PRECISION FARMING FROM ABOVE

How Commercial Drone Systems are Helping Farmers Improve Crop Management, Increase Crop Yields and Create More Profitable Farms.

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WRITING MATTERS PUBLISHING

Precision Farming From Above: How Commercial Drone Systems are Helping Farmers Improve Crop Management, Increase Crop Yields and Create More Profitable Farms.

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It does not replace the advice of professional commercial drone surveying operators and other professionals in the agriculture sector. The reader is advised to seek professional advice before implementing any of the insights they might gain from reading this book or before undertaking any of the described activities using drones.

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Note to Readers

For Readers in South Africa

Please note, at the time of printing, we are finalising our drone operating licensing and permits with the South African Civil Aviation Authority (SACAA).

Louise is already a licensed drone *pilot* with over 300 flying hours. She was one of the first women to obtain her pilot license from the *South African Civil Aviation Authority* in 2016.

Terreco Aviation's intention is to be the premier provider of *commercial drone* surveys in South Africa. We will commence providing a full range of drone services once we have completed the licensing process in 2019.

For reasons outlined in the book, you should only deal with licensed pilots and service providers.

For Readers Outside South Africa

We can now, however, quote and provide our services in jurisdictions *outside* South Africa.

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The reader is advised to seek professional advice before implementing any of the insights they might gain

from reading this book or before undertaking any of the described activities using drones.

For reasons outlined in this book, you are cautioned against using unlicensed, amateur service providers using *recreational drones*.

Be advised that you may be held as liable as the operator in the event that you have breached civil aviation laws, public safety or both.

Wherever you are based, note that infringing airspace laws carry stiff penalties for justifiably good reasons.

At a Glance

Extensive Review

Precision Farming from Above is the result of an extensive review of books, reports, webinars and websites produced by international leaders, software developers and manufacturers within the drone industry as it relates to *commercial drone* aerial surveys, *precision farming* and agribusiness development, as distinct from *recreational drones* used by the general public.

The term *drone* is inclusive of *unmanned aerial vehicles* (UAVs), *unmanned aerial systems* (UAS), *remotely piloted aircraft* (RPA), *remotely piloted aircraft systems* (RPAS) and *remotely piloted vehicles* (RPV).

The book explores the use of sophisticated pilot-operated, *commercial drone surveying systems* as applied to agriculture.

It includes:

- Drone technology - recreational vs commercial
- Aerial surveys for agribusinesses
- High resolution cameras
- GPS guided flight programming software
- Data analysis
- Application

Importantly, I will include:

- Pilot licensing
- Civil aviation regulations
- Compliance

I especially want farmers – globally - to understand the enormous benefits *commercial drone surveying systems* offer to their businesses as it relates to *precision farming,* productivity gains and more sustainable land and crop management.

Precision Farming from Above explains how this is achieved through the fundamental combination of:

- The versatility and manoeuvrability of the aircraft that carry the cameras;
- The variety and sophistication of cameras carried by the drones;
- The programmable flight planning software for accurate surveying and photography;
- The analytical power of the online software platforms;
- The comparatively rapid conversion of processed information into actions for farmers to apply.

The book also explains the massive advantages in turnaround time for this range of high-quality information to be converted into actionable data for farmers. This can be anything from minutes to 48 hours, and into a variety of compatible formats.

This high-tech, precision farming approach means farmers have a near real-time understanding about the state of their farms and are therefore more able to make more informed, proactive and effective decisions on their current and future activities.

They are also able accurately to operate on a *plant-by-plant* basis because of the resolution of the data, rather than the traditional *field-by-field* basis. This translates into achieving more efficient and sustainable operations, with the many benefits to time, budgets and management strategies this offers.

Who Should Read this Book?

Precision Farming from Above is specifically aimed at progressive farmers who have medium to large-sized operations that they may own or operate as individuals or as part of cooperatives.

In any case, *Precision Farming from Above* is relevant to any farmer anywhere in the world who is looking to improve land management, increase crop yields and operate a more profitable and environmentally sustainable agribusiness.

In this book, the term *farmer* is inclusive of anyone growing crops for commercial reasons.

Three Predictable Problems

While farmers face many problems, their productivity and profitability is consistently disadvantaged by three recurring and predictable factors:

- The quality of information they have about the state of their crops, soils or structures.
- Being tied to mundane time-consuming tasks.
- Inefficient management strategies.

Commercial drone surveying, high grade data and the smarter, precision farming they introduce are providing solutions to these issues.

References and Glossary or Terms

Readers will find an extensive list of references and a glossary of terms used at the back of this book.

About the Author

Louise Jupp has a Master's Degree in Environmental Science.

She has over 26 years' experience in environmental management in the UK, Europe and Western, Central and Southern Africa.

She co-founded *Terreco Aviation (Pty) Ltd* with her business partner in 2016.

Her goal is to help farmers and growers world-wide achieve more profitability and financial security in their agri-business operations, and to do so in an innately more sustainable way.

Louise is a licensed drone pilot with over 300 flying hours. She was one of the first women to obtain her license from the *South African Civil Aviation Authority* in 2016.

Overview:
Precision Farming From Above

Introduction

I have friends who are farmers in South Africa. Most have been farming for several generations. They are passionate about their families, their farms and their livelihoods.

However, I worry about the future of farming, and their future.

Farming is increasingly more demanding and stressful. Many factors that are associated with growing good quality crops and generating secure incomes, are unpredictable.

Too many things can go wrong, or are beyond their direct control, such as droughts, freak weather conditions, or a weakening currency.

A good harvest can be as much a product of luck as good planning and management. And yet, a strong national agricultural base is essential for all developed and developing countries.

Farming Predictions

Many nations are currently producing enough food to feed their populations. But studies predict global agricultural production must substantially increase to respond to the expected global population growth.

A *PwC* report (2016) states global *'aggregate agricultural consumption will increase by 69% from 2010 to 2050. This increase will be mostly stimulated by population growth from 7 billion to 9 billion by 2050.'* [1]

The predicted populations of the Middle East and Africa are expected to be 3.4 billion alone. This is *'likely to be more than the populations of China and India combined.'* [2]

Specific to South Africa, a *World Wide Fund for Nature* (WWF) report predicts food production or imports will need to *'more than double'* if it is to feed a population that is expected to increase from 49 million in 2009 to 82 million by 2035. [3]

Farming Is a Business

Farmers know they play a critical role in feeding a nation, driving trade, contributing to the gross national product, providing employment and supporting the industrial growth of nations.

But the reality is: *farming is a business.*

Farmers world-wide must still generate a steady income to provide for their families, pay employees and maintain a profitable successful business.

And most want to pass a successful family business on to the next generation and continue a proud lineage that typically already goes back several generations.

All of this takes place within the global reality of a wide range of factors, including: changing weather patterns; changing global markets and financial drivers;

more environmentally aware consumers; and a growing need to utilise natural resources more conservatively, to name but a few.

Under these circumstances, farmers are looking for anything that will give them the *edge* to maximise their yields, maximise their financial returns and maintain a stable business from one year to the next.

Such an *edge* would help farmers reduce their vulnerabilities to the vagaries and uncertainties that are inherent to food production processes.

Superior Knowledge Gives You The Edge

Some farmers are already responding to these factors and achieving the *edge* they want.

The most successful ones are adopting more effective farming methods that enable them to compete more successfully with greater economic certainty and purchasing power.

Specifically, they have achieved this *edge* because they have *superior information about their farms*, and, as a consequence, they have better management strategies in place to enable them to be more productive.

Importantly, they are better placed to increase their yields and to do so in a sustainable and predictable way.

However, this is *not* the norm.

I See The Opposite

I see farmers who struggle from one season to the next, often due to no fault of their own, but because they are vulnerable to factors currently viewed as outside their immediate control.

They are vulnerable because they don't have enough high-grade information about their farms.

They spend valuable time on mundane activities. And they have no truly dependable strategy for the oncoming season.

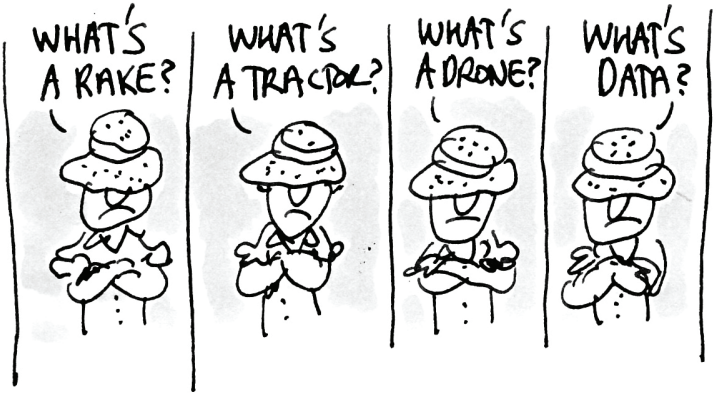
The reality for many farmers is that they carry a growing debt burden and the real risk of bankruptcy if their harvest does not meet expectations.

But there is hope.

Precision Farming

The same major analytical reports describing the need for global agriculture sectors to rise to the challenge of feeding an expanding population also conclude that farming practices are radically changing.

Commercial farmers are already embracing *smart* or *precision* agriculture in order to become more efficient, more productive and more sustainable.



The key to smarter agriculture is having more and better quality information about the farm.

There are already a variety of *smart* farming techniques and technological innovations available to farmers including *smart* tractors, combine harvesters and chemical delivery systems.

I see that *commercial drone surveys* are increasingly a key part of the solution and a method for bringing the benefits of *precision agriculture* to a greater number of farmers.

Aerial surveys using sophisticated pilot-operated, commercial drones, high-end software and detailed analytics are fast becoming an essential tool in the farmer's toolbox.

They are as fundamental as a tractor.

Commercial Drone Surveys

Drone surveys give impeccable high-resolution detail that surpasses what is available via traditional fixed wing or helicopter surveys.

In most cases this information is immediate, safer to obtain and significantly more affordable and versatile.

Around the world, access to *smart farming* techniques through professional drone surveying is giving farmers real, powerful and immediate opportunities to gain control over the unpredictable, to improve their circumstances and to achieve their goals.

To paraphrase the analysts, drone surveys are increasingly part of modern farming because they are transforming a traditionally data poor industry into one where farmers can, for the first time, make informed crop management decisions based on real-time data. [4]

Agriculture world-wide is *already* benefiting from professional drone surveying. For example, *'drought assessment, plant stress monitoring, crop health monitoring, yield monitoring and field surveying before planting.'*

More farmers are starting to realise the potential value of professional drone surveys in providing rapid, high quality intelligence.

Recreational vs Commercial Drones

Drones have military origins, but civilian uses are now far outstripping their military applications.

Be clear, I am *not* talking about small light weight, *recreational drones* that show up in the toy or electronics section of a department store. The demand for and ease with which *toy drones* can be purchased and used by all ages compared to just five years ago is staggering.

Drone suppliers would have you believe that anyone can purchase a drone and expect to fly it as soon as they've finished reading the *Quick Start How-To Guide!*

However, the major drone manufacturers, such as *DJI*, are moving away from the recreational market and have created industry-specific *commercial drones* and accessory bundles in recognition of the enormous commercial value and applications of their products.

I am talking about sophisticated, commercial, industry-standard drone systems that can only be operated by properly trained, qualified and licensed pilots who must comply with civil aviation requirements.

Furthermore, the information collected via specialist cameras and processed using proprietary software must be analysed and interpreted to maximise the full value of the data for agricultural applications. In other words, the full value of a commercial drone system is not attributed to just the drone or the camera or software but to the integrated system comprising all these features.

There is more value beyond the usual perception that drones are just for taking nice aerial photographs of farms.

Commercial Drones

Commercial drones, in their dominant multi-rotor configurations, typically quadcopter, are largely the result of a convergence of technological advances, including those associated with electric motors, GPS, batteries and smartphones. This led to the initial development of drones which were lighter, easier to control and manoeuvre in flight, and able to carry high-grade cameras that provide real-time data flow.

Operating software for the more sophisticated models (e.g., the *DJI Phantom 4 Pro* series) includes flight management, obstacle avoidance, autonomous flying and fail-safe features that reduce the inherent risk of crashing.

Tablets or smartphones can be used to fly the drones, providing a heads-up display for the pilot with a traditional radio controller.

Data, in the form of photographs and videos, are stored on board the drone using microSD cards. Alternatively, you can *live-stream* footage directly to other devices.

Toys or Tools?

Perhaps you have seen small drones hovering above neighbouring properties, buzzing about at local events, gliding through picturesque areas, or even zipping through obstacles at breakneck speed in televised drone races.

Alternatively, you might have seen quirky news stories about pizzas being delivered by drones, or *Amazon* considering the delivery of their parcels by fleets of drones.

You should know that in most countries, as soon as a drone is used for a *commercial application*, *it is no longer deemed a toy*, and it comes under stringent aviation laws.

This is especially so in South Africa.

While some farmers have realised the potential drones offer to their business, there is a pervading perception that drones are a gimmick, a *toy* used for playful hijinks, taking nice photos or videos and even for spying on neighbours! (Which, by the way, is highly illegal.)

I frequently hear such comments from farmers when we display our drone services.

This is an unfortunate perception that prevents farmers from benefiting from the true potential of commercially applied drones. They are *tools.* More than that they are management tools.

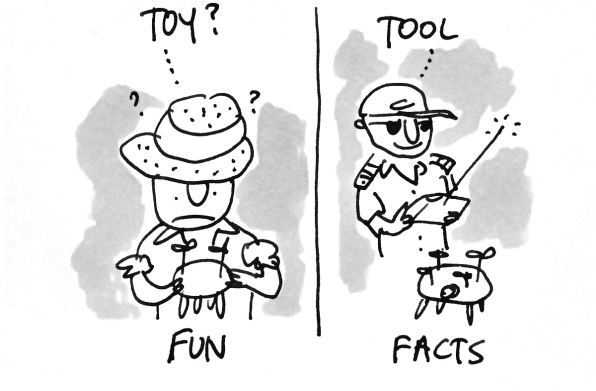
Commercial drone surveying is a professional service utilising sophisticated equipment and software and reliant on a trained and experienced, *and licensed,* team.

If you're only seeing the value of drones from the recreational perspective of drone racing or just taking pretty pictures, then you're seriously missing a significantly bigger picture.

Worse, you're missing out on the immense benefits commercial drone surveying offers to your farming business.

This is one reason why I have written this book.

I want to break the myth that drones are just *toys.*



I want to make clear distinctions between *recreational drones (toys)* - and *commercial drones (tools)* and in doing so, explain how *commercial drone system*s can be applied to great advantage for modern agriculture.

I am referring to the use of high tech, highly sophisticated *commercial drones* – technically *aircraft* - that are subject to the stringent rules and regulations set and managed by international and national civil aviation authorities.

The *same* rules and regulations that typically:

- Consider drones a category of *aircraft;*
- Define commercial and private (or recreational) uses of drones;
- Require drone operating companies to comply with the *same* requirements as manned aviation operators;
- Describe the manner in which commercial drone operations may be safely carried out in defined airspace by *licensed* commercial operators;
- Require operators to be regularly audited for performance and compliance;
- Require full insurance cover to operate;
- Require drone pilots to obtain a *Remote Pilot's License* from approved training schools after completing a theory examination and flying test.

All of the above are certainly true of the South African and European requirements.

Licensed Drone Pilots

In South Africa, commercial drone companies or operators and their pilots are legally held accountable for their activities to the *same* extent as manned aviation operators and pilots.

For example, a licensed drone pilot, such as myself, will suffer the same consequences as a commercial manned aviation pilot if found to have had an alcoholic drink eight hours before flying!

We are also legally required to operate safely and provide clients with a professional service.

In short, there is a world of difference between responsibility and accountability for commercial drone *pilots* (and operators) compared to recreational pilots and hobbyist drone users.

Thankfully, this perception about drones as toys is rapidly changing.

The value of *commercial drone* services across many commercial sectors is being explored, recognised, developed and exploited – and, I emphasise, including *agriculture*.

There is no question that, globally, commercial drones are becoming indispensable business management tools and are rapidly transforming those businesses that have adopted the use of commercial drone systems. [5]

Agriculture is the second largest drone market that will benefit from commercial drone-based services, after infrastructure.

The global value of commercial drone services to agriculture alone is already estimated to be in the order of USD$32.4 billion. This represents 25% of the total global value of drones across multiple markets. [6]

If You're a Farmer, Then This Book Is For You

If you are ready to become a more successful farmer, then this is the book for you. I've written this book to show you what commercial drones and drone services can do for your agribusiness.

Specifically, I describe:

- Why commercial drone systems, incorporating supporting software and specialist high quality cameras, are invaluable to *your* business.
- How commercial drone surveying is one of the most important tools you can and must integrate into *your* farming operations, especially if you want to acquire that edge towards being more financially successful.
- The types of data *you can collect*.
- How easy it is to collect a range of invaluable information using commercial drone systems; and
- How *you* can use this information to increase your yields, profitability and environmental performance.

I also add references to case studies from around the world to demonstrate how and why commercial drone services are essential management tools that you must consider utilising in your business.

To get the most from this book, I would encourage you to critically review situations you encountered during your last growing season.

You might have wished you had more warning about a specific problem that had occurred with your crops or soils.

Or a mundane, time-consuming task that kept you away from an essential activity which had knock-on effects.

Or you felt as if you were just reacting to one long costly crisis management situation.

Consider how these problem areas affected your *top*

and *bottom-line* and whether the solutions you've applied to date worked as well as you really needed at the time, assuming you were able to monitor their performance.

Compare your experiences against the information presented in this book and ask yourself what you might have achieved had you used professional drone services.

How To Get The Most From This Book

This book has been specifically written for farmers with medium to large sized farms growing crops, including grains, root crops, sugar cane, coffee and tea, hops, pastures, plants for seeds and oils, nut and fruit orchards and vineyards.

I have focused on South African farmers, but everything I present in this book has global relevance for farming operations of all sizes.

The term *farmers* equally refers to *growers* throughout the book.

Additionally, any reference to *crops* or *plants* is equally interchangeable with any produce grown for consumption in one form or another.

Similarly, where I have used the terms *fields* or *farms*, these can be exchanged for orchards, vineyards and plantations.

Finally, the term *commercial drone systems* collectively refers to the essential combination of:

- The aircraft (or drone);
- The specialist camera(s);
- Flight planning software;
- Data processing and analytical software used to generate actionable data.

The true value of the commercial drone service to agricultural businesses is the sum of all these components especially when operated by highly-trained and licensed service providers.

If you are prepared to integrate the high-tech services described in this book into your business, then you can achieve better yields and more financial success.

This will result from having:

- Better information on what's happening on your farm;
- Using your time more productively; and
- Being able to build and implement better management strategies for maximising your resource efficiency and your farm's productivity.

Whatever your current views on drones, commercial drones are already here.

Professional drone services are already delivering immense benefits to farmers world-wide. I know that the information delivered by commercial drone surveying to farmers is a game changer.

My goal is to clearly explain these benefits to you so you are left in no doubt about the value of commercial drone surveying *for your business*.

By the time you've completed this book you will know more about what drones can do for you to the extent you will be asking yourself, "*Can I afford <u>not</u> to use them?*"