Feeding returns

The ripening prospects for ‘precision agriculture’

Is the agricultural industry rising to the challenge of growing populations, higher-calorie diets, declining arable land and climate change? These factors place an urgent responsibility on the world’s food industry to raise its productivity. The outlook is challenging, yet there are encouraging signs that agriculture is undergoing a second ‘green revolution’ as new technologies are introduced.

Can ‘precision agriculture’ feed the world?

The world’s population will rise to 9.7 billion by 2050 from 7.3 billion currently – an increase of 2.4 billion from today.[i] Over this same period, climate change and urbanisation is expected to shrink available agricultural land per person by 17%.[ii] These factors are combining to present an ultimatum to the world’s food industry to raise its productivity.

Encouragingly, the global agricultural and chemical (AgChem) sector appears to be rising to the challenge, not just via better yield-enhancing seeds and fertilisers, but by applying connected computing power and rich environmental data to traditional farming methods. Precision agriculture using big data, GPS and ‘internet of things’ connectivity has the potential to revolutionise the way in which is our food produced.

AT A GLANCE

With 2.4bn more mouths to feed by 2050 global food production must double between 2015 and 2050

Given declining arable land, we need agricultural productivity growth

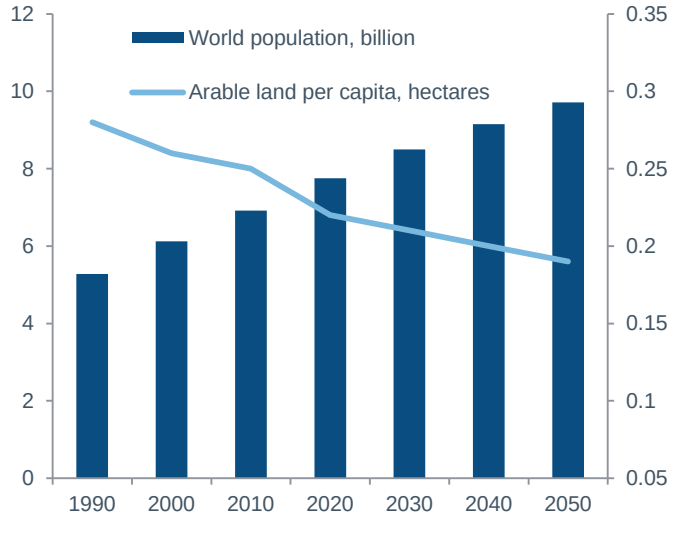
Agriculture is responding by embracing the Internet of Things.

The use of big data, GPS, drones and environmental sensors usher in an era of ‘precision agriculture’

Largest productivity improvements to come from low income nations

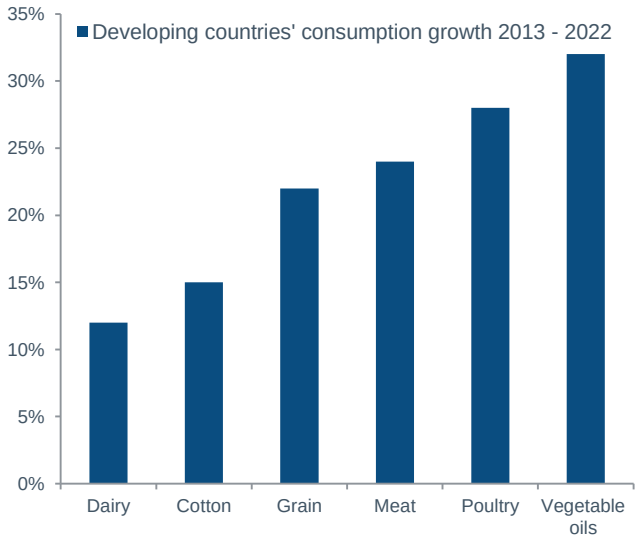
Investment opportunities for contrarians/long-term investors

Chart 1: Diminishing arable land per capita…



Source: Financial Times and Bayer May 2016, World Bank June 2016

Chart 2: Yet accelerating agricultural demand



Source: 2015 Global Agricultural Productivity Report®, Global Harvest Initiative and Paul Westcott and Ronald Trostle, USDA Agricultural Projections to 2022. USDA ERS, (February 2013).

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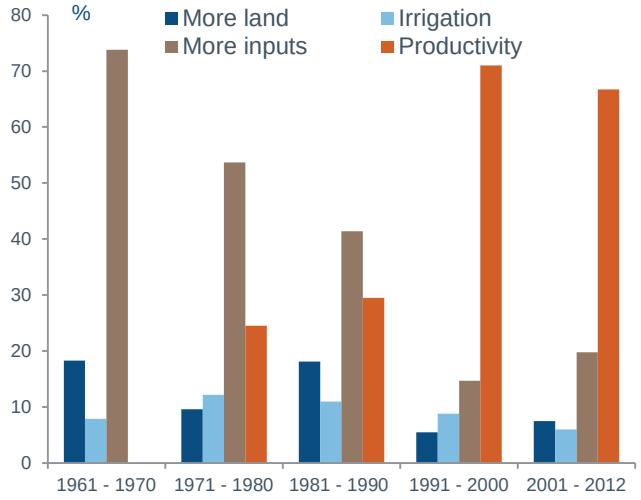
Productivity promise via innovation

As the rising world population squeezes the available arable land per head, agriculture can no longer rely on traditional sources of growth, such as farming more land or simply adding more inputs, such as fertilisers (chart 3).

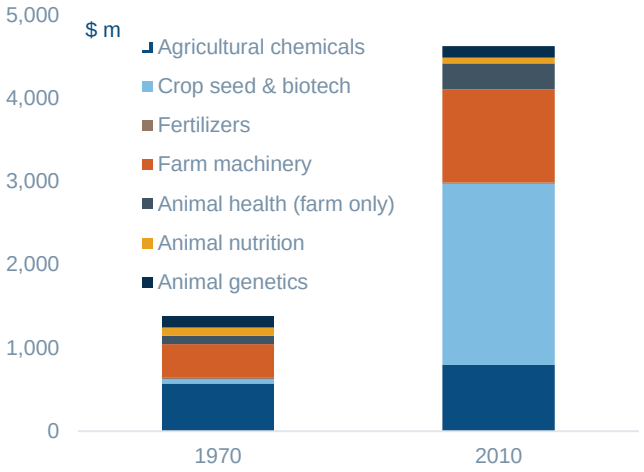
The emphasis has swung towards productivity via innovation: improving yields fro existing resources through crop protection and new seed development (chart 4).

Chart 3: Productivity is now driving growth in agriculture



Source: USDA, Economic Research Service; international agricultural productivity data product. June 2016

Chart 4: Big increase in US seed & biotech research



Source: 2015 Global Agricultural Productivity Report®, Global Harvest Initiative & Keith Fuglie, Paul Heisey, John King, Carl Pray, Kelly Day-Rubenstein, David Schimmelpfennig, Sun Ling Wang and Rupa Karmakar-Deshmukh, 2011. "Research Investments and Market Structure in the Food Processing, Agriculture Input and Biofuel Industries Worldwide" ERR-130, USDA ERS, Washington, DC.

Food production must double between 2015 and 2050

Research by the Global Harvest Initiative has forecast global food demand to 2050 and matched this with projected world food supply – assuming a continued rate of productivity as measured by total factor productivity (TFP) of 1.72%.[iii]

The implication of the two projections is that the current rate of TFP will not be enough to prevent food shortages. The required rate is 1.75% per year. Given that the rate of TFP in low-income countries is 1.5% per year, this is where the scope for the biggest increase in yields lies. In round numbers, global food production must double between 2015 and 2050.[iv]

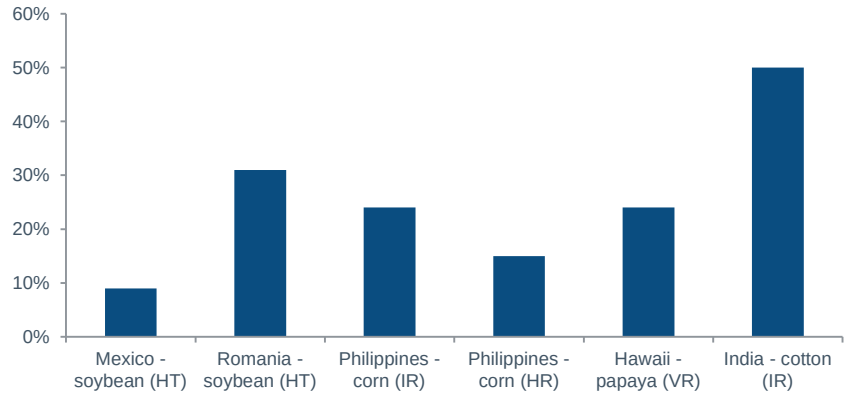
Seeds lead the innovation

To maximise resistance from damaging pesticides and insects, the AgChem industry has developed pesticide- and insect-resistant seeds. This research has ultimately led to the invention of genetically modified (GM) seeds and leading US agricultural products company, Monsanto, has been at the forefront of these developments. GM seeds have been successful in raising yields, but only with real significance in developing countries so far (see chart 5).

Increased yields have been achieved by avoiding the unintended crop damage from pesticides and by planting rows much closer together. Prior to the innovation of GM seeds, farmers had to leave enough space between each planted row to allow mechanical access to control weeds.

Despite the efficiency gains, the process of genetic modification remains highly controversial. The main criticism is that by taking a gene from one species and transferring it to another, science has created something unnatural, which could in turn impact the natural ecosystem in unexpected ways. For example, there is concern that GM seeds reduce diversity, fears that pesticide a resistant gene might transfer itself to the weeds, the threat that GM crops could encourage excessive use of pesticides and the possibility that GM products may upset bacterial flora in the guts of humans and animals.

Chart 5: Yield enhancements using GM products



Source: Monsanto website June 2016. HT- herbicide tolerant, IR – insect resistant, VR – virus resistant.

High hopes for biological crop protection

'Biological crop chemistry' is a generalised term for all **naturally** derived agricultural products that aim to improve crop protection and plant productivity. This branch of the AgChem industry is at an early stage of development similar to where the seed industry was in the 1980s. Its main ambition is to develop a biological equivalent of chemical pesticides.

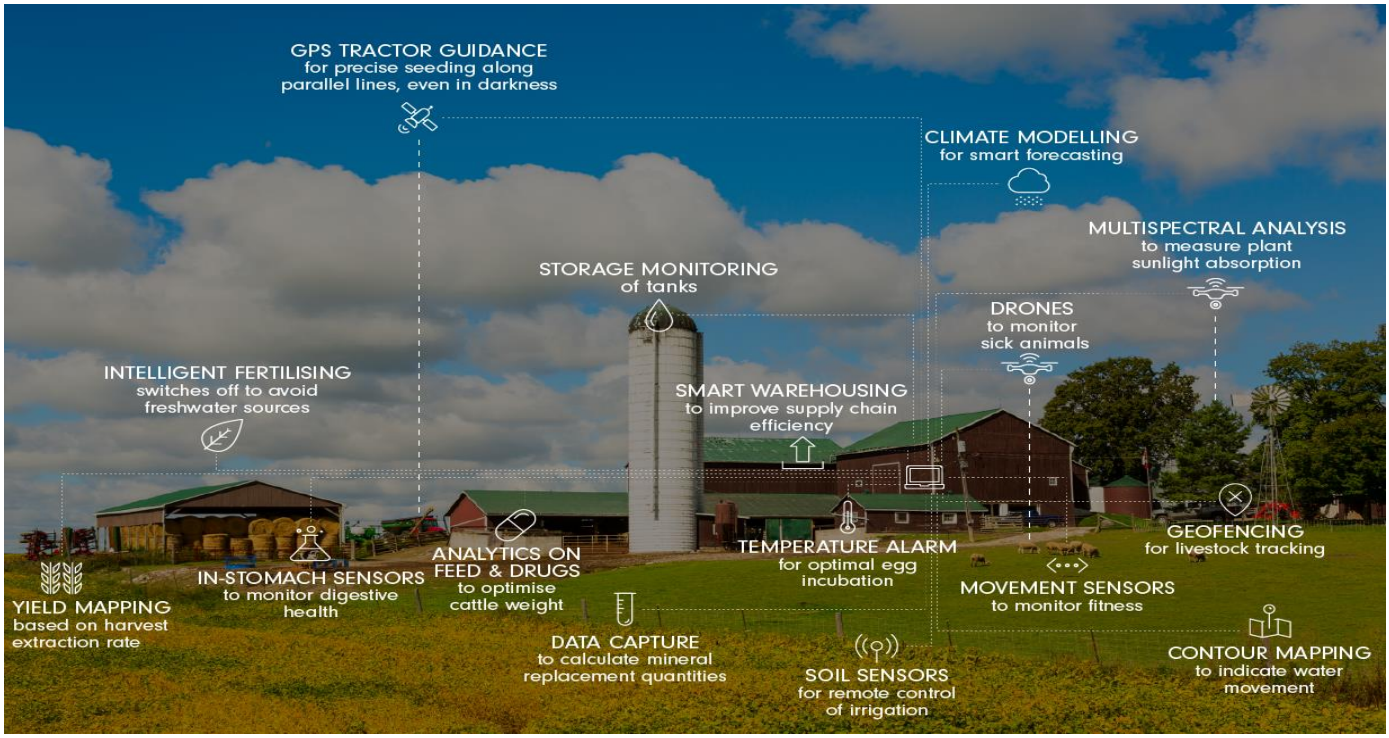
The focus of current research is on developing crop protection from microbials such as bacteria, fungi, viruses and yeast. Being organic they can avoid the unintended damage to the environment associated with chemical crop protection products.

This significant difference is one of the key drivers of the prospective growth of biological formulations as regulators are increasingly responding to claims from the environmental lobby. The European Commission has responded by restricting the use of approved chemical pesticides from a peak of around 1,000 to about 450 today.[v]

Precision Agriculture: some examples

Farmers are embracing a range of innovative methods, collectively known as 'precision agriculture'. Satellite Global Positioning Systems (GPS) play a central role in combination with internet-connected sensors that produce rich data, enabling more efficient practices. The modern '*connected farm'* is using a range of techniques such as targeted seeding, precise fertiliser application, farm & field planning, soil sampling & climate optimisation, tractor guidance & yield mapping.

'The connected farm'



Source: Fidelity International August 2016

- **Environmental sensors** can now be placed directly in the soil to record temperature and moisture, allowing farmers to optimise inputs such as irrigation or fertilisers which can be controlled and delivered remotely. A range of devices can monitor sick or pregnant animals, the ripeness of crops, and the damage to crops from weather.
- **Rich data** - the use of sensors transforms agricultural vehicles and equipment into mobile recording and data transmission systems. The US agricultural machinery company John Deere claims that using sensors to deliver precision agriculture has raised profitability by $5 - $100 per acre and helped to increase productivity by 15%.[vi]
- **Tractor guidance** is a popular use of satellite technology to reduce costs. When towing machinery in the field, GPS offers exact guidance along parallel lines to avoid retracing routes or missing areas for seeding. GPS also reduces lost working days to weather and darkness, enabling accurate navigation in poor visibility such as rain, fog or at night.
- **Improved efficiency** - John Deere's HarvestLab technology uses infrared sensors to detect the quality and macronutrient content of crops and organic inputs like silage in real time during harvesting. The use of in-cab real-time moisture & yield data can drive mechanical variations (such as the

height of cutting machinery) that increase throughput and reduce excess fuel use. Tractors and drones can also be fitted with cameras to transmit detailed images of the farm that helps with field planning and yield mapping.

- **Programmable machinery** is also helping farmers to protect the environment. For instance, once the location of sensitive areas, such as freshwater streams, has been established then the machinery applying synthetic products such as fertilisers can be turned off at these specific locations to ensure pollution is minimised.[vii]

- **Regulation** is also driving the use of technology. In Europe, under the Common Agricultural Policy (CAP), farmers are incentivised to farm sustainably so that similar quantities of nutrients are returned to the soil as are extracted. The use of sensors connected to data collection programmes is vital in this regard, so that the right amounts of minerals, such as nitrogen, phosphate and potassium, can be calculated for return to the soil.

- **Modern livestock production** is improving the speed with which cattle can be brought to market. By using data analysis to improve feeding practices across different breeds of livestock, farmers are optimising the feeding of their animals with refined formulations of feed, hormones and antibiotics delivered by machine with dosages set by computer. This speeds the time to achieve desired weights so that cattle can be ready for market in about 16 months rather than 30 months.[viii]

Stock spotlight on Monsanto

Monsanto is a leading agricultural biotechnology company that has been quick to apply cutting-edge techniques from the pharmaceutical and technology industries to the agriculture domain.

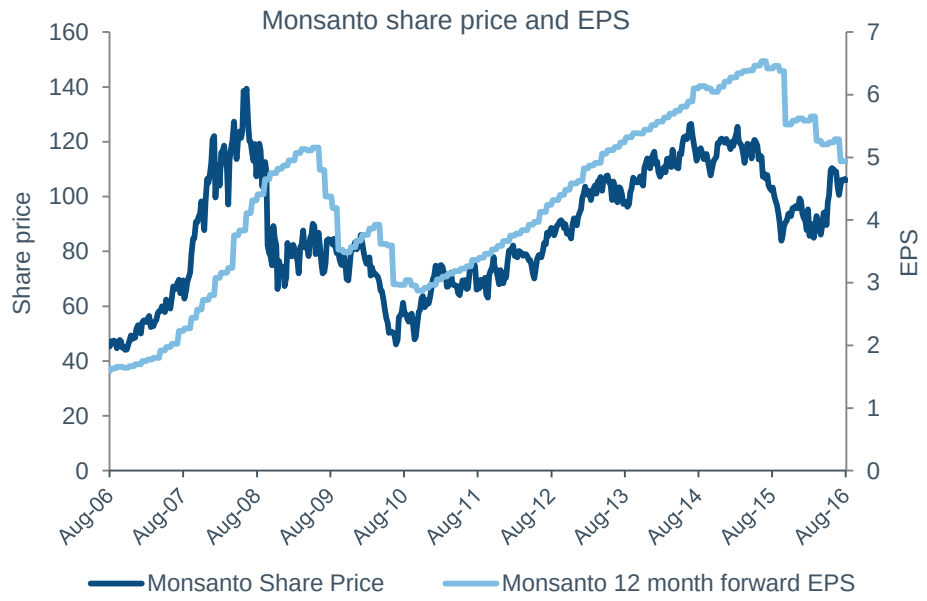
A leading provider of genetically modified seeds and grains, the company was quick to see the value of genetic information in agriculture. This specialisation allows the company to enjoy protection from the high barriers to competitor entry, attractive recurring revenues and an enviable platform for new product development.

The company has been notably quick to see the value in the *Internet of Things* (IoT). In 2013, Monsanto bought the Climate Corporation for around $1bn, which is a company specialising in digital services to the agricultural sector.

Using IoT architecture, big data, climatology and agronomy to carefully examine weather patterns, Monsanto can provide fully automated weather insurance products to farmers. Their technology platform absorbs weather measurements from 2.5 million locations on a daily basis and processes that data along with 150 billion soil observations to generate 10 trillion data points for weather simulations. There is over 50 terabytes of live data in the company's systems at any one time.

The combination of Monsanto's leading intellectual property in the seed business and Climate Corp's edge in weather data science on an evolving IoT platform should foster further incremental improvements in agricultural productivity. Some commentators are suggesting that we could see an increase in value of $10 per acre, which supports a strong structural growth outlook for Monsanto.

Chart 6: Monsanto share price reflects the success of GM products



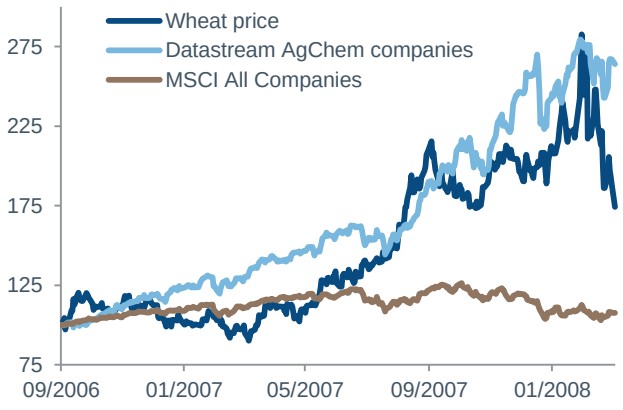
Source: Thomson Reuters DataStream, as at 12.08.16

Fertile conditions for contrarian investors

While there are long-term growth opportunities associated with the need to increase food productivity, the cyclical nature of investing in agricultural commodities means investments must be approached with selectivity and caution . The supply-side response to higher prices of a few years ago combined with plentiful harvests have resulted in a surplus supply of agricultural commodities.

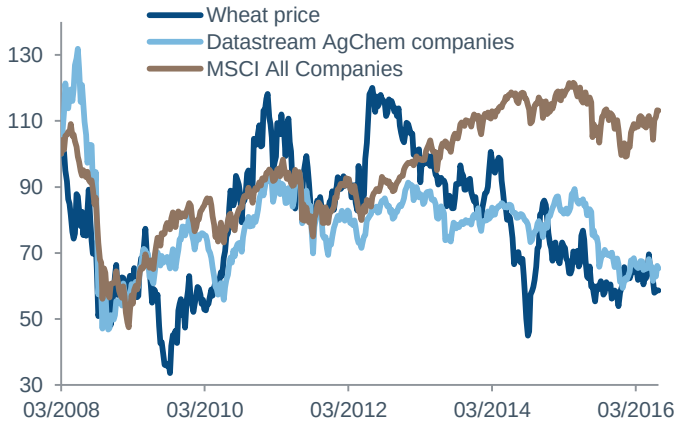
The cycles of supply and demand can change quickly however, due to variations in climate. Given we are at a surplus point in the cycle, contrarian or or simply long-sighted investors may look to take advantage of the current trough conditions (and relatively attractive valuations) on offer in the AgChem sector – see charts 7 and 8.

Chart 7 The up cycle for AgChem



Source: DataStream July 2016

Chart 8 The down cycle for AgChem



Source: DataStream July 2016

Taking a contrarian or a long term view certainly seems to be the stance of the corporate sector as there has been a significant increase in merger & acquisition (M&A) activity in the last year. Notable examples include the agreed $120bn merger between Dow and DuPont, the proposed $43bn acquisition of Syngenta by ChemChina and the more recently announced $64bn offer for Monsanto by Bayer.

These proposed mergers and acquisitions represent an ambition for the acquiring companies to achieve a better balance in their businesses as well to achieve cost savings – to be found in spreading the high cost of research and development across a bigger customer and revenue base.

This trend in M&A coincides with our analysts' view that the AgChem industry is close to the low point of its current cycle. Should this prove to be the case, the sector may well start to see a reversal of fortune.

As with other sectors, the more cyclical areas will offer a higher gearing to any rising prices and in the AgChem sector such stocks are to be found in the fertiliser-producing companies such as *Mosaic*, *CF Industries* and *Agrium* Inc. Reflecting our view of the cycle, Fidelity International has been taking an increasingly positive view of such stocks.

Summary

The AgChem sector is entering into a significant phase of innovation to raise productivity in the face of a burgeoning demand outlook thanks to population growth and supply challenges due to declining arable land.

Listed companies have a central part to play in undertaking and funding research, introducing new products and applying new techniques to meet this productivity challenge. While some of the AgChem sector share prices have been correlated with lower agricultural commodity prices, contrarian or long sighted investors may wish to take a cue from significant trends in corporate activity and look for opportunities within the AgChem sector for the longer term.

[i] Source: Global Harvest Initiative 2016

[ii] Source: Bayer CEO Financial Times 24 May 2016

[iii] Total factor productivity is the ratio of agricultural outputs (crop or livestock) to inputs (land, labour, fertilizer, feed, machinery)

[iv] Source: Global Harvest Initiative 2016

[v] Source: European Commission June 2016

vi Source: RCRWireless News February 2016

vii Source: ComputerWeekly.com 'How John Deere uses connectivity to make farms more efficient'

viii Source: Farming in the 21st century: A modern business in a modern world. Arlene Dohm