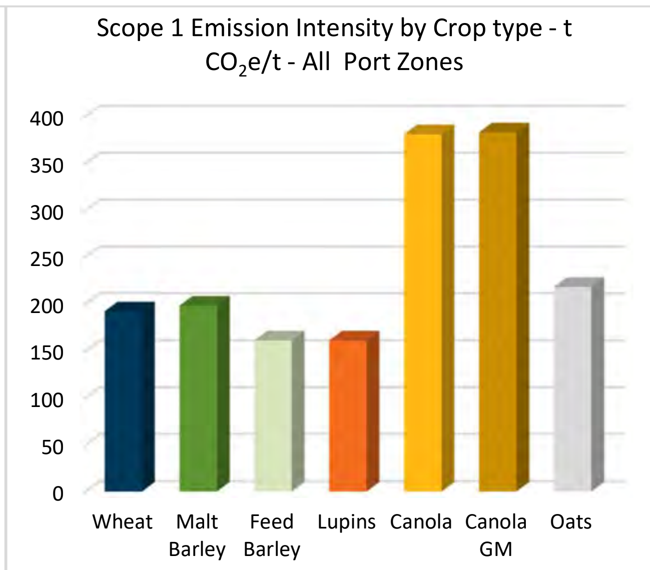
Building on the previous hypothesis, high rainfall growers may produce more GHG emissions than their low rainfall counterparts on a per hectare basis, but when comparing their emissions output to their production, it was hypothesised that the rainfall zones would produce similar levels on a per tonne basis. Looking at the data for the grains supplied, this hypothesis was confirmed in the All Port Zones dataset for wheat, malt barley, feed barley, canola and GM canola. In the same dataset, oats and lupins increased intensity and volume of emissions As the rainfall increased.

The difference for lupins can potentially be explained through the practice of applying nitrogen to cereal and oilseed crops as best practice, but not to pulses and legumes. Through this, the lupins would not receive the same volume as fertiliser and therefore not produce the same volume of emissions as the cereal crops. The majority of the emissions for the lupin crops would come from crop residue which is directly related to the level of production of the crop.



Continuing to focus on the emissions of individual crop types, below is two graphs displaying the breakdown of Scope 1 emissions by crop enterprise.



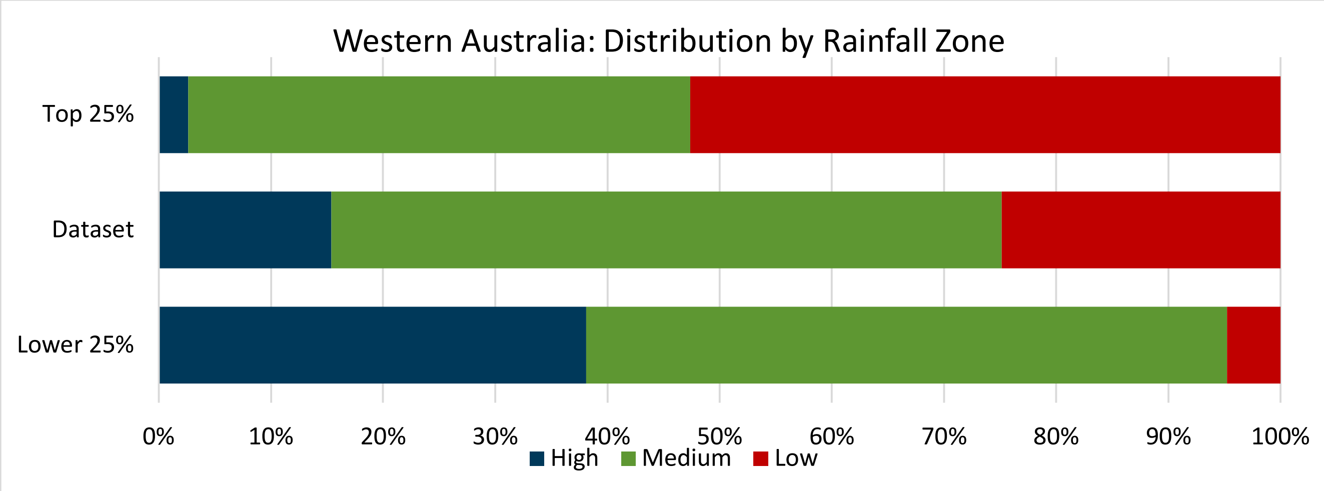


Based on the information displayed, both varieties of canola had the highest intensity per tonne of production. The assumption can be made that this would be due to the significantly lower yield of canola when compared to cereal crops produced in the same conditions, as well as the tendency for growers to apply additional nitrogen to canola crops to boost production or oil content. Lupins and feed barley had the lowest intensity. There are multiple reasons that could explain the difference of emissions intensity between the malt and feed barley. One possibly is that it could be from a difference in agronomic management in the case of growers wanting to improve their protein, another possibility could be a difference in yield received, however this is yet to be confirmed with further analysis.

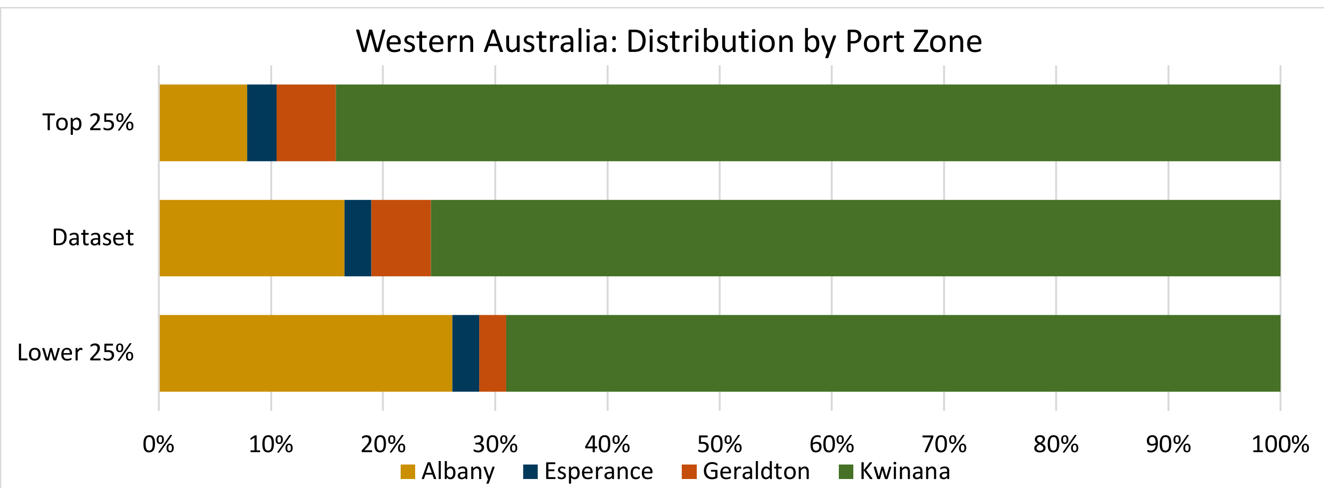
In the Aglytica Profit Series, clients are ranked for the financial benchmarking based on their five year average Return on Assets Managed (ROAM). For their Carbon emissions ranking, their ranking is determined from their emissions production on a per hectare and per tonne of production for their cropping and livestock enterprises.

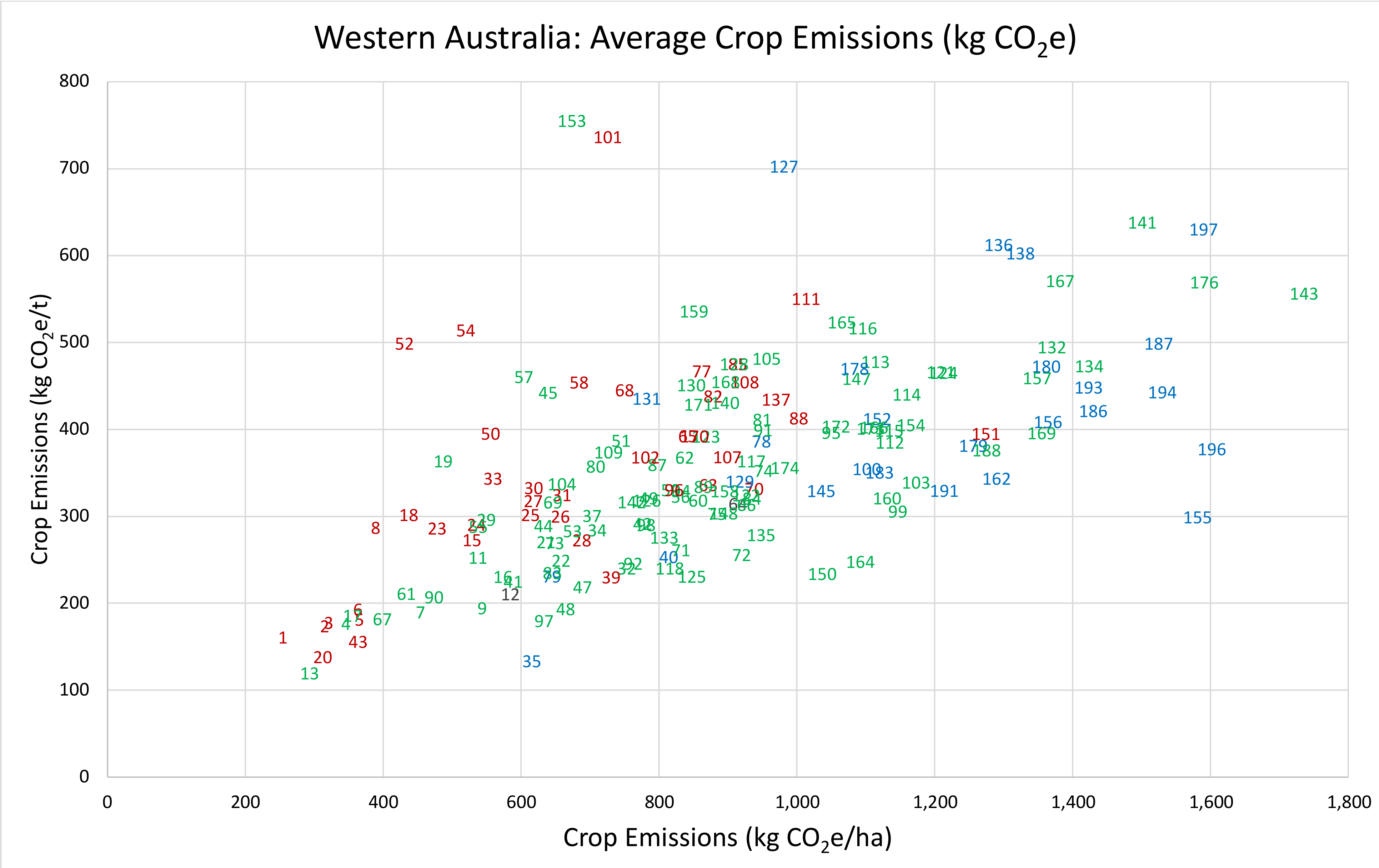
Looking at the graph below, the majority of the Top 25% is comprised of low and medium rainfall growers. Taking into consideration that the LRZ represent approximately 25% of the overall dataset, they represent over half the Top 25%

for the 2021 season and less than 10% of the Lower 25%. The high rainfall zone comprises approximately 15% of the overall dataset, however these growers represent less than 5% of the Top 25% and close to 40% of the Lower 25%.

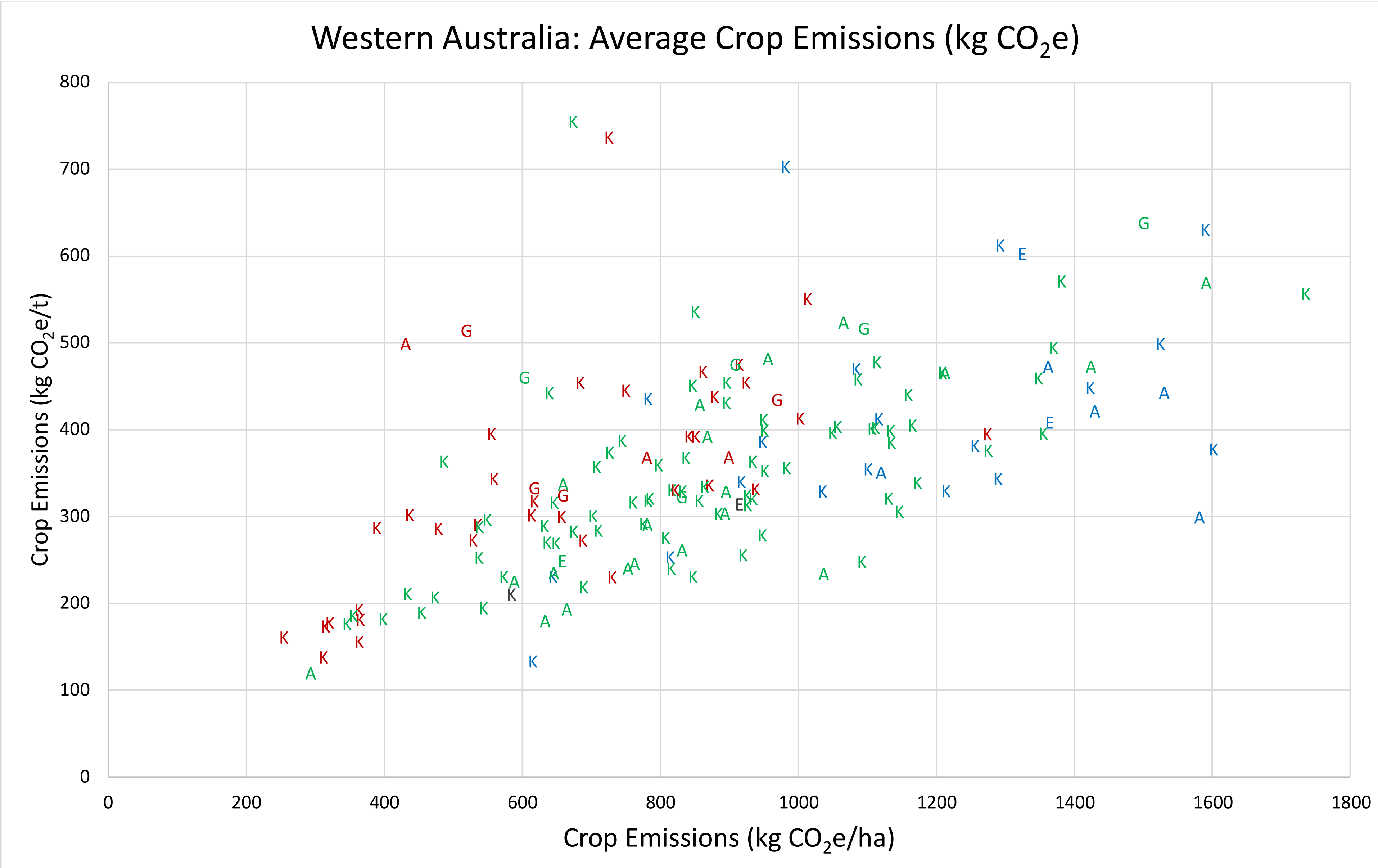


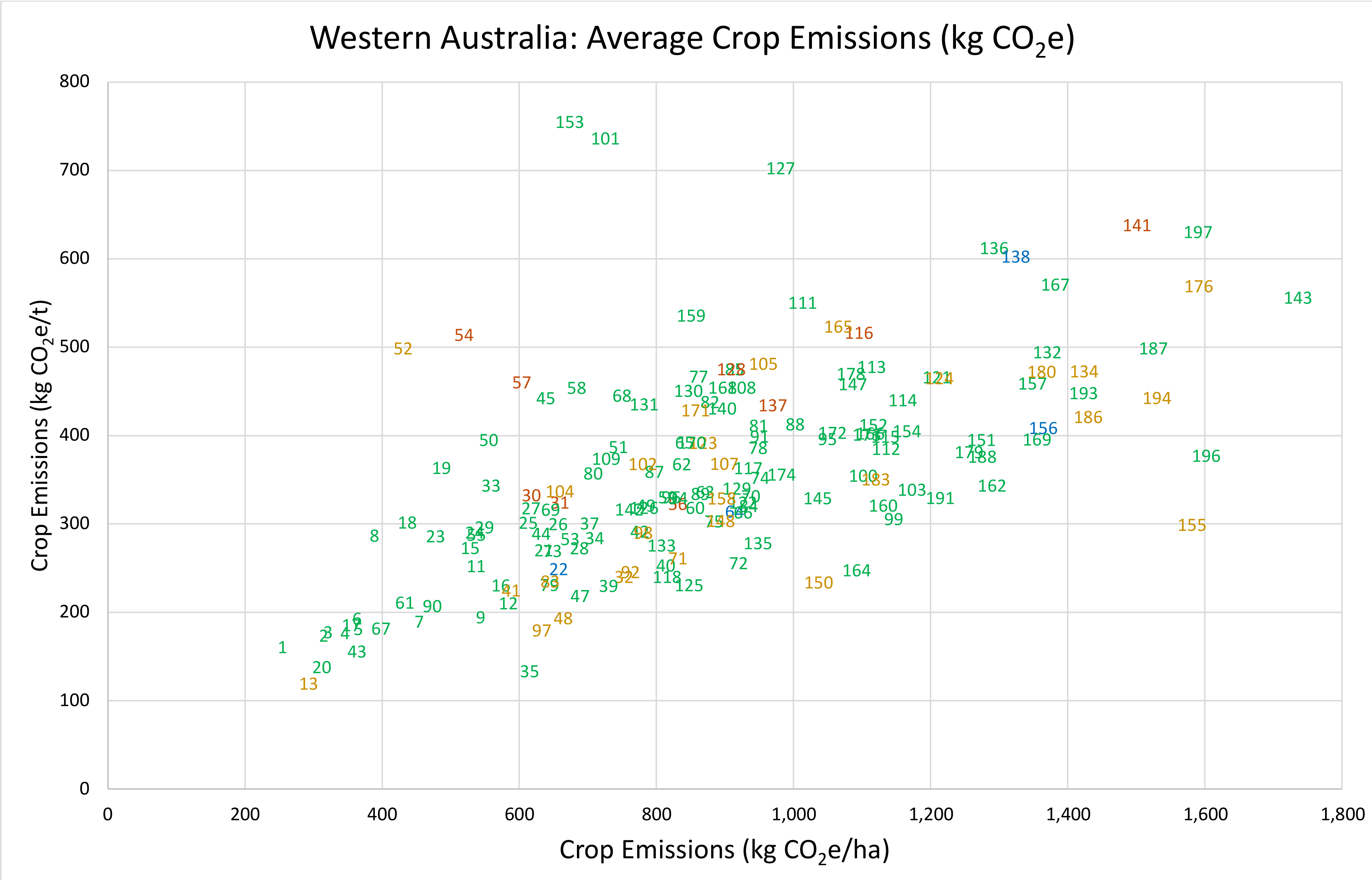
When looking at the distribution by Port Zone, Kwinana represents approximately 75% of the overall dataset. This makes it unsurprising that it dominates the Top and Lower 25%, however it's distribution is not equal between the two with 85% representation in the Top 25% and approximately 70% for the Lower 25%. While the Kwinana Port Zone's distribution was favourable to the majority falling in the Top 25%, the Albany Port Zone did the reverse. The Albany Zone represented approximately 17% of the overall dataset, approximately 25% of the Lower 25% but less than 10% of the Top 25%.

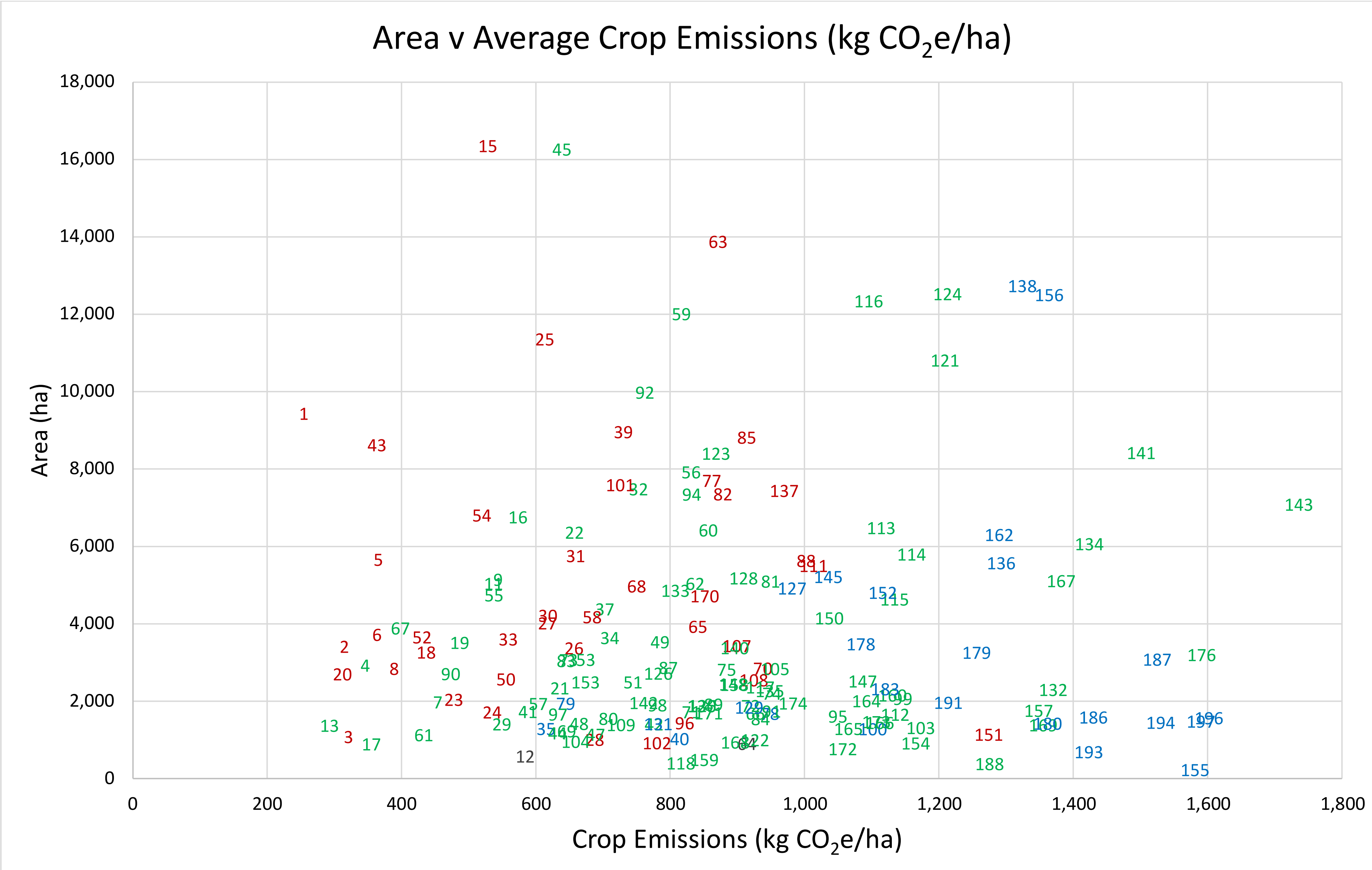


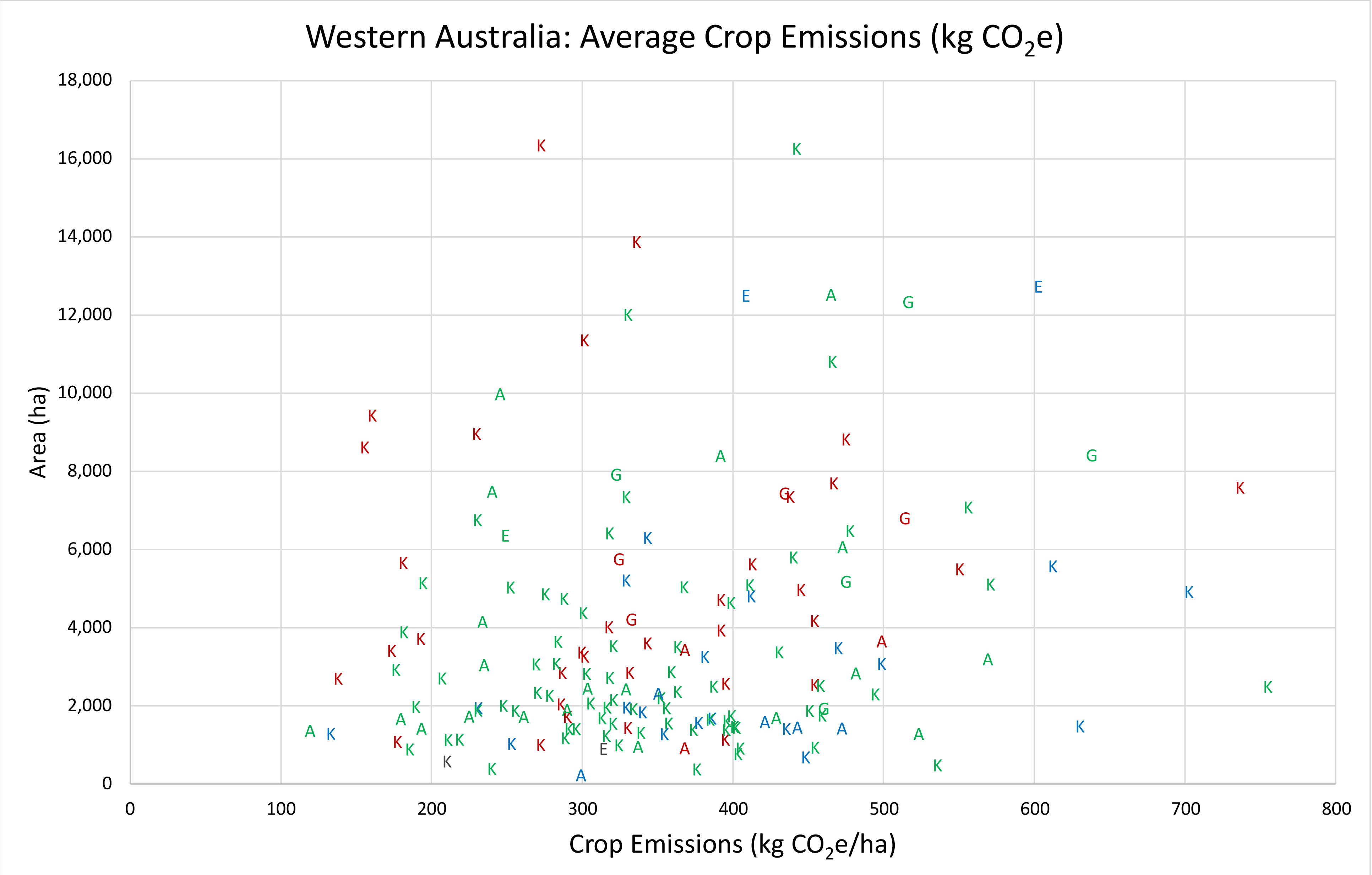


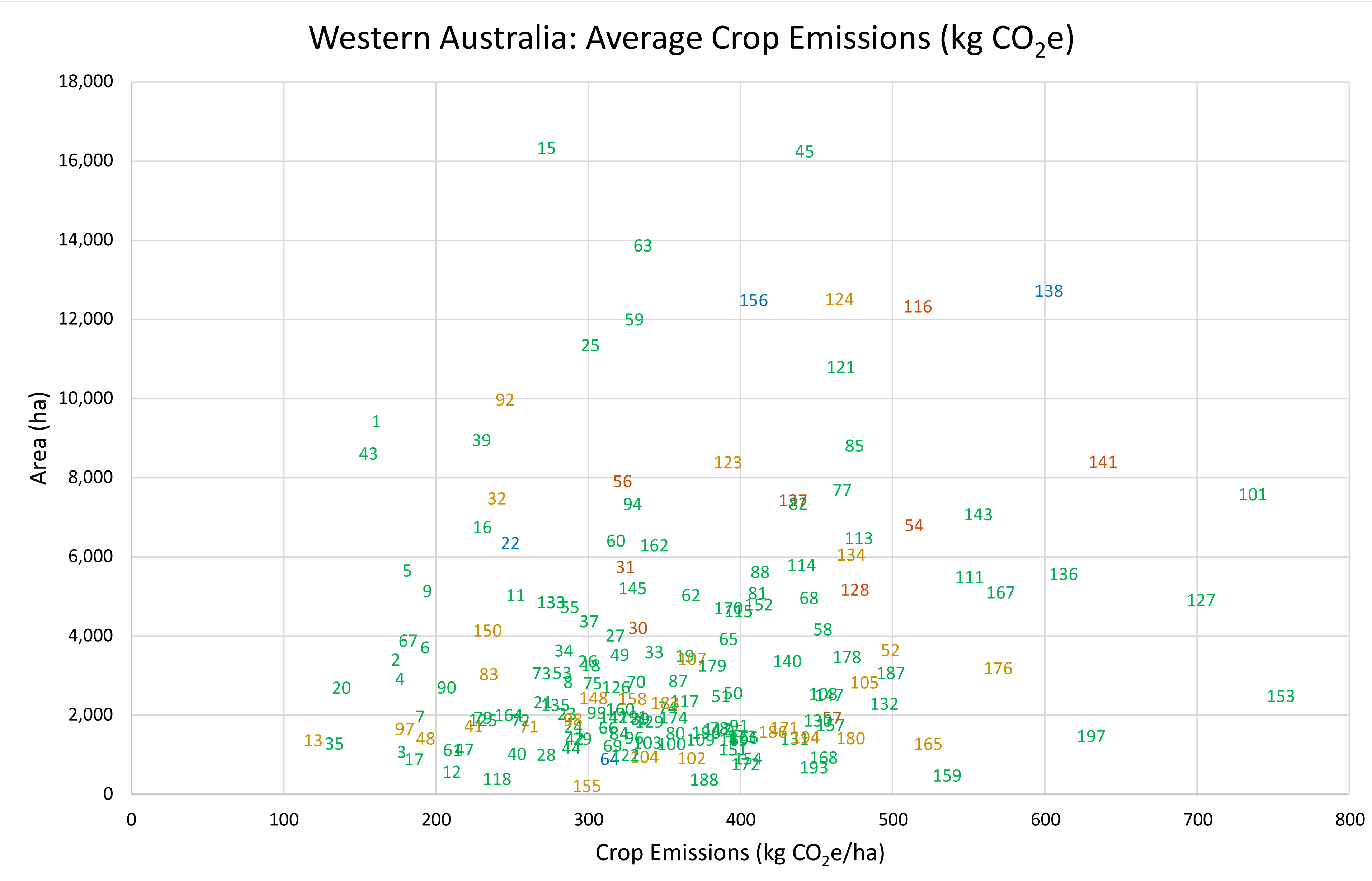
Western Australia: Average Crop Emissions (kg CO_2e)
Crop Emissions (kg CO_2e/t)
800
700
600
500
400
300
200
100
0
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
Crop Emissions (kg CO_2e/ha)


Western Australia: Average Crop Emissions (kg CO_2e)
Crop Emissions (kg CO_2e/t)
Crop Emissions (kg CO_2e/ha)
0
100
200
300
400
500
600
700
800
0
200
400
600
800
1000
1200
1400
1600
1800


Western Australia: Average Crop Emissions (kg CO2e)
Crop Emissions (kg CO2e/t)
Crop Emissions (kg CO2e/ha)
0
100
200
300
400
500
600
700
800
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800


Area v Average Crop Emissions (kg CO_2e/ha)
Area (ha)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
Crop Emissions (kg CO_2e/ha)


Western Australia: Average Crop Emissions (kg CO_2e)
Area (ha)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0
100
200
300
400
500
600
700
800
Crop Emissions (kg CO_2e/ha)


Western Australia: Average Crop Emissions (kg CO_2e)
Area (ha)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0
100
200
300
400
500
600
700
800
Crop Emissions (kg CO_2e/ha)

Aglytica Profit Series 2021: All WA Port Zones

Profit Series 2021		Low Rainfall			Medium Rainfall			High Rainfall			All Clients				
		Lower 25% 16 Clients	Average 64 Clients	Top 25% 16 Clients	Lower 25% 40 Clients	Average 159 Clients	Top 25% 40 Clients	Lower 25% 9 Clients	Average 37 Clients	Top 25% 10 Clients	Lower 25% 65 Clients	Average 260 Clients	Top 25% 65 Clients	0's	No.
Scope 1 -Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	1,442	2,628	4,139	2,047	2,869	3,905	2,186	3,706	4,825	1,934	2,924	3,672	N	191
Farm - CO2 tonnes of CO2 Equivalent	(t CO2e)	455	561	728	326	496	757	250	674	797	302	534	697	N	190
Farm -CH4 tonnes of CO2 Equivalent	(t CO2e)	375	276	198	603	511	340	784	834	632	604	500	288	N	191
Farm -N20 tonnes of CO2 Equivalent	(t CO2e)	685	1,811	3,213	1,118	1,866	2,807	1,152	2,197	3,395	1,034	1,897	2,686	N	191
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	1,024	2,369	3,945	1,374	2,319	3,580	1,346	2,772	4,088	1,264	2,390	3,386	N	190
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)	539	435	331	841	826	574	1,260	1,167	737	846	797	490	N	129
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	412	460	496	676	669	706	823	921	933	658	655	613	N	191
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	391	455	514	598	595	635	697	858	811	596	599	568	N	190
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	626	6,427	425	1,115	1,097	1,232	1,387	1,446	1,588	1,038	2,321	7,501	N	123
Scope 1 -Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	392	459	508	583	604	649	702	799	759	568	590	565	N	179
Malt Barley	(Kg CO2e /ha)	483	473	504	610	602	644	685	887	701	620	614	556	N	159
Feed Barley	(Kg CO2e /ha)	203	321	386		460	552		765	765	244	391	457	N	26
Lupins	(Kg CO2e /ha)	269	267	264	307	317	351	248	382	414	304	312	309	N	120
Canola	(Kg CO2e /ha)	431	487	533	661	657	694	767	904	953	645	655	626	N	126
Canola GM	(Kg CO2e /ha)	498	599	584	727	714	761	716	901	911	734	743	707	N	75
Oats	(Kg CO2e /ha)	527	480	502	628	647	628	659	812	836	635	653	503	N	78
Oaten Hay	(Kg CO2e /ha)		726	733	835	818	815	837	1,052	841	840	869	750	N	64
Sheep	(Kg CO2e /ha)	626	534	425	1,215	1,072	1,017	1,398	1,450	1,589	1,090	1,019	823	N	114
Cattle	(Kg CO2e /ha)		557		1,076	1,407	2,410	896	1,327	1,794	1,071	1,263	1,678	N	14
Scope 1 -Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	167	188	202	210	185	191	208	210	170	198	189	188	N	179
Malt Barley	(Kg CO2e /t)	178	180	196	211	190	177	245	221	166	210	192	176	N	159
Feed Barley	(Kg CO2e /t)	137	155	162		167	205		159	159	142	160	170	N	26
Lupins	(Kg CO2e /t)	160	148	146	167	160	160	158	194	199	166	160	152	N	120
Canola	(Kg CO2e /t)	378	351	308	399	373	392	430	418	400	394	374	350	N	126
Canola GM	(Kg CO2e /t)	452	370	353	433	373	373	353	414	400	414	383	377	N	75
Oats	(Kg CO2e /t)	187	166	191	239	203	167	420	309	226	263	218	162	N	78
Oaten Hay	(Kg CO2e /t)		97	109	128	125	125	159	150	155	133	130	125	N	64
Scope 1 -Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)	144	189	254	161	161	169	160	152	145	158	165	197	N	114
Cattle	(Kg CO2e /DSE)		148		158	184	265	175	198	210	161	183	210	N	14

Profit Series 2021		Low Rainfall			Medium Rainfall			High Rainfall			All Clients				
		Lower 25% 16 Clients	Average 64 Clients	Top 25% 16 Clients	Lower 25% 40 Clients	Average 159 Clients	Top 25% 40 Clients	Lower 25% 9 Clients	Average 37 Clients	Top 25% 10 Clients	Lower 25% 65 Clients	Average 260 Clients	Top 25% 65 Clients	0's	No.
Scope 2 -Greenhouse Gas Emissions	**2021**														
Scope 2 Crop Emissions	(t CO2e)	22	51	91	32	52	74	16	59	146	26	53	77	N	183
Scope 2 Livestock Emissions	(t CO2e)	3	2	4	5	5	3	6	6	3	5	4	2	N	101
Scope 2 Whole Farm	(t CO2e)	24	52	93	35	55	75	20	64	148	29	55	79	N	183
All Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	2,260	3,775	5,652	2,840	3,963	5,381	3,003	5,618	7,601	2,760	4,134	5,195	N	194
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	1,617	3,372	5,441	2,066	3,313	5,025	2,078	4,227	6,498	1,932	3,445	4,844	N	194
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)	965	681	362	1,055	1,069	786	1,387	1,830	1,103	1,104	1,105	672	N	121
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	640	684	695	954	924	923	1,216	1,343	1,514	956	924	860	N	194
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	575	663	728	858	852	910	1,085	1,244	1,212	869	860	822	N	194
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	894	695	451	1,552	1,363	1,148	1,564	2,065	3,439	1,382	1,333	1,248	N	116
All Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	732	857	948	1,079	1,098	1,182	1,377	1,509	1,504	1,069	1,085	1,044	N	179
Malt Barley	(Kg CO2e /ha)	914	886	969	1,094	1,092	1,162	1,382	1,608	1,344	1,123	1,120	1,020	N	159
Feed Barley	(Kg CO2e /ha)	482	705	812		886	1,085		1,535	1,535	573	806	933	N	26
Lupins	(Kg CO2e /ha)	766	672	631	778	821	910	1,080	1,056	971	830	809	767	N	120
Canola	(Kg CO2e /ha)	750	864	905	1,134	1,151	1,223	1,548	1,662	1,791	1,142	1,160	1,102	N	126
Canola GM	(Kg CO2e /ha)	942	1,111	1,094	1,330	1,307	1,385	1,395	1,661	1,639	1,380	1,365	1,284	N	75
Oats	(Kg CO2e /ha)	1,071	860	921	1,115	1,120	1,072	1,338	1,490	1,430	1,150	1,151	843	N	78
Oaten Hay	(Kg CO2e /ha)		1,029	1,163	1,354	1,316	1,334	1,523	1,745	1,457	1,384	1,403	1,213	N	64
Sheep	(Kg CO2e /ha)	894	662	451	1,564	1,361	1,195	1,576	2,045	3,454	1,378	1,322	1,246	N	114
Cattle	(Kg CO2e /ha)		851		1,118	1,636	3,104	950	1,777	1,874	1,374	1,559	2,132	N	13
All Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	306	350	379	388	337	348	407	397	337	371	347	349	N	179
Malt Barley	(Kg CO2e /t)	336	341	379	380	347	319	495	405	320	383	353	325	N	159
Feed Barley	(Kg CO2e /t)	336	365	367		326	405		318	318	333	348	367	N	26
Lupins	(Kg CO2e /t)	441	372	347	463	425	419	687	569	460	488	427	377	N	120
Canola	(Kg CO2e /t)	685	634	523	685	656	699	864	770	747	698	667	615	N	126
Canola GM	(Kg CO2e /t)	854	685	663	796	685	681	692	767	720	781	706	688	N	75
Oats	(Kg CO2e /t)	382	301	357	435	358	284	897	601	387	500	396	276	N	78
Oaten Hay	(Kg CO2e /t)		141	173	209	204	206	293	254	267	224	213	207	N	64
All Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)	197	222	265	206	201	196	180	201	270	199	206	241	N	114
Cattle	(Kg CO2e /DSE)		203		164	198	341	186	258	219	202	217	276	N	13

Profit Series 2021		Low Rainfall			Medium Rainfall			High Rainfall			All Clients				
		Lower 25% 1 Clients	Average 4 Clients	Top 25% 1 Clients	Lower 25% 5 Clients	Average 20 Clients	Top 25% 5 Clients	Lower 25% 2 Clients	Average 9 Clients	Top 25% 3 Clients	Lower 25% 8 Clients	Average 33 Clients	Top 25% 9 Clients	0's	No.
Scope 1 -Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	923	1,702	2,069	4,360	3,957	4,065	1,658	2,513	2,586	3,337	3,297	2,732	N	29
Farm - CO2 tonnes of CO2 Equivalent	(t CO2e)	143	273	304	770	689	608	153	353	461	562	551	485	N	29
Farm -CH4 tonnes of CO2 Equivalent	(t CO2e)	377	465	573	1,249	851	1,102	576	1,026	685	991	840	591	N	29
Farm -N20 tonnes of CO2 Equivalent	(t CO2e)	403	964	1,192	2,342	2,417	2,355	929	1,134	1,440	1,783	1,907	1,656	N	29
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	507	1,186	1,420	2,909	2,990	2,819	1,018	1,358	1,811	2,194	2,347	2,065	N	29
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)	415	516	649	1,935	1,243	1,246	640	1,156	775	1,372	1,102	666	N	25
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	699	529	517	616	764	853	802	969	976	661	781	710	N	29
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	542	437	407	546	643	684	715	970	894	573	693	606	N	29
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	1,084	939	1,248	890	1,438	1,643	1,270	1,437	1,602	1,005	1,358	1,406	N	25
Scope 1 -Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	600	469	408	599	676	689	790	878	937	631	690	618	N	28
Malt Barley	(Kg CO2e /ha)	567	432	412	612	675	726	748	1,003	965	627	712	572	N	27
Feed Barley	(Kg CO2e /ha)					555	555		765	765		660	660	N	<5
Lupins	(Kg CO2e /ha)	369	303		290	322	378	335	356	461	321	326	354	N	17
Canola	(Kg CO2e /ha)	640	523	395	582	704	739	759	966	992	629	739	693	N	22
Canola GM	(Kg CO2e /ha)				760	760		771	912	992	765	851	882	N	10
Oats	(Kg CO2e /ha)	600	600		621	652	641	660	991		625	739	727	N	15
Oaten Hay	(Kg CO2e /ha)				708	773	1,032	1,101	1,322	1,566	905	993	779	N	10
Sheep	(Kg CO2e /ha)	1,084	986	1,248	1,242	1,392	1,526	1,270	1,422	1,602	1,209	1,344	1,396	N	21
Cattle	(Kg CO2e /ha)				932	1,363	1,795		1,059		932	1,211		N	<5
Scope 1 -Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	181	170	169	195	190	174	178	217	229	190	193	175	N	28
Malt Barley	(Kg CO2e /t)	197	168	156	183	197	153	193	235	228	187	201	157	N	27
Feed Barley	(Kg CO2e /t)					210	210		159	159		185	185	N	<5
Lupins	(Kg CO2e /t)	135	144		196	158	142	112	147	154	160	153	150	N	17
Canola	(Kg CO2e /t)	326	335	376	379	371	324	407	447	426	374	383	333	N	22
Canola (GM)	(Kg CO2e /t)				424	382		392	433	424	408	412	355	N	10
Oats	(Kg CO2e /t)	202	202		251	183	140	357	297		262	215	166	N	15
Oaten Hay	(Kg CO2e /t)				103	121	111	110	144	138	106	130	123	N	10
Scope 1 -Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)	141	145	134	186	165	171	145	149	159	164	157	160	N	21
Cattle	(Kg CO2e /DSE)				161	192	223		168		161	180		N	<5

Profit Series 2021

Profit Series 2021		Low Rainfall Lower 25% 1 Clients	Low Rainfall Average 4 Clients	Low Rainfall Top 25% 1 Clients	Medium Rainfall Lower 25% 5 Clients	Medium Rainfall Average 20 Clients	Medium Rainfall Top 25% 5 Clients	High Rainfall Lower 25% 2 Clients	High Rainfall Average 9 Clients	High Rainfall Top 25% 3 Clients	All Clients Lower 25% 8 Clients	All Clients Average 33 Clients	All Clients Top 25% 9 Clients	0's	No.
Scope 2 -Greenhouse Gas Emissions	**2021**														
Scope 2 Crop Emissions	(t CO2e)	8	15	1	94	77	39	7	26	29	65	55	31	N	27
Scope 2 Livestock Emissions	(t CO2e)	3	1	0	16	7	6	1	7	4	9	6	3	N	21
Scope 2 Whole Farm	(t CO2e)	12	17	1	102	81	44	9	33	32	71	59	33	N	27
All Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	1,236	2,581	2,820	6,090	5,529	5,480	2,763	3,398	3,435	4,727	4,608	3,959	N	29
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	809	1,967	2,167	4,760	4,518	4,047	1,899	1,841	2,145	3,624	3,520	2,988	N	29
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)	427	614	653	2,662	1,518	1,791	864	1,557	1,291	1,654	1,373	1,092	N	23
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	948	761	704	934	1,051	1,082	1,434	1,404	1,358	1,019	1,096	985	N	29
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	878	723	622	974	963	926	1,334	1,293	1,107	1,018	1,009	830	N	29
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	1,115	1,010	1,256	1,225	1,715	1,847	1,714	2,825	4,502	1,320	1,972	2,812	N	22
All Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	1,142	918	784	1,216	1,255	1,224	1,706	1,581	1,526	1,285	1,277	1,093	N	28
Malt Barley	(Kg CO2e /ha)	1,108	866	788	1,241	1,268	1,264	1,663	1,717	1,477	1,289	1,308	993	N	27
Feed Barley	(Kg CO2e /ha)					1,143	1,143		1,535	1,535		1,339	1,339	N	<5
Lupins	(Kg CO2e /ha)	964	878		861	766	851	1,471	1,029	1,122	1,039	848	857	N	17
Canola	(Kg CO2e /ha)	1,175	1,006	771	1,191	1,304	1,293	1,705	1,714	1,574	1,291	1,357	1,195	N	22
Canola GM	(Kg CO2e /ha)				1,415	1,392		1,717	1,624	1,572	1,566	1,531	1,393	N	10
Oats	(Kg CO2e /ha)	1,139	1,139		1,290	1,178	1,057	1,570	1,765		1,316	1,332	1,169	N	15
Oaten Hay	(Kg CO2e /ha)				1,140	1,210	1,522	2,011	2,075	2,287	1,576	1,556	1,071	N	10
Sheep	(Kg CO2e /ha)	1,115	1,010	1,256	1,287	1,682	1,929	1,714	2,765	4,502	1,351	1,947	2,864	N	21
Cattle	(Kg CO2e /ha)				1,029	1,464	1,899		1,884		1,029	1,674		N	<5
All Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	345	331	325	396	355	308	385	388	370	386	359	311	N	28
Malt Barley	(Kg CO2e /t)	386	337	299	372	370	266	428	405	351	384	373	282	N	27
Feed Barley	(Kg CO2e /t)					433	433		318	318		376	376	N	<5
Lupins	(Kg CO2e /t)	353	433		648	410	312	490	472	374	535	428	376	N	17
Canola	(Kg CO2e /t)	599	647	733	785	694	564	915	803	673	774	712	582	N	22
Canola (GM)	(Kg CO2e /t)				790	698		872	781	664	831	748	550	N	10
Oats	(Kg CO2e /t)	383	383		528	340	228	848	561		563	402	266	N	15
Oaten Hay	(Kg CO2e /t)				165	191	161	201	234	201	183	208	169	N	10
All Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)	145	149	134	193	198	220	195	252	374	181	209	281	N	21
Cattle	(Kg CO2e /DSE)				177	207	236		278		177	242		N	<5

Profit Series 2021		Low Rainfall			Medium Rainfall			High Rainfall			All Clients				
		Lower 25% 1 Clients	Average 4 Clients	Top 25% 1 Clients	Lower 25% 9 Clients	Average 35 Clients	Top 25% 9 Clients	Lower 25% 3 Clients	Average 10 Clients	Top 25% 3 Clients	Lower 25% 12 Clients	Average 49 Clients	Top 25% 13 Clients	0's	No.
Scope 1 -Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	2,628	2,628		1,903	3,295	5,265	11,292	10,896		2,007	3,876	4,731	N	25
Farm - CO2 tonnes of CO2 Equivalent	(t CO2e)	201	201		257	496	831	2,471	1,945		249	600	699	N	25
Farm -CH4 tonnes of CO2 Equivalent	(t CO2e)	1,219	1,219		291	186	6	0	175		424	226	87	N	25
Farm -N20 tonnes of CO2 Equivalent	(t CO2e)	1,208	1,208		1,355	2,613	4,428	8,821	8,776		1,334	3,050	3,945	N	25
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	1,269	1,269		1,573	3,083	5,257	11,292	10,697		1,529	3,619	4,630	N	25
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)	1,360	1,360		496	466	19		399		668	535	203	N	12
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	693	693		442	609	780	887	847		478	631	862	N	25
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	628	628		438	552	558	887	847		465	579	583	N	25
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	768	768		517	615			786		567	648	786	N	10
Scope 1 -Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	559	559		469	568	533	930	797		482	586	514	N	25
Malt Barley	(Kg CO2e /ha)	658	658		467	569	563	994	994		494	591	488	N	23
Feed Barley	(Kg CO2e /ha)					459						459		N	<5
Lupins	(Kg CO2e /ha)				203	289	329	299	299		203	290	329	N	8
Canola	(Kg CO2e /ha)	593	593		455	601	606	863	904		478	629	688	N	22
Canola GM	(Kg CO2e /ha)				391	437	484	842	842		391	572	484	N	<5
Oats	(Kg CO2e /ha)					704	392					704	392	N	<5
Oaten Hay	(Kg CO2e /ha)				1,117	857	646				1,117	857	646	N	<5
Sheep	(Kg CO2e /ha)	768	768		470	663			786		529	689	786	N	9
Cattle	(Kg CO2e /ha)				920	920					920	920		N	<5
Scope 1 -Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	242	242		139	158	155	227	193		154	164	142	N	25
Malt Barley	(Kg CO2e /t)	151	151		133	155	143	192	192		135	156	136	N	23
Feed Barley	(Kg CO2e /t)					125						125		N	<5
Lupins	(Kg CO2e /t)				153	152	130	330	330		153	174	130	N	8
Canola	(Kg CO2e /t)	418	418		314	333	332	390	359		332	339	316	N	22
Canola GM	(Kg CO2e /t)				335	328	321	416	416		335	357	321	N	<5
Oats	(Kg CO2e /t)					191	124					191	124	N	<5
Oaten Hay	(Kg CO2e /t)				83	136	109				83	136	109	N	<5
Scope 1 -Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)	143	143		146	158			135		145	154	135	N	9
Cattle	(Kg CO2e /DSE)				214	214					214	214		N	<5

Profit Series 2021		Low Rainfall			Medium Rainfall			High Rainfall			All Clients				
		Lower 25% 1 Clients	Average 4 Clients	Top 25% 1 Clients	Lower 25% 9 Clients	Average 35 Clients	Top 25% 9 Clients	Lower 25% 3 Clients	Average 10 Clients	Top 25% 3 Clients	Lower 25% 12 Clients	Average 49 Clients	Top 25% 13 Clients	0's	No.
Scope 2 -Greenhouse Gas Emissions	**2021**														
Scope 2 Crop Emissions	(t CO2e)	13	13		66	92	164	264	371		57	112	197	N	24
Scope 2 Livestock Emissions	(t CO2e)	6	6		4	5			2		4	4	2	N	7
Scope 2 Whole Farm	(t CO2e)	19	19		68	93	164	264	372		60	113	198	N	24
All Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	5,778	5,778		2,367	4,065	6,123	17,943	17,736		2,854	5,227	6,884	N	25
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	1,301	1,301		2,028	3,763	6,123	17,943	17,525		1,924	4,765	6,779	N	25
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)	4,477	4,477		509	950			421		1,302	1,283	421	N	9
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	1,525	1,525		551	718	661	1,409	1,378		690	803	782	N	25
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	644	644		545	700	661	1,409	1,389		559	753	787	N	25
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	2,529	2,529		529	907			828		929	1,078	828	N	9
All Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	858	858		736	958	856	1,834	1,655		753	1,010	909	N	25
Malt Barley	(Kg CO2e /ha)	958	958		733	942	893	1,867	1,867		765	983	765	N	23
Feed Barley	(Kg CO2e /ha)					1,119						1,119		N	<5
Lupins	(Kg CO2e /ha)				359	643	906	1,017	1,017		359	690	906	N	8
Canola	(Kg CO2e /ha)	888	888		729	1,010	939	1,785	1,875		755	1,083	1,193	N	22
Canola GM	(Kg CO2e /ha)				723	802	881	1,747	1,747		723	1,117	881	N	<5
Oats	(Kg CO2e /ha)					1,161	645					1,161	645	N	<5
Oaten Hay	(Kg CO2e /ha)				1,365	1,298	1,012				1,365	1,298	1,012	N	<5
Sheep	(Kg CO2e /ha)	2,529	2,529		477	928			828		888	1,094	828	N	9
Cattle	(Kg CO2e /ha)													N	<5
All Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	371	371		219	268	252	448	399		241	283	250	N	25
Malt Barley	(Kg CO2e /t)	220	220		208	259	230	361	361		210	262	217	N	23
Feed Barley	(Kg CO2e /t)					305						305		N	<5
Lupins	(Kg CO2e /t)				278	318	357	1,119	1,119		278	419	357	N	8
Canola	(Kg CO2e /t)	626	626		501	557	519	807	745		522	577	526	N	22
Canola GM	(Kg CO2e /t)				620	602	584	863	863		620	689	584	N	<5
Oats	(Kg CO2e /t)					321	204					321	204	N	<5
Oaten Hay	(Kg CO2e /t)				101	215	170				101	215	170	N	<5
All Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)	470	470		148	232			143		212	248	143	N	9
Cattle	(Kg CO2e /DSE)													N	<5

Aglytica Profit Series 2021: Geraldton Port Zone

Profit Series 2021		Low Rainfall			Medium Rainfall			High Rainfall			All Clients			0's	No.
		Lower 25% 1 Clients	Average 4 Clients	Top 25% 1 Clients	Lower 25% 1 Clients	Average 5 Clients	Top 25% 2 Clients	Lower 25% ? Clients	Average ? Clients	Top 25% ? Clients	Lower 25% 2 Clients	Average 9 Clients	Top 25% 3 Clients		
Scope 1 -Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	3,085	3,464	3,712	931	5,120	6,437				2,231	4,384	5,529	N	9
Farm - CO2 tonnes of CO2 Equivalent	(t CO2e)	833	1,046	836	92	1,205	1,306				301	1,134	1,150	N	9
Farm -CH4 tonnes of CO2 Equivalent	(t CO2e)	0	313	844	374	331	300				528	323	481	N	9
Farm -N20 tonnes of CO2 Equivalent	(t CO2e)	2,252	2,106	2,032	465	3,583	4,830				1,401	2,926	3,897	N	9
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	3,085	3,104	2,740	516	4,880	6,437				1,631	4,090	5,204	N	9
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)		481	972	414	600					600	529	972	N	5
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	533	465	396	319	580	623				446	529	548	N	9
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	536	487	403	267	564	630				399	530	554	N	9
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)		505	378	421	611					611	548	378	N	5
Scope 1 -Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	553	552	435	304	630	656				445	595	582	N	9
Malt Barley	(Kg CO2e /ha)	684	554	425	325	396					396	475	425	N	<5
Feed Barley	(Kg CO2e /ha)		253									253		N	<5
Lupins	(Kg CO2e /ha)	372	343	284	151	267	316				219	300	305	N	7
Canola	(Kg CO2e /ha)	569	466	363		644	644					525	504	N	<5
Canola GM	(Kg CO2e /ha)	567	629		348	703	747				483	682	747	N	7
Oats	(Kg CO2e /ha)		293	293	308	308					308	301	293	N	<5
Oaten Hay	(Kg CO2e /ha)		620	620								620	620	N	<5
Sheep	(Kg CO2e /ha)		501	378	421	566					566	527	378	N	5
Cattle	(Kg CO2e /ha)		284			1,828					1,828	1,056		N	<5
Scope 1 -Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	214	213	145	186	202	188				179	207	174	N	9
Malt Barley	(Kg CO2e /t)	153	148	143	152	254					254	201	143	N	<5
Feed Barley	(Kg CO2e /t)		126									126		N	<5
Lupins	(Kg CO2e /t)	158	165	162	177	155	148				162	159	153	N	7
Canola	(Kg CO2e /t)	409	330	251		430	430					363	340	N	<5
Canola (GM)	(Kg CO2e /t)	413	409		294	372	333				308	383	333	N	7
Oats	(Kg CO2e /t)		121	121	200	200					200	160	121	N	<5
Oaten Hay	(Kg CO2e /t)		100	100								100	100	N	<5
Scope 1 -Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)		186	143	116	127					127	163	143	N	5
Cattle	(Kg CO2e /DSE)		139			139					139	139		N	<5

Profit Series 2021		Low Rainfall			Medium Rainfall			High Rainfall			All Clients			0's	No.
		Lower 25% 1 Clients	Average 4 Clients	Top 25% 1 Clients	Lower 25% 1 Clients	Average 5 Clients	Top 25% 2 Clients	Lower 25% ? Clients	Average ? Clients	Top 25% ? Clients	Lower 25% 2 Clients	Average 9 Clients	Top 25% 3 Clients		
Scope 2 -Greenhouse Gas Emissions	**2021**														
Scope 2 Crop Emissions	(t CO2e)		44	20		160	221				119	111	154	N	7
Scope 2 Livestock Emissions	(t CO2e)		1	1		4					4	1	1	N	<5
Scope 2 Whole Farm	(t CO2e)		45	21		161	221				123	111	154	N	7
All Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	3,722	4,864	5,088	1,585	8,085	10,294				3,692	6,653	8,559	N	9
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	3,722	4,472	3,996	1,166	7,839	10,294				3,077	6,342	8,195	N	9
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)		522	1,092	419	615					615	559	1,092	N	5
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	646	665	543	543	925	988				749	809	839	N	9
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	646	693	587	603	938	988				783	829	854	N	9
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)		522	425	425	627					627	564	425	N	5
All Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	886	948	747	735	1,257	1,256				983	1,119	1,086	N	9
Malt Barley	(Kg CO2e /ha)	1,049	898	748	756	923					923	911	748	N	<5
Feed Barley	(Kg CO2e /ha)		593									593		N	<5
Lupins	(Kg CO2e /ha)	533	676	621	746	903	912				894	806	815	N	7
Canola	(Kg CO2e /ha)	902	759	617		1,309	1,309					942	963	N	<5
Canola GM	(Kg CO2e /ha)	900	1,129		772	1,338	1,337				1,010	1,278	1,337	N	7
Oats	(Kg CO2e /ha)		503	503	740	740					740	621	503	N	<5
Oaten Hay	(Kg CO2e /ha)		930	930								930	930	N	<5
Sheep	(Kg CO2e /ha)		517	425	425	577					577	541	425	N	5
Cattle	(Kg CO2e /ha)		285			1,979					1,979	1,132		N	<5
All Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	343	362	249	449	411	360				405	389	323	N	9
Malt Barley	(Kg CO2e /t)	236	243	251	353	593					593	418	251	N	<5
Feed Barley	(Kg CO2e /t)		295									295		N	<5
Lupins	(Kg CO2e /t)	227	330	354	872	565	428				703	464	403	N	7
Canola	(Kg CO2e /t)	649	538	427		873	873					649	650	N	<5
Canola (GM)	(Kg CO2e /t)	656	725		652	719	599				651	721	599	N	7
Oats	(Kg CO2e /t)		208	208	479	479					479	344	208	N	<5
Oaten Hay	(Kg CO2e /t)		151	151								151	151	N	<5
All Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)		193	160	118	129					129	167	160	N	5
Cattle	(Kg CO2e /DSE)		139			150					150	145		N	<5

Aglytica Profit Series 2021: Kwinana Port Zone

Profit Series 2021		Low Rainfall			Medium Rainfall			High Rainfall			All Clients				
		Lower 25% 13 Clients	Average 52 Clients	Top 25% 13 Clients	Lower 25% 25 Clients	Average 99 Clients	Top 25% 25 Clients	Lower 25% 5 Clients	Average 18 Clients	Top 25% 5 Clients	Lower 25% 42 Clients	Average 169 Clients	Top 25% 43 Clients	0's	No.
Scope 1 -Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	1,414	2,638	4,091	1,793	2,354	3,216	2,195	3,329	3,118	1,796	2,551	3,363	N	128
Farm - CO2 tonnes of CO2 Equivalent	(t CO2e)	553	549	703	284	405	590	275	656	752	290	475	593	N	127
Farm -CH4 tonnes of CO2 Equivalent	(t CO2e)	323	221	198	523	535	333	685	833	743	511	489	250	N	128
Farm -N20 tonnes of CO2 Equivalent	(t CO2e)	637	1,894	3,190	986	1,419	2,292	1,236	1,840	1,624	995	1,597	2,521	N	128
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	1,059	2,457	3,879	1,221	1,785	2,902	1,491	2,401	2,265	1,241	2,037	3,116	N	127
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)	423	363	318	668	793	523	1,408	1,237	853	748	761	425	N	87
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	366	444	460	690	670	650	821	909	894	688	640	565	N	128
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	356	448	480	626	598	630	718	811	777	612	586	551	N	127
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	526	8,815	412	1,175	1,098	996	1,534	1,512	1,513	1,166	2,919	809	N	83
Scope 1 -Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	362	444	471	610	595	645	708	760	590	597	567	548	N	117
Malt Barley	(Kg CO2e /ha)	461	465	492	625	600	650	706	825	705	630	600	572	N	105
Feed Barley	(Kg CO2e /ha)	203	326	391		448	530				256	370	429	N	22
Lupins	(Kg CO2e /ha)	253	252	248	315	324	347	224	406	451	322	312	297	N	88
Canola	(Kg CO2e /ha)	386	480	487	713	667	715	771	875	918	676	644	612	N	79
Canola GM	(Kg CO2e /ha)	498	593	556	770	727	737	697	900	904	767	741	671	N	55
Oats	(Kg CO2e /ha)	503	486	502	631	650	638	661	747	781	635	640	552	N	58
Oaten Hay	(Kg CO2e /ha)		779	733	845	821	822	815	954	914	841	849	776	N	49
Sheep	(Kg CO2e /ha)	526	446	412	1,248	1,079	799	1,534	1,537	1,514	1,223	1,001	724	N	79
Cattle	(Kg CO2e /ha)		830		921	1,446	2,410		1,596	1,794	1,124	1,401	2,102	N	7
Scope 1 -Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	161	186	202	223	192	198	228	209	151	216	192	195	N	117
Malt Barley	(Kg CO2e /t)	185	187	192	217	197	190	316	216	191	228	197	187	N	105
Feed Barley	(Kg CO2e /t)	137	157	147		166	185				157	161	169	N	22
Lupins	(Kg CO2e /t)	164	146	137	166	161	160	184	201	210	169	161	150	N	88
Canola	(Kg CO2e /t)	405	352	299	423	389	428	442	416	440	413	382	349	N	79
Canola GM	(Kg CO2e /t)	452	362	368	451	375	360	384	404	432	441	379	371	N	55
Oats	(Kg CO2e /t)	182	167	191	233	209	177	532	314	215	282	222	178	N	58
Oaten Hay	(Kg CO2e /t)		95	109	126	125	122	190	152	154	138	130	139	N	49
Scope 1 -Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)	145	200	269	163	162	166	168	155	149	160	169	205	N	79
Cattle	(Kg CO2e /DSE)		157		164	184	265		228	210	157	193	237	N	7

Profit Series 2021		Low Rainfall			Medium Rainfall			High Rainfall			All Clients				
		Lower 25% 13 Clients	Average 52 Clients	Top 25% 13 Clients	Lower 25% 25 Clients	Average 99 Clients	Top 25% 25 Clients	Lower 25% 5 Clients	Average 18 Clients	Top 25% 5 Clients	Lower 25% 42 Clients	Average 169 Clients	Top 25% 43 Clients	0's	No.
Scope 2 -Greenhouse Gas Emissions	**2021**														
Scope 2 Crop Emissions	(t CO2e)	27	57	94	22	30	44	11	35	27	20	38	60	N	125
Scope 2 Livestock Emissions	(t CO2e)	3	3	3	3	4	2	5	7	8	4	4	2	N	69
Scope 2 Whole Farm	(t CO2e)	28	58	96	24	33	44	13	38	32	23	40	61	N	125
All Greenhouse Gas Emissions for Whole Business	**2021**														
Farm - All Gases tonnes of CO2 Equivalent	(t CO2e)	2,119	3,730	5,474	2,503	3,325	4,551	2,966	5,075	4,265	2,526	3,647	4,604	N	131
Crop - All Gases tonnes of CO2 Equivalent	(t CO2e)	1,806	3,466	5,243	1,765	2,636	4,231	2,213	3,609	3,361	1,850	2,977	4,340	N	131
Livestock- All Gases tonnes of CO2 Equivalent	(t CO2e)	470	512	346	911	1,002	561	1,506	2,132	1,129	952	1,045	469	N	84
Farm - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	548	653	633	967	952	923	1,181	1,312	1,281	977	916	812	N	131
Crop - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	566	653	666	872	864	933	1,060	1,205	1,133	866	849	802	N	131
Livestock - Kg of CO2 Equivalent per ha	(Kg CO2e /ha)	585	561	433	1,692	1,371	866	1,632	1,657	1,560	1,573	1,235	798	N	80
All Greenhouse Gas Emissions per Hectare	**2021**														
Wheat	(Kg CO2e /ha)	710	840	875	1,101	1,090	1,198	1,354	1,450	1,160	1,103	1,052	1,020	N	117
Malt Barley	(Kg CO2e /ha)	968	886	946	1,102	1,100	1,210	1,371	1,537	1,325	1,113	1,109	1,068	N	105
Feed Barley	(Kg CO2e /ha)	482	713	791		824	1,042				638	753	881	N	22
Lupins	(Kg CO2e /ha)	733	646	571	812	848	898	944	1,073	1,068	835	813	732	N	88
Canola	(Kg CO2e /ha)	707	853	806	1,178	1,159	1,306	1,469	1,599	1,656	1,155	1,135	1,061	N	79
Canola GM	(Kg CO2e /ha)	942	1,108	1,064	1,389	1,323	1,327	1,315	1,672	1,648	1,415	1,360	1,223	N	55
Oats	(Kg CO2e /ha)	1,048	867	921	1,089	1,111	1,130	1,307	1,389	1,381	1,116	1,122	947	N	58
Oaten Hay	(Kg CO2e /ha)		1,078	1,163	1,371	1,335	1,354	1,465	1,626	1,552	1,383	1,390	1,329	N	49
Sheep	(Kg CO2e /ha)	585	517	433	1,698	1,382	858	1,632	1,662	1,576	1,579	1,231	793	N	79
Cattle	(Kg CO2e /ha)		1,417		927	1,637	3,104		1,671	1,874	1,148	1,615	2,489	N	7
All Greenhouse Gas Emissions per tonne	**2021**														
Wheat	(Kg CO2e /t)	308	350	378	400	350	366	439	401	297	397	355	363	N	117
Malt Barley	(Kg CO2e /t)	381	357	372	384	361	350	627	408	359	407	366	349	N	105
Feed Barley	(Kg CO2e /t)	336	370	318		316	363				390	350	366	N	22
Lupins	(Kg CO2e /t)	455	369	312	448	431	418	775	549	493	467	425	371	N	88
Canola	(Kg CO2e /t)	772	641	497	694	680	789	839	759	792	705	680	605	N	79
Canola GM	(Kg CO2e /t)	854	677	700	814	684	649	724	752	785	814	697	678	N	55
Oats	(Kg CO2e /t)	381	303	357	413	362	313	1,121	615	380	524	400	312	N	58
Oaten Hay	(Kg CO2e /t)		136	173	207	205	204	349	262	261	230	215	240	N	49
All Greenhouse Gas Emissions per DSE	**2021**														
Sheep	(Kg CO2e /DSE)	161	226	277	221	201	179	179	171	155	206	203	224	N	79
Cattle	(Kg CO2e /DSE)		268		165	205	341		239	219	160	224	280	N	7

Next Steps

In early 2022, Farmanco was the recipient of a grant from the SW WA Drought Resilience Adoption and Innovation Hub to develop the analyser platform from enterprise level to paddock level benchmarking. This program extension applies to the emission and financial benchmarking, assisting growers to make better decisions through advanced knowledge of their natural capital, financial and production information. This project will be integrating the platform with third party tools (such as MyJohnDeere and Agworld), allowing users to have easy access to the most common carbon calculator, in an online platform. This will allow them to benchmark their emissions, by enterprise and paddock. With this data, they will be able to compare their business against their peers and identify potential actions they might take to reduce emissions and the relative costs and difficulties in doing this.

Within this extended Platform, the calculation and benchmarking of GHG emissions at a Paddock level will enable growers to create a pathway of measurements and best practise Key Performance Indicators (KPI) against authorised GAF method. These indicators will be presented as a series of raw data measures combined with tables, charts and graphs to provide ease of interpretation of not only carbon measurements on a comparative basis, but also what best practise looks like with carbon measures compared against financial, production and machinery use.

As with the existing Profit Series, each contributing farm business will receive their individual ranking against the complete data set. This ranking will allow a grower to compare their results against their peers within each KPI to understand where there are adjustments, and improvements that can be made to their business to enhance financial, productivity and a reduction in Green House Gas (GHG) emissions. There will also be the capability to produce generic data outputs that can be used to distribute outcomes and results of the Benchmarked results to a wider audience throughout the tenure of the project.

The development and deployment of easily measured carbon outputs at a granular paddock level, marked against a large database of similar businesses will provide insight into individual producers' relative performance. The highly granular level of the KPIs will allow focus on a grower's operation toward significantly lowering their carbon footprint relative to their financial performance, productivity, and efficiency.

The same measures will also then afford the opportunity to apply best practise as derived through the full dataset in terms of improvement in efficiency and productivity, moving producers away from a formulaic approach toward decisions and practices born of data-based reasoning.

The focus on carbon outputs and measurements, overlayed with farm performance, will lead to significant opportunities to change the manner in which success is measured, leading to insights that will have the opportunity to greatly increase profitability and sustainability to those utilising the tools developed. Further use and application of the paddock level intelligence at hand will significantly benefit growers in terms of their rates of application of fertiliser, utilisation of optimised seed variants, crop rotations and mixed farming decisions to maximise profitability, while minimising their GHG footprint.

Should you wish to learn more about Aglytica, as well as undertake a Carbon Audit for your business please visit:

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