From Diets to Tech: The Opportunity in Sustainable Agriculture

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Key Points

- Carrying on with business as usual is not an option for global agriculture and food systems. In fact, an academic study suggests an 87% increase in GHG emissions and a 67% increase in demand for cropland to meet the anticipated increase in food demand between 2010 and 2050.¹
- The use of innovative technologies such as Precision and Digital Ag, biological solutions and seed technology are key to boosting agricultural productivity with a reduced environmental impact.
- Protein production needs to be made more sustainable with improving productivity in the form of animal feed and health. A shift in people’s diets—from animal-based to more plant-based—is also necessary.
- A third of all food produced for human consumption is lost or wasted along the supply chain with losses and waste at every stage in the food system.
- Based on our analysis, the Barings Global Agriculture strategy has invested in companies that are part of the solution with 84% of its AUM allocated across sustainability related themes.²
- At Barings, we fully integrate ESG into our analysis and investment decision-making, as this allows us to better assess both the potential risks facing the company and the opportunities presented to it, particularly those that may not be apparent or included in traditional fundamental analysis.

The Food and Agriculture Organization of the United Nations (FAO) estimates that direct greenhouse gas (GHG) emissions from agriculture are responsible for 11% of total global emissions.³ If we include burning biomass and deforestation to the calculation, the share jumps to 24%.

Sustainable agriculture is about doing ‘more with less’ to balance the requirement to feed an increasing global population, but with a reduced environmental impact and sustainable land management. If we are going to feed 10 billion people in 2050 in a sustainable manner, we need to change both food production and consumption—particularly if the amount of land available to agriculture is lower. This will require the technological revolution that is currently underway. In this paper, we describe some of the innovations that are increasing the productivity and sustainability of both arable farming and protein production.

2. As of March 31, 2021.
The Challenge

Dr. Marco Springmann from Oxford University’s Oxford Martin Programme on the Future of Food wrote a paper titled, “Options for keeping the food system within environmental limits”, in which he explored the environmental impact of sharply increasing food production and consumption from 2010 to 2050.\(^4\) Dr. Springmann found that in the absence of technological change and other mitigation measures, a rise in the demand for food would add to the environmental pressures on the food system (FIGURE 1). The projected increases are a baseline projection to 2050 and are shown as a percentage increase from 2010 levels. The most striking impact is in the projected increase of 87% in GHG emissions and 67% of cropland over this 40-year forecast period. A key reason for the massive jump in GHG emissions is the increase in animal-based products—demand for animal-based products is expected to rise not only because of the expected higher global population but also due to increasing wealth in emerging markets, creating a shift in diets toward animal-based products.

As well as being resource intensive, agriculture does require a large amount of land. What is particularly striking is that 50% of global habitable land is used for agriculture. The World Wildlife Fund also estimate that 77% of this agricultural land is used for livestock, but is only responsible for 17% of food calorific intake (FIGURE 2). This does not seem to be a sustainable use of land for food production.

The large agricultural land area and increasing food demand have implications for the biodiversity of the planet, which is important to mitigate climate change. Biodiversity is the variety and abundance of species and the quality and the extent of ecosystems—and a loss in biodiversity threatens food systems and agricultural productivity. For instance, more than 75% of global food crop types rely on animal pollination.\(^5\) Therefore, as we seek to increase food production, we need to reduce the amount of land to produce food in order to maintain biodiversity. This reduction in agricultural area clearly conflicts with the significant increase in food demand until 2050, and thus places more pressure to find technological solutions to boost yields.

A further element of addressing the challenge is clearly to reduce the amount of food waste. The system is currently inefficient and unsustainable: a third of all food produced for human consumption is lost or wasted along the supply chain with losses and waste at every stage in the food system.\(^6\) Without accounting for GHG emissions from land use change, the carbon footprint of food produced that is not eaten would be the third biggest global emitter of GHG behind China and the U.S.


**FIGURE 1:** Environmental Impact of an Increase in Food Demand (2010–2050)

**FIGURE 2:** Land Area for Food Production


Sustainable Arable Farming Solutions

In arable farming, we believe sustainable farming solutions will involve technologies in:

- Precision and Digital Ag, which is transforming agriculture and boosting yields by optimising crop inputs.
- Bio-solutions, which are providing a more environmentally friendly solution for protecting and growing crops.
- Seed technology, which is structurally increasing yields.

**PRECISION AND DIGITAL AG**

Precision and Digital Ag technologies have seen structural growth from when they first started appearing on the market in 2005. These technologies have boosted yields, reduced waste and increased farmer profitability—a case of doing more in terms of output with less or the same amount of inputs in terms of crop protection, fertiliser and seeds. Big data, using historical data combined with the current conditions, and using satellite or aerial imagery, is analysed to provide farmers with solutions of what to grow in terms of types of seeds, fertiliser and crop protection products and when to plant and harvest the crop. This data can be programmed into the planter so that the machine autonomously plants the seeds in the correct density. In addition, there is a variable rate fertiliser application that works in a similar way to seeds, where farmers can apply more fertiliser in the most productive parts of the field.

AGCO estimate that through using their complete Precision Ag tech portfolio a farmer can see a 20% improvement in profitability over five years by both improving yield and reducing cost. Clearly, the incremental profit benefit will also depend on the prevailing crop price at the time. AGCO’s “Precision Planting” division has the objective of achieving a one-year payback for farmers on their equipment—which, in our view, is compelling. AGCO’s precision planting division can also retrofit old equipment to transform old planting equipment to make it smart, if budgets are tight and a farmer needs a more economical solution.

**FIGURE 3: Economic and Sustainability Benefits of Precision Ag Technologies**

<table>
<thead>
<tr>
<th>Improved Outcomes Driven by Existing Technologies</th>
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<tbody>
<tr>
<td>Fuel Saved</td>
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<tr>
<td>Fertiliser Reduced</td>
</tr>
<tr>
<td>Soybeans Saved</td>
</tr>
<tr>
<td>Herbicides Reduced</td>
</tr>
<tr>
<td>Seed Corn Saved</td>
</tr>
<tr>
<td>Emissions Avoided</td>
</tr>
</tbody>
</table>

One farm can achieve lower GHG emissions equivalent to 1,000,000 passenger vehicle miles per cycle*

*Based on a 6,500 acre farm

John Deere estimates that a Midwest farmer growing corn and soybeans on a 6,500 acre farm using their latest technology today through planting to harvest can save on key crop inputs of fertiliser, seeds and herbicides, as well as over 16,000 gallons of diesel fuel. This has a material economic benefit of $40 per acre, or over $260,000 for the whole farm.\(^7\)

Deere has a technology, acquired through the Blue River Technology acquisition in September 2017, which can reduce herbicide application by up to 90%. Deere claims a weed-heavy farm can spend up to $80 per acre on herbicide. Typically, when a farmer applies herbicides they tend to spray the whole field, whereas Deere’s See & Spray technology uses cameras to only spray identified weeds—thus potentially cutting herbicide usage by a staggering amount. When Deere acquired Blue River Technology, the technology was being applied to lettuces, but Deere has now focused on using this technology on row crops and increasing the speed at which farmers can spray herbicide through the field, which is critical to providing a practical tool. This is clearly a win from both an economic and environmental perspective. The See & Spray technology is still in its infancy but it does have great potential for reducing herbicide application in the long term.

Precision and Digital Ag is also providing a tool for managing carbon levels in the soil, which is important as it would provide a system where farmers generate carbon credits and are actually paid to reduce emissions and sequester carbon. North American fertiliser and agriculture retail company Nutrien and global fertiliser company Yara International have already begun to roll out a farmer carbon credit trading system. We believe this carbon market, while still developing with the first pilot programmes being rolled out this year, has huge potential. Nutrien suggest that agriculture could be a major source of carbon credits and potentially represent 30% of the total carbon market by 2050, while Yara estimate that the agriculture carbon credit programme has the potential to be worth $10 billion.\(^8\)

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7. Source: Deere 2020 Sustainability Report.
**BIO-SOLUTIONS**

Bio-solutions is another method for farmers to reduce chemical pesticide usage and replace it with alternative methods such as enzymes and microbes instead. Bio-solutions can protect plants against pests and diseases (as a substitute for herbicides, pesticides and insecticides) and biological inoculants can help plants with nutrient uptake, for example more efficient uptake of fertiliser. In both of these categories, microbials still only account for a low to mid single digit percentage of the total market size, but have great potential.

Novozymes estimates that if all U.S. cornfields and chicken production applied bio-solutions, it would result in an additional production of 130 million gallons of biodiesel, 10 billion gallons of bioethanol, 2.3 billion extra pounds of protein rich animal feed and 21 TWh of bioelectricity. This productivity enhancement would be delivered while saving 90 million metric tons of GHG emissions, which is equivalent to taking 18 million U.S. passenger cars off the road.

Global crop protection company UPL has a ProNutiva programme, which provides a practical combination of bio-solutions and chemical pesticides to promote the growth of the crop. Chemical pesticides are still necessary as at present they at provide a complete solution for farmers to protect crops with a consequent benefit on crop yields. In the ProNutiva programme, UPL claims that farmers have a better yield and quality crop by using more bio-solutions, which also results in less bioresidues after harvest. UPL is a leading player in bio-solutions and has a commercial and innovation partnership with Novozymes.

**SEED TECHNOLOGY**

We will continue to need increasing seed yields to improve productivity, particularly if the land available to agriculture is reduced over the long term. Over the last 30 years, the majority of the yield growth in row crops has been generated from higher yielding seeds. This has been driven through enhancements in germplasm, which is the basic genetic material of a seed. Improvements through seed breeding can increase the quality of the germplasm and the yield potential. Genetically Modified (GM) crops supplement the traditional breeding of crops by inserting certain traits in the seeds. GM seeds can have pest management traits, herbicide tolerance and drought resistance. Although there is some concern with GM seeds around biodiversity loss, we believe this is outweighed by the advantages of higher yields and less chemical pesticide usage.

Leading seed companies such as Corteva and Bayer are in the vanguard of developing the germplasm and GM seed traits. The potential of the crop is first determined by the quality of the seeds, making it imperative to plant good quality seeds. In addition, the European Green Deal’s Farm-to-Fork strategy outlines the need for farmers to have access to a range of quality seeds for plant varieties adapted to the pressures of climate change.
Sustainable Protein Production Solutions

Animal protein production is responsible for the majority of agriculture’s direct GHG emissions. We look at how animal-based production can be made more sustainable through more efficient animal feed, improving animal health and sustainable agriculture. Finally, we look at plant-based protein alternatives such as plant-based meat and dairy products, which have a much lower environmental impact.

INCREASING THE SUSTAINABILITY OF MEAT PRODUCTION

The use of feed additives can improve feed efficiency and the health of animals, as well as reducing the environmental footprint. Feed additives can reduce the amount of grain and edible oils to produce the same amount of protein. An additive called eubiotics improves the gut health of animals and can displace the use of antibiotics. Dutch chemical company DSM has invented an animal feed additive called Bovaer—which is part of the company’s Project Clean Cow—that inhibits cows’ methane emissions by up to 30%, according to DSM. There have now been 26 studies published on this product and it has been filed for registration in Europe, with DSM guiding to commercialisation of the product in 2022.

New Zealand giant dairy co-operative Fonterra and DSM have signed a collaboration agreement to accelerate the transition to lower methane agriculture—and the Clean Cow technology could potentially help New Zealand take a leadership role in low carbon dairy production.

U.K. animal breeding company Genus genetically improves the health and quality of pigs and cows through breeding their elite animals and identifying desirable traits. While breeding to create superior animals has been going on for centuries, improvements in science have now made it possible to identify key traits in animals and breed those animals to create even more elite animals, including those which have particular characteristics such as feed efficiency, more calves or pigs per litter and healthier calves and pigs. Animal health products such as vaccines, parasiticides, medicated feed additives, anti-infectives and diagnostics can also help to improve productivity in the livestock industry.

SUSTAINABLE AQUACULTURE

Sustainable aquaculture could also be a part of the solution for protein consumption. Farmed salmon production is relatively efficient in terms of the carbon footprint and there is no risk of by-catch of other species when compared to wild catch in the sea (FIGURE 4). In our opinion, it is not surprising to see salmon farmers Mowi and BakkaFrost in the top three of the Coller FAIRR Protein Producer Index. This index was developed by the FAIRR Initiative in order to assess 60 of the largest listed global meat, dairy and aquaculture companies against 10 environmental, social and governance factors—all of which are aligned with the Sustainable Development Goals.

The sustainability of salmon production can be further enhanced through using more sustainable fish meal and oil, which is used to feed the fish that we consume. Pelagic fish is used in the production of fish meal and fish oil. Dutch chemical companies Corbion and DSM have used fermentation technology to produce an algae from sugar or corn that is high in Omega 3 and can be used in fish feed as a substitute for the fish meal and oil.

FIGURE 4: Farmed Salmon Has a Relatively Low Carbon Footprint

<table>
<thead>
<tr>
<th>Protein Type</th>
<th>Carbon Footprint (g CO2e/40g)</th>
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<tbody>
<tr>
<td>Farmed Atlantic Salmon</td>
<td>0.6</td>
</tr>
<tr>
<td>Chicken</td>
<td>0.9</td>
</tr>
<tr>
<td>Pork</td>
<td>1.3</td>
</tr>
<tr>
<td>Beef</td>
<td>5.9</td>
</tr>
</tbody>
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Carbon footprint is measured in grams of carbon dioxide equivalent per typical serving (40g) of edible protein of the product.
PLANT-BASED MEAT AND DAIRY

Plant-based protein production has much lower GHG emissions and water usage than animal-based equivalents. Therefore, from an environmental perspective, it would be beneficial if consumers incorporated a more plant-based diet. In fact, we are seeing some evidence of this in the U.S.

**FIGURE 5: Market Share of Alternative Dairy/Meat in U.S. Retail Channel**

The University of Michigan did a life cycle analysis of a Beyond Meat plant-based burger compared to an equivalent beef burger and found that the Beyond Meat burger produced up to 90% lower GHG emissions than traditional equivalents, while using 99% less water. Interestingly, the target audience of these products is not just vegans and vegetarians but also meat eaters. According to Beyond Meat, 93% of consumers who bought the Beyond Burger at Kroger grocery stores in the U.S. also purchased meat products during the first half of 2018. Beyond Meat are trying to produce products that are indistinguishable from meat. The company has taken a scientific approach of analysing meat by its composition including amino acids, lipids and vitamins. These nutritional values in animal meat can also be found in an abundance in plants. The plant-based meat is produced through a heating and cooling process. Beyond Meat believe that there are three key pillars that are crucial for plant-based meats to become more mainstream:

- **Taste and sensory**
  High quality products that are indistinguishable from animal meat

- **Nutritional content**
  Manufacturing a product that is superior in nutritional content

- **Pricing**
  Bring down prices at parity or below animal protein

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The biggest challenge for plant-based burgers is the premium pricing, as the quality has improved and they are generally healthier than animal alternatives. However, plant-based burgers are gaining momentum. For instance, McDonalds is launching their McPlant burgers in the U.S. following a successful test of the concept in Canada. Beyond Meat is also supplying KFC, Starbucks, Pizza Hut, Dennys, Subway and Taco Bell. Impossible Burgers are now sold in 17,000 grocery stores in the U.S. compared to about 150 stores one year ago. Plant-based burgers are also being sold in Asia and Europe, and U.K. food retailer Tesco even has its own brand plant-based burgers. While the global plant-based meat market is less than 1% of the animal meat market, these factors suggest it has great potential for growth going forward.

PLANT-BASED DAIRY PRODUCTION

Plant-based milk is a possible alternative for consumers who have lactose intolerance. In part due to this reason, Asia Pacific is the largest market for plant-based milks and, according to Morgan Stanley, represented around 50% of the market in 2017. Plant-based milks are a more mature market than the meat market, suggesting that growth rates are likely to be lower than the plant-based meats market where the recent improvement in quality has been significant and is helping to drive strong growth from a low level.

Key Takeaway

Food production and diets need to change in order to sustainably meet the anticipated increase in demand by 2050, while achieving other objectives such as increasing biodiversity—which is crucial in managing climate change.

Technology is creating a revolution in agriculture, particularly with Precision and Digital Ag, which is boosting productivity with a reduced environmental footprint. These technologies importantly also increase the economic sustainability of the farmer—in particular, AGCO estimate that full adoption of Precision Ag technologies could result in a $80 billion improvement in farmer profitability globally. Further, Digital Ag and Precision Ag technologies provide the prospect of a carbon trading place for agricultural emissions, which gives farmers an economic incentive to adopt more environmentally friendly farming techniques. In our opinion, this is a very exciting prospect to advance sustainability across the industry. The agricultural machinery companies with Precision Ag technologies could disproportionately benefit from this structural growth opportunity.

The growing emphasis on more environmentally friendly solutions will likely provide structural growth in biological solutions and increasingly displace synthetic chemical pesticides. Seed technology continually boosting yields will likely remain important to increase production without further inputs. We would also argue that there is a place for GM seeds as part of the solution to sustainably increase production and reduce chemical pesticide use.

Animal-based meat production will need to become more environmentally sustainable with improving animal feed and health. However, it is also clear that the amount of animal-based meat in diets will also likely need to reduce as it is so resource intensive to produce. In our view, it seems inevitable that plant-based alternatives such as plant-based meat and dairy products will continue to gain traction, particularly with the decline in prices of plant-based products.

Uncovering Opportunities

Based on our analysis, the Barings Global Agriculture strategy has invested in companies that are part of the solution with 84% of its AUM allocated across sustainability related themes. Sustainable arable farming solutions and protein solutions are two key sectors in helping to improve sustainability in agriculture and associated food chains, but there are many more sustainability related themes in the industry—from health and wellness, to circular economy/bio-products, to distribution and forestry.

The health and wellness theme is about improving or increasing access to more nutritious food. For example, ingredient companies such as Tate & Lyle can improve the nutrition of food by increasing the protein and fibre content and reducing salt, sugar and saturated fats. Meanwhile, the distribution theme focuses on companies that responsibly source food or provide a more sustainable and efficient transportation alternative—such as Bunge and ADM. Increased agricultural trade will likely become more necessary with increasing global populations particularly in Asia, and with a need to protect more land for biodiversity. In the circular economy/bio-products theme, companies such as Neste provide a biologically based alternative to fossil fuel based products such as renewable biodiesel. Finally, wood is a green building material that can be produced on an endlessly renewable cycle. Wood based companies that responsibly source their timber and maintain their resources, including Weyerhaeuser and Interfor, are providing a sustainable alternative to some less environmentally friendly materials such as steel and concrete.

FIGURE 6: Barings Global Agriculture Strategy Breakdown

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