



S&P Global
Commodity Insights

MAXAR



Harvesting Insights in the Era of **DIGITAL AGRICULTURE**



Harvesting Insights in the Era of Digital Agriculture



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INTRODUCTION:

The tools used to support agricultural decision making are advancing rapidly. The popularity of Business Intelligence software is increasing, producing clearer and more effective analysis. There has also been huge advances in tools for weather prediction, with forecasts available for virtually anywhere on the planet. Finally, there has been a tremendous growth in trading, Futures Markets and other forms of financialization. Let the subject-matter from S&P Global **Commodity Insights**, Maxar and ZE Power give you the latest information on data sources and risk management to give you an edge in the rapidly developing field of Digital Agriculture.

AIMAN EL-RAMLY: ZE POWERGROUP

There are many challenges within the markets that we face and agriculture has a major impact on the ability to feed individuals. According to the most recent estimates by the UN, there are currently 7.3 billion people on the planet, there is an estimation of 9.6 billion people to be expected by 2050. This would cause a drastic increase of approximately 2.3 billion more individuals to feed. In the past, we used to discuss important topics such as the food crisis. In this event, predictions were made on there not being enough food available over the planet to feed

the entire global population. With the continuous advancements in technology and better understanding of data, we can conclude that running out of food may no longer be the case.



Another challenge that we must be prepared for in which we have already begun to feel its effects is climate change. Water scarcity, rising global temperature, and extreme weather conditions are affecting crop yields. Regardless of being a skeptic of climate changes, data does suggest that there is a trend in warming that has already established itself, we must be prepared for these effects to continue.

Relating to climate change, there is an issue in the lack of investment in geopolitics. Currently, we are in the risky stage in world development, where the underdeveloped countries

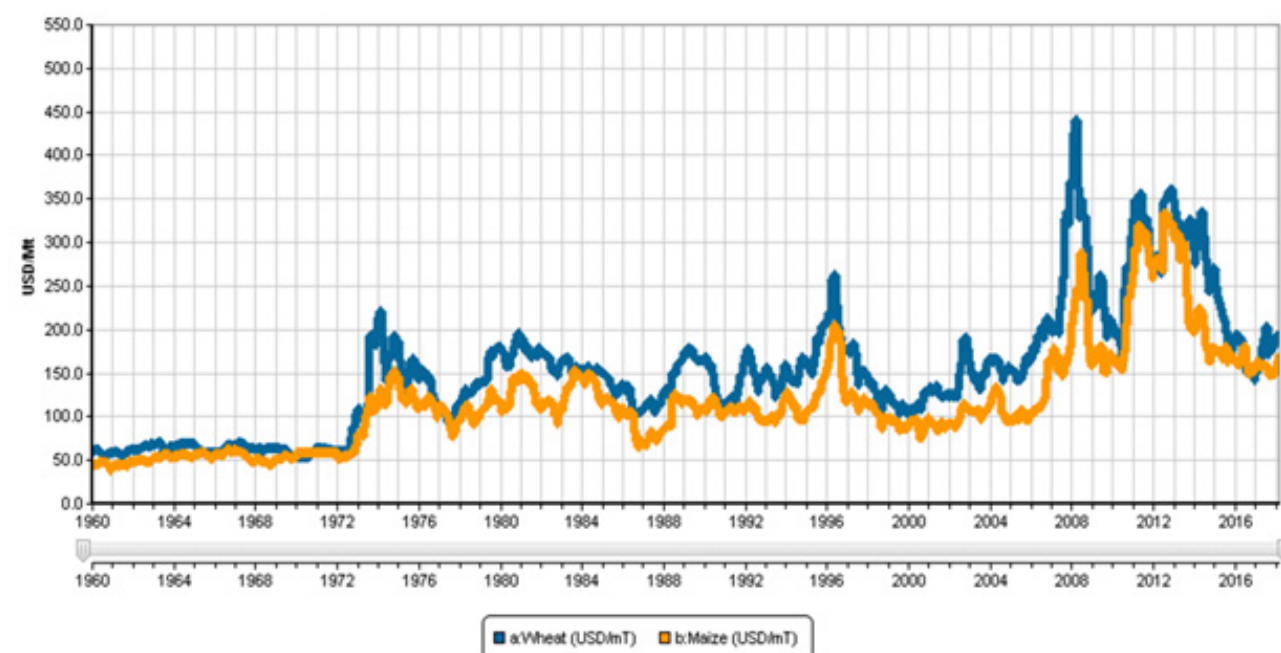
are not investing even though they are extremely hungry and populous. The more developed countries are simultaneously fighting each other.

Whenever you have a complex supply chain including agriculture, there are both risks and opportunities that present themselves. There are always chances for disruptions that can arise. In these areas of disruption, the exposure to risk is greater, it can sometimes not be



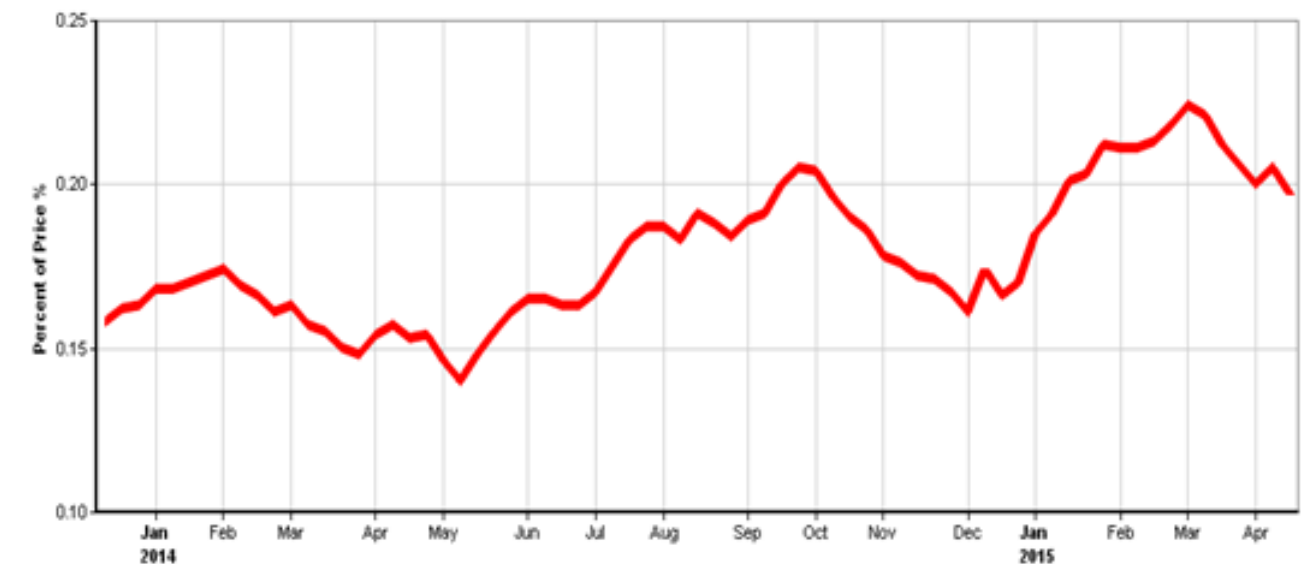
very manageable. This is especially the case when you have a commodity with a higher transport cost. A major portion of the cost of foods are caused due to the packaging, transportation and the retailer. There are a number of factors in understanding the total costs of eating. In addition to geopolitical risks, there is a sweeping impact of things such as weather and climate, which can also be game changers in its own right.

In this graph, we are highlighting the combination of crop yield against factors such as global crisis. These could be events such as an oil crisis or a sanction, both could have major implications, such



as an impact on commodity prices. During the OPEC crisis, we can analyze that during the 70s, we have a deep increase in food prices as the manufacturing or the beginning part of the supply chain, the fuel cost rise. When we take out a market through a sanction, we have major increase in the cost of oil prices, as well as the market prices of wheat and corn.

This graph illustrates the shift in the major cost on delivered cost that would arise due to transportation. In this case, transport is approximately twenty percent of the cost of a product. Depending on the fuel costs, tariffs and other surcharges, you can have a very different delivered cost.



Returning to the topic of sanctions, this will be an important subject of importance especially for all individuals related to agriculture. Russia could be considered a large market, both as a supplier and a consumer. We have witnessed that sanctions cause large shifts in commodity prices which would include money, housing, foods, transportation, debt relations, finance relations, and change in political relationships. Upon further analysis, the geopolitical situation is causing a downward value of the ruble, conversely we have the cost of beef delivered in Russia



increasing. This relationship between food stocks and currency is adding a large amount of general strife. Russia is now vowing painful responses, we are seeing these events play out in the news daily.

It is not just affecting the US and Russia, there is a global effect that is taking place. Trade relations are extremely complex. When we allow sanctions to take place, logistics around food delivery and pricing changes. To add, the EU is highly likely to garner a major impact. Effects that occur are both upstream and downstream, things such as fuel and more refined products such as food s that are packaged with multiple ingredients as an example. These events coupled with mediocre performance and crops causes a large amount of pressure on food pricing. Volatility in foods can be perceived as a result of strong demand, poor supply, and failure in some currencies.

There have been many advances in agricultural data, with more data becoming available online. With tools such as fertilizer dispersion, we can look at moisture and temperature sensors in fields. Multiple data driven tools are being developed to assist farmers and corporations invest in crops, granting large amounts of access to granular data. Some farmers are deciding to work together, they are signing up with major corps like John Deer and Monsanto. There is a great possibility that at some point in time, this type of data will be commercialized and available to everybody.



There are multiple sources of data that are available at this point in time. Large

libraries of data regarding agricultural statistics, financials, and weather data are available in various formats such as, PDF reports, XML, CSV files, and more. These sources have to be collected, harmonized and shared within an open database for ease of access. ZE partners with Oracle and Microsoft SQL to ensure this ease. We produce and open database on our side that we can make available to clients or install on-site. In addition, when you want to visualize this data in other downstream systems, our adaptors ensure that possibility. Currently, we are in the days of Business Intelligence, many clients use Tableau, Spot fire, and Microsoft PowerBI, we have developed partnerships to integrate with most downstream platforms.

We collect from over 900 external suppliers including thousands of separate feeds and reports. Our data manager automates the collection of data, administration, and security, while inputting it into an open and sharable database. Various analysis and visualization tools are provided, a few possibilities of this could be directly in Excel using our own BI tool or a dashboard. We have automation tools to transform data paired with a very rich API layer. This exists to be able to share intelligence, to be able to share corporate data with ERP systems, with your in house corporate apps, with the I-tools, with any downstream system or corporate system that exists.

ERIC WERTZ: Maxar

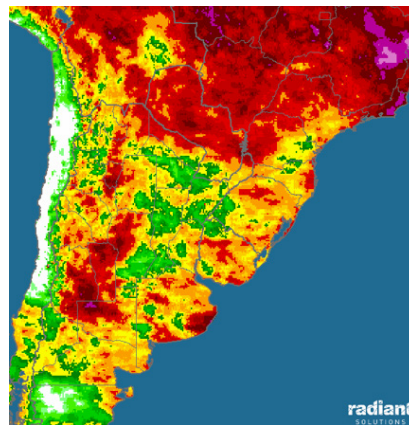
Now-a-days, there is an ongoing kind of debate about the merits of station vs gridded data. These are two images taken from our Global Weather Interactive product. For station data you're pretty much at the mercy of however many data points you have from various stations. That's the software we have in house, and that's how the map turns out. With gridded precipitation data you can get data effectively at pretty much at any point. You can see that at that resolution you can pick out more geographical features, especially as you get to the mountainous western coast.

Now taking a deeper look at station data. The general rule of thumb is that station data is typically the best data. If there is a station in your area of interest, you likely should use it. As most of you on the line know, especially as we're looking into agricultural interests, we don't have these nice weather stations set up in the middle of every corn field all over the world. That's not necessarily a realistic solution on that side. That said though, if you do have a station, it is true observation data at a specific location, nothing really beats ground data but again it has limitations due to the point of specificity.

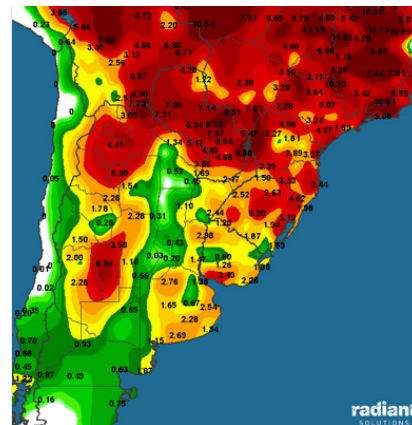


I know there is a lot of data out there, if you Google search weather data I'm sure you can find something free online, but, as the saying goes, cheap things are usually the most expensive. So what is the main advantage of data provided by Maxar? We perform a lot of rigorous data control. We'll consistently give you a value every day. You won't get any kind of erroneous values; if you do have sensitivity to the accuracy of this weather data that's pretty important. There are some entities out there that when you tell them their weather station is down they just shrug and move on. So it's always important to have an organization like ours to make sure you have the right data.

Another benefit of station data over the gridded data, too, is that a lot of the time they have a longer history. Some of these new gridded data sets, especially the higher resolution ones



Gridded Precipitation Data



Station Precipitation Data

only go back a handful of years at this point in time. Obviously as we move further and further into the future we'll have more gridded history. Some of the stations, especially, in major cities and locations have histories going back 50+ years and that makes forecasting for those locations easier as well.

Moving on to the gridded data. It is available anywhere on the globe. We actually do have an API here at Maxar where you just give our API latitude and longitude coordinates and it spits back a weather forecast of that area. Anywhere from the Midwest plains to the South Pole, if for whatever reason you need that. That just shows that there is no limitation to where you can get your data from. One other benefit, sometime gridded data can give you some parameter that stations don't have a good track record of having available; especially soil and solar parameters. You may be familiar with the fact that soil moisture and soil temperature sensors are quite expensive and not that straight forward to maintain for some organizations, so using remote sensing data we're able to give a very good proxy for that. Many times these stations care mostly about temperature, precipitation, and to a lesser extent wind. Having gridded data you can pretty much have any sort of weather parameter of note available. In most cases, and this is the case for our API as well, the forecast grids are also available for that same point,

are also available for that same point, you can just plug in that lat/long for a forecast and observation and you can get that data.

Overall, it generally does have good accuracy, but it's always important to understand what you're leveraging and that's where the meteorologist comes in to help you out. As always, bear in mind that the gridded data is not a true observation, only an estimate. Therefore, if you do have that station data available you should certainly look to use that. Gridded data does give you a solid proxy, especially if you're considering more remote areas of the world, where station data is difficult to come by.

KYLE TAPLEY : Maxar

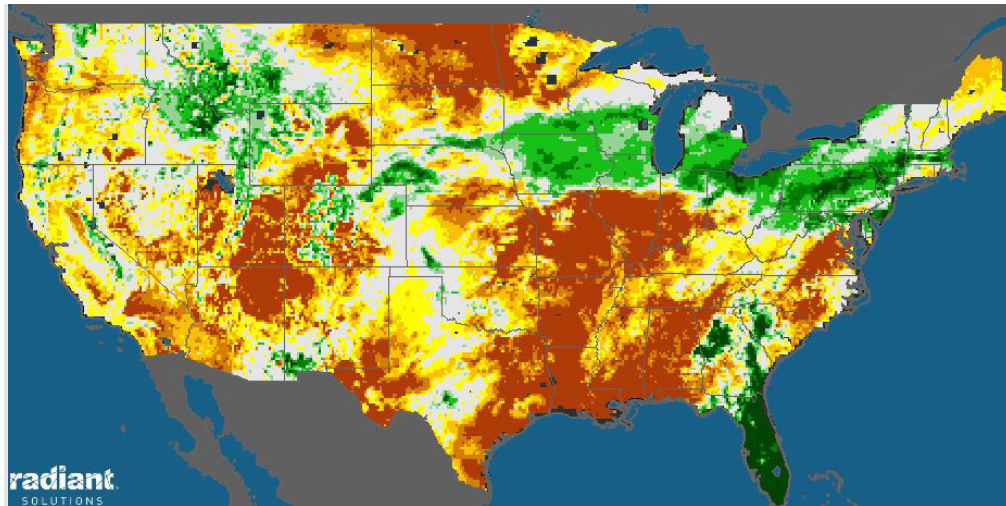
One of our most popular products certainly on the agricultural side is Global Weather Interactive. This is a web-based platform that allows you to map and download historical and forecast data, weather data and some derived agricultural data sets as well. We have station based and gridded data sets within this tool. The main parameter people are looking at are temperature, precipitation, growing degree days, some different vegetative imagery, soil moisture, soil temperature; those are the main parameter that we have available within this. We have data back to 2000 for most of those parameters.

We have forecast data out for the next 15 days for most of these parameters as well and there is global coverage. Also, especially for agriculture where there's so many crops grown in so many areas we also have crop area overlays that allow you to see exactly, get a general idea of where some of these different crops are grown in the different parts of the world.

Some other things that we have available are crop production estimates. Crop modeling has been one of our main tasks for decades, both for the US government and commercial purposes. We have a database of harvested acreage, yield, and production estimates going back to 2000 and in some cases even earlier than that for all your major crops and growing areas around the world. We update those on a weekly bases and we also have the historical forecasts for the different variables going back several years. USDA also does their own estimates of crop acreage, yield, and production but they only update on a monthly basis. They are a little slow to react to changing weather patterns, it can be viewed as a bit conservative in which we can use our expertise in weather forecasting to project forward. There's some advantages to that weekly update that we have for these different variables.

This is what it looks like as far as some of the weekly reports that we put out, so you can see our harvested acreage, yield, and production estimates for all the various crops, for all the various countries. For the major producing countries you go down to even the state or administrative level below the country level for the major producing countries.

Another type of data set that is particularly useful for agriculture is the satellite-derived vegetative indices. Currently, we look at Vegetative Health Index and NDVI, they are two types of those satellite-derived crop indices that are out there. These can be used to help estimate crop yields, they correlate with yields for different crops in different parts of the world. Some crops are a little bit easier than others to derive yields from, from these indices, corn in particular is probably one of the better ones you can get a pretty good handle on



what yields are by looking at some of these satellite-derived products. We also have this data available within our Global Weather Interactive platform. We'll soon have a new NDVI product as well.

Finally, our newest dataset that we have available are some of the high-res estimated precipitation datasets that are out there. In the US we use a dataset called Stage IV which is primarily using radar to estimate rainfall and then calibrating that by the actual surface observation. It gives you a really good look at where and how much precipitation we have across different parts of the world.

STEPHANIE WILSON : S&P GLOBAL PLATTS

Let's begin by defining what a 'benchmark' is, as there are a few definitions. For S&P Global Platts, this is the physical price that is used by commodity market participants to underpin financial products.

You may not have heard of S&P Global Platts, but you've probably heard of the Brent crude oil price: Platts assesses the physical price that underpins that financial contract on a daily basis: which in turn prices out more than 50% of the world's crude oil. We have over 100 years of experience pricing commodities in the oil, energy, petrochemicals, metals and shipping markets.

We are a trusted, independent source of pricing information, analysis, news and data. We have no vested interest in the direction of a price - unlike so many other market commentators - only in the accuracy of that price when we are capturing the data. These published prices are often picked up by the industry and referenced in physical contracts, in addition to being used as the reference for futures products. This adds a layer of sophistication to trading strategies and, importantly, enables risk management for market participants.

Some markets in the agricultural space are in dire need of more effective risk management tools and I think it's fair to say the wheat industry has been firmly in this category until fairly recently.

The Black Sea - and in particular, Russia - eclipsed the US and Europe as the major source of exports for wheat some time ago; it's the largest source of uncommitted volume, available on an international basis, making it the seaborne marginal tonne. Deals done at the margin - or on a spot basis - give us the absolute best indicator of value on any given day; it's where supply and demand meet. However, the mechanisms we use to hedge wheat are largely yet to catch up.

Currently the Black Sea wheat export market is about two times the size of that of the US and five times larger than the European market, but many market participants are still using established futures contracts such as CME and Matif - which reference physical European and US wheat prices - in order to price the physical wheat that's coming out of Russia, because that's the only way they can successfully forward sell and hedge their exposure.

As such, hedging potential in the Black Sea wheat market has been very limited until recently, as there was a significant break between price movements that we saw in these existing futures markets and the reality of the physical price that we've been capturing here at S&P Global **Commodity Insights** since 2014 as both are responding to very different fundamental drivers.

To give you some examples; if a hurricane goes tearing through the US, or the crop in Europe is of poor quality, wheat grown in Russia, bought and sold referencing or hedged out with these CME or Matif futures prices is suddenly exposed to fundamentals that have absolutely no bearing to events in Russia or the physical market there.



And this is very evident when you look at correlations between the paper values and the Russian wheat physical price. If we use Europe or US wheat to try and hedge Russian wheat, it's proving to be less and less effective, because the correlation between physical and paper prices is now below 70%, which is not ideal. Anything below 50% and you're actually adding more risk rather than mitigating it. Matif is around 66.9%, CME is even worse at 58.7%.

This is why we've seen such strong interest in the financial, cash settled futures referencing the S&P Global Black Sea Wheat assessment which was listed on CME in December 2017. We've seen a very strong take up amongst brokers, with seven active and more than 20 market participants trading the paper. We are also starting to see significant interest from hedge funds, banks, financial supplies and other would be speculators, which will start to add to liquidity.



People tend to get nervous when they hear the word 'speculator' in the context of financial contracts, but realistically in these markets where we're looking to build that liquidity, you need those participants at the back end of the curve with a different risk profile who are prepared to take risks on the macro picture. This effectively builds out a forward curve and gives those with an interest in hedging their physical exposure someone to hedge against, and this is what truly unlocks the risk management potential of a futures market.

You can hedge physical exposure, trade the spreads of timing, arbitrage, quality; you can fix a flat price with premium, or use a floating price in a physical contract, so you start to see a much more sophisticated market really beginning to emerge.

Open interest on the CME S&P Global Black Sea Wheat futures has already eclipsed over 1 million tonnes because industry participants buying and selling wheat are seeing the benefits to using mechanisms that track the

reality of the most competitive point of the physical market, which accurately captures values with standardized quality, location and timing.

In order to make our assessment of the physical market, we employ a survey approach which means that we contact brokers, traders, buyers, sellers, millers and even growers to collect bids, offers and trades for the day which we test in the market to make sure that they're freely available for everyone.

We understand that price is a function of time more than anything else. Value changes in seconds, minutes or sometimes even days, which is why we impose strict practices around when we assess the market.

We will then take the most competitive offer and bid available in the market and assess value on the basis of supply, demand, any quality differences and any other mitigating information that might have a bearing on the value. In our experience, the assessment is rarely midpoint between the bid and offer, because value is rarely at the midpoint, although we do see the spread between bids and offers narrowing as the market becomes more efficient and participation in the process increases.

Nor is assessed value always in line with deals concluded on that day. Any trades considered have to be at a price available to everyone, concluded at arm's length between non-affiliated parties and most importantly it has to be repeatable; which is to say it can't be a one off value.

When we come to assess a market, we look very closely at the fundamentals and we try to approach it in such a way as to pool the liquidity around where and when the bulk of trade is being done. This is a process we refer to as normalization. We take trades from across the market that would fit into our specifications at one point, whether that's the location, the quality, the time, and in order to give the most detailed picture of the market we apply calculations to bring them back into what we consider our assessment specifications.

To summarize then, the benefits of the futures market are really multifold. There's no real limit on how to use them and ultimately it's all about managing your risk and your appetite. Hedging is only ever managing your risk - trying to boost your profit, limit your losses, guarantee a price. It's a way to increase certainty in what's really becoming a more uncertain and volatile world. Risk is inherent in commodity markets and the best risk is undoubtedly calculated risk.

QUESTIONS:

1. Are there any instances in which you would use gridded data over station data?

Most instances you would use it as if you're looking to get very remote areas. A lot of the times in the US you're decently covered stations, obviously not perfect but there can be a lot of difficulty getting data for certain areas such as, India and South America. Brazil's actually gotten quite a bit better over the past year or two. When you're areas of interest are really void of any sort of station data at that point you should probably just kind of bag it and start just going down the route of gridded data.

Especially in agriculture where you're looking at areas that are not necessarily built up and have a lot of air ports where these observing stations typically are located. I think in agriculture one of the areas where gridded data is particularly useful.

For anyone that does things with energy as well, you might be familiar with a lot of these. Stations are at air ports or major cities so it's a bit of a different story on the energy side where you do have these weather stations located where a lot of energy consumption is. With Ag and energy it's a pretty different story as Kyle alluded to.

2. What is the best route to turn complex data analysis into readily implementable solutions for farmers or decision makers?

The first thing is, develop your data catalog. Understand what data is used for and relevance; the next step in that is really to harmonize that data, typically that's going to happen through a system, so you have to develop a system of record either you buy that from a company like ourselves or you develop something in house. The next is really to create the roles in the corporate around sharing that data and what platforms you will create to share that.

3. What are the benefits of using these FOB indexes over something like a domestic CCP in Russia and Ukraine?

When we talk around kind of what's happening in some of these markets because we have seen some local markets derivative products kind of springing up in recent months. You can do that, and obviously if that's what you're trading and you want something to hedge against some of the domestic bases that's absolutely your choice and that's a good way to go. I think when we're looking at the benefits of international vs domestic we do have to take in to account things like currency, and also who your counterparties will be. I know in the Ukraine at the moment there is a move towards domestic pricing with a contract against it. That's fine as long as your exposure and your counterparty is with the Ukraine. When it comes to sort of playing in the international market, you would have to make a conversion to get from the cost of getting your product to port into the international market, as well. That's another layer of added complication when it comes to sort of pricing out your exposure there.

SUMMARY:

Agriculture and technology are intertwined, it is evident that there is a positive correlation between the two fields. With a vast number of tools being implemented to track insights relating to multiple agricultural aspects, it has resulted in improved decision-making in terms of trading and the Futures Markets. Accurate forecasts predictions have been generated solely due to the productivity occurring due to the digital agriculture. We can conclude that Business Intelligence is essential for the agricultural market in terms of increasing efficiency in terms of conducting concise analysis. With data backing up high-level business decisions, you can remain confident that you will be making the right choice.

KYLE TAPLEY*Senior Agricultural Meteorologist, MAXAR*

- Generate daily weather forecasts for major crop areas around the world
- Contribute to Radiant's full suite of weather products and aid in generating crop production estimates
- Contribute to monthly and seasonal weather forecasts
- Consult with industry traders on a daily basis
- Frequent speaker at agricultural conferences around the world

**ERIC WERTZ***Manager of Weather Data Solutions at MAXAR*

Eric Wertz is the Manager of Weather Data Solutions at MAXAR. Originally from New Jersey, he has been employed with MDA since 2009. Eric graduated from Penn State University in 2009 with both a B.S. and M.S. in Meteorology.



Previously an Operational Meteorologist, Eric is now responsible for assuring the quality and procurement of all weather data that comes through MAXAR's doors. He works with clients across various industries from energy to agriculture to weather derivatives. Lately, Eric has been more involved with assisting in the development of Maxar's API capabilities, especially as location specific weather forecast and actual data become more critical to agricultural interests.

Eric often travels to client locations to better understand their weather needs. He also frequently attends Weather Risk Management Association (WRMA) events and has taken part in Maxar's Annual Crop Tour.

STEPHANIE WILSON*Managing Editor, EMEA Agriculture, S & P Global Commodity Insights*

Stephanie Wilson leads S&P Global Commodity Insights coverage of the EMEA Agricultural markets. She is responsible for the team covering wheat, corn, sugar, ethanol and biodiesel, while developing content – news, price assessments and market commentary – published in many of Platts key publications and real-time services. Key price benchmarks published by the EMEA team include Platts FOB T2 Ethanol, as well as FOB Black Sea Wheat and Corn.

Stephanie joined Platts' Singapore office as Managing Editor, Asia LNG, where she spent five years developing the JKM, an assessment of LNG prices for spot cargoes delivered to Japan and South Korea. She previously covered coal and onshore gas at S&P Global, and prior to this spent six years at a competing publishing company, where she covered a wider range of energy and petrochemicals markets in Europe, Africa, the Middle East and Asia, initially based in London and later in Singapore.

Stephanie holds an honours bachelor's degree in journalism from the University of Westminster, London.

**AIMAN EL-RAMLY**

*CHIEF STRATEGY OFFICER, ZE POWERGROUP AND
CHIEF OPERATING OFFICER FOR ZE POWER ENGINEERING.*

Aiman El-Ramly is the Chief Strategy Officer of **ZE PowerGroup** and the Chief Operating Officer for **ZE Power Engineering**. He has 30 years of progressive experience in the energy, commodities and technology spaces. Aiman has significant understanding of what is needed for corporations of all sizes to run and grow effectively. His experience and proven expertise allows him to state unequivocally that transforming data into actionable intelligence is essential to achieving corporate market objectives.

Aiman is an internationally renowned sought after speaker on a variety of global **socio-economic** and **data technology** topics. His strong communication and relationship-building skills are able to effectively sell the promise of his organization to customers, partners and inspire his team.



ABOUT:

ZE AND ZEMA

ZE is a technology leader providing customers with software and services that transform decoupled and fragile data-related routines into streamlined, transparent, secure, and automated business processes. ZEMA, ZE's award-winning flagship software, is a comprehensive data management and business process automation software solution. With its unparalleled data library, analytical functionalities, curve management, and integration capabilities, ZEMA offers a modular, end-to-end, automated solution for clients of all sizes, operating in any industry.



S&P GLOBAL COMMODITY INSIGHTS

S&P Global Commodity Insights is the leading independent provider of information and benchmark prices for the commodities and energy markets. Customers in over 150 countries look to our expertise in news, pricing and analytics to deliver greater transparency and efficiency to markets. Founded in 1909, Platts' coverage includes oil and gas, power, petrochemicals, metals, agriculture and shipping. A division of S&P Global, S&P Global Commodity Insights is headquartered in London and employs over 1,000 people in more than 15 offices worldwide. These include global business centers such as New York, Shanghai and Sao Paulo, and major energy centers such as Houston, Singapore and London, where S&P Global Commodity Insights is based.

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Maxar is the global leader for weather risk and commodity weather support. The company provides special reports on key market-moving concerns, serves as the industry's leading archive of cleaned global historical weather information, maintains high levels of communication, and offers 24/7/365 consultation with its worldwide client base. Raidant Solution's products support client decision making processes throughout the majority of the weather risk, energy, and agricultural markets.

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E: contact@ze.com

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www.spglobal.com/en

E: support@spglobal.com

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www.maxar.com

E: info@maxar.com