Building a smarter food system

Global food & agribusiness (F&A) has much to do: it needs to increase food availability, improve access to food, ensure balanced nutrition and stabilise the global food system. This expansion is further complicated in markets where clear growth signals have given way to the more subtle, but equally powerful trends of urbanisation and modified consumer behaviour.

The recently adopted 2030 Agenda for Sustainable Development sets clear global goals for ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture. It will require ambitious action across global F&A. Action, in turn, requires investment that is targeted and well managed, so farmers, F&A companies and others that are taking the required measures and associated risks receive acceptable returns on their investments.

Rabobank has great confidence in global F&A; we believe it has the capacity to meet these goals and projected demands. While we foresee production increases in crops, meat and fish, and dairy across all regions—especially in those least constrained by resources and external pressures—we believe the nature of food production and distribution can and should change.

In Rabobank’s view, transition to a smarter food system will provide an opportunity to realise many of the necessary gains.

A smarter food system is more productive, more (globally) integrated, less wasteful and more profitable. It is more efficient in using resources to produce and deliver the food consumers need, where and when they need and want it, making it more sustainable.

A smarter food system combines technology and (big) data, and uses algorithms to change the way decisions are made and the speed with which decisions are taken—in food production, processing and distribution. By greatly improving supply chain connections, it offers scope to lift food production, optimise the use of resources, reduce waste and improve access to food. It should also improve stability in the global food system, encouraging investors along supply chains.

The road ahead will be bumpy, and full of climatic and other challenges. A key issue will be to engage—to communicate with society about the meaning and consequences of feeding 9 billion people in a sustainable way in 2050.

At Rabobank, we are excited about the prospects offered by building a smarter food system, and we invite you to join us on a journey to discover what exactly a smarter food system means and what it can offer.

Berry Marttin
Member of the Executive Board, Rabobank
Our food system needs to be smarter. Let’s build it.
The global food system needs to change

The current system—successful in many ways—needs to achieve even more, while, at the same time, pressure on the system is growing from four major drivers.

Pressure is mounting on the global food system. We need to:
1. Improve resource efficiency
2. Better meet consumer expectations
3. Improve profitability
4. Improve resilience

We need improved outcomes from the global food system:
1. Increase food availability
2. Improve access to food
3. Stimulate balanced nutrition
4. Enhance system stability

Change is inevitable. The combined need to improve resource efficiency and profitability, as well as the need for increased food availability, signals the direction of change.
We need to focus on boosting productivity

Growth in production needed to meet future demand will increasingly depend on lifting yields, and technology and data will have an important role in realising this.

**Future global crop production:**
Yield increases and cropping intensity will become even more important

<table>
<thead>
<tr>
<th></th>
<th>1961-2007</th>
<th>2005/07-2050f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arable land expansion</td>
<td>14%</td>
<td>10%</td>
</tr>
<tr>
<td>Increases in cropping intensity</td>
<td>9%</td>
<td>10%</td>
</tr>
<tr>
<td>Yield increases</td>
<td>77%</td>
<td>80%</td>
</tr>
</tbody>
</table>

**Future global meat production:**
Productivity gains become more important than increases in animal numbers

<table>
<thead>
<tr>
<th></th>
<th>1961/63</th>
<th>2005/07</th>
<th>2050f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of animals (millions)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>1,045</td>
<td>1,532</td>
<td>2,032</td>
</tr>
<tr>
<td>Pigs</td>
<td>424</td>
<td>917</td>
<td>1,141</td>
</tr>
<tr>
<td>Poultry</td>
<td>4,435</td>
<td>19,160</td>
<td>37,030</td>
</tr>
<tr>
<td>Carcass weight (kg per animal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>158</td>
<td>200</td>
<td>227</td>
</tr>
<tr>
<td>Pigs</td>
<td>65</td>
<td>79</td>
<td>84</td>
</tr>
<tr>
<td>Poultry</td>
<td>1.3</td>
<td>1.6</td>
<td>1.7</td>
</tr>
</tbody>
</table>

“Intensification—higher yields and more intensive use of land—needs to contribute 90% of the growth in global crop production to 2050.”

*United Nations Food and Agriculture Organization, 2012*

“Higher productivity—combining higher offtake rates and higher carcass weights—will become more important in meeting global livestock and dairy production needs to 2050.”

*United Nations Food and Agriculture Organization, 2012*

Source: FAO, 2012; Rabobank, 2015
A smarter food system can deliver what we need. A smarter food system is more productive, less wasteful and more profitable. It uses resources more efficiently to produce and deliver food where and when it is needed.
We’re starting to move to a smarter food system

Investors have started to back this trend as three sweet spots emerge: farming, processing and food logistics.

Investments in smarter food system start-ups—impressive though they are—are just a part of the story. New deal flow activity does not capture the sizeable investments being made by existing F&A companies, which are focused in three sweet spots.

Building a smarter food system is of increasing interest to investors—as evidenced by new deal flow activity.

<table>
<thead>
<tr>
<th>Year</th>
<th>Investments (Billion USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.5</td>
</tr>
<tr>
<td>2011</td>
<td>0.5</td>
</tr>
<tr>
<td>2012</td>
<td>0.5</td>
</tr>
<tr>
<td>2013</td>
<td>2.0</td>
</tr>
<tr>
<td>2014</td>
<td>3.0</td>
</tr>
<tr>
<td>2015</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Source: AgFunder, Rabobank, 2015

**Farming systems**
- Goals are to optimise farming systems, lift production and reduce losses

**Food processing**
- Goals are to achieve efficiency gains

**Trading, distribution and logistics**
- Goals are to improve food safety and traceability, and reduce waste
The base for a smarter food system is rapidly expanding

The world is fast becoming even more connected, and these connections can be harnessed as a force for positive change in global F&A.

Growth projections for the ‘Internet of Things’ highlight the potential—across all facets of society and industry—especially if innovators use this connectivity to create new business models, rather than simply digitising existing processes

Source: Gartner, 2014; McKinsey, Rabobank, 2015
Examples of a smarter food system in the works

Around the world and along supply chains

Building a smarter food system is about making the incremental gains that lift availability and improve access across the global food system. Boosting productivity and reducing wastes are fundamental building blocks in global F&A—they improve profitability and encourage ongoing investment.

Integrating (big) data into decision-making and other business processes in real time is a common challenge across the many case studies and development areas we have reviewed.
Everyone can gain from a smarter food system

Gains are available along supply chains and across sectors in global F&A.

**Farm Inputs**
- Phenomics are speeding up innovation: enabling two- to sixfold productivity gains

**Farming**
- Drones take farming to new heights: lifting productivity by 5% above business-as-usual
- Smart irrigation helps us to use water effectively: reducing water use by as much as 80%

**Processing**
- Fresh produce monitoring can lift quality and reduce waste: Fruit and vegetable losses and waste can be reduced by 25%-40%
  
**Distribution**
- Poultry production and processing gets connected: lifting productivity by 5% above business-as-usual

**Retail**
- The data cooperative is coming: Harnessing big data can create some USD 10 billion of value at crop farms worldwide, each year
- Big data helps food retailers create customer value: Retailers are looking to recover margins of at least 1%

Source: Rabobank, 2015
Phenomics are speeding up innovation

A smarter system can identify beneficial traits in seedlings and plants quickly and accurately, accelerating the production of new hybrids. New hybrids boost productivity and profitability.

Automated phenotyping offers multiple benefits over traditional human measurements—two- to sixfold productivity gains are possible:

- Increased speed and accuracy
- Reduced cost
- Shorter timeframe to introduce new varieties
- Improved fit between trials and field uses

LemnaTec’s technology takes image-based biological measurements—in the field, glasshouse or laboratory—and analyses the data to accelerate the identification of desirable traits in seedlings and plants. Drought and salt tolerance, and disease resistance are just a few examples.

Seed development and production enhance the integration along supply chains—seed companies can link more closely with seed multipliers and customers.

Source: LemnaTec, Rabobank, 2015
Remote technologies, such as drones, show great potential to reduce operating costs and increase productivity. Tech-savvy farmers and growers in areas with strong connectivity are already benefiting.

**Boosting livestock productivity:**
A livestock farm in New Zealand has identified some 40 applications for drone and sensor technology that are linked to the farm office. This has delivered:
- a large reduction in farm machinery running costs
- a 14% reduction in stock losses
- a 50% reduction in deaths of cast sheep
Analysing daily grass growth is the next goal — this information could help increase lamb production and, in the process, boost income by some USD 200/hectare.

**Boosting horticulture productivity:**
Noukatech provides a drone-based mapping solution for US specialty crops, such as vineyards and citrus farms. Drone-mounted sensors collect data on crop conditions. Algorithms translate data into targeted grower actions, such as nutrient applications, irrigation and harvesting schedules, as well as product marketing. The system boosts productivity through:
- Improved accuracy on crop conditions
- Less time spent surveying crops
- More targeted and efficient application of inputs
- Better prices for extra produce

**Productivity gains of the order of 5% above business-as-usual gains are achievable — through reduced inputs, targeted interventions and increased output.**

**Not a drone deal... at least not yet**
- Drones and aerial sensors are a work in progress.
- System reliability, algorithms that generate actionable advice, and real-time decision-making at scale are just some of the challenges to implementation.
Smart irrigation helps us to use water effectively

Current rates of global agricultural water demand are unsustainable. The efficiency of water and chemicals use can improve—by targeting what water is needed, and when and how inputs are applied.

**Smart farming systems improve the efficiency of water and chemicals use—by as much as 80%:**

- Variable rate irrigation—with pivots linked to GPS and field data—delivers water use efficiency gains.
- Plant and soil data sensors provide real-time information to inform variable rate delivery, saving water.
- New spray systems and soil treatments optimise the delivery of water and chemicals, reducing inputs.

Yara’s ZIM probe measures a plant’s water stress to enable irrigation on demand

Tule sensor systems provide field data to inform irrigation needs

On Target spray systems apply an electrical charge to create a fine mist of droplets that is delivered into the plant’s canopy


Smart irrigation systems improve the efficiency and effectiveness of water, nutrients and chemicals delivery to crops. They vary the applied rates, the timing of application and even the method of delivery in order to better meet crop needs.
The data cooperative is coming

Smarter crop farming—driven by big data, precision-farming equipment and algorithms—offers significant scope for boosting productivity. Farmers, suppliers and their customers need new relationships to build scale by sharing data and expertise.

Smarter crop farming can create some USD 10 billion of value at crop farms worldwide, each year

Value creation depends on data that enables a transformation from intuitive to more accurate and precise fact-based decisions

This data needs to be generated through data aggregation

Data in a farmer-owned data cooperative creates a level playing field for those that develop data-intensive solutions for farmers

Data cooperatives can also provide peer data, increase market transparency and support farmers’ marketing decisions

Source: Rabobank, 2015
Poultry production and processing gets connected

Increasing control over poultry hatching, production and processing—using online sensors that deliver data to remote control centres that respond in real-time—can boost productivity and profitability.

**Optimising production:**
- Improved monitoring at hatcheries improves feed efficiency and reduces the need for animal health inputs.
- Automated feeding systems respond to real-time data on flock demand.
- Indoor air quality sensors linked to control systems enable responses to heat and air quality stresses in real-time.
- Individual birds can be identified by sensor devices, facilitating targeted health interventions rather than flock-based approaches.

**Optimising distribution and consumer information:**
- Sensors in trucks enable remote monitoring of stress and welfare.
- Consumers can download the story of their chicken, using QR codes affixed in processing.

**Optimising system performance:**
- Processors can monitor the performance of poultry farmers, providing guidance on potential productivity and welfare gains.

Smarter poultry production and processing could achieve productivity gains of up to 5% above business-as-usual.

Source: University of Cambridge/Zoetis, Jackman/University College Dublin, Metabolic Robots, Rabobank; 2015
Fresh produce monitoring can lift quality and reduce waste

Fresh produce growers, processors, distributors and retailers can reap significant gains through the active monitoring of fruit and vegetables along supply chains.

Radio frequency identification (RFID) tagging has long been used for high-value non-food products, and its potential is crossing over into fresh produce, helping to improve the tracking of shelf life and quality of fresh produce.

The cost of RFID tags is coming down, making them an affordable option for fresh produce retailers and distributors.

Cooperatives and distributors will make this technology accessible in emerging markets, while food retailers will be the drivers in developed markets.

Improved decision-making based on quality measured by smart sensors reduces waste by 25%-40% in F&A supply chains

Enhancing fresh produce in emerging markets

RFID monitoring can improve production and processing in emerging markets. Big data can calculate the optimal time between harvest and processing, and can reduce the costs of inspection and manual monitoring.

Enhancing fresh produce in developed markets

RFID monitoring can be used by retailers to improve the prediction of shelf life and, hence, quality. It also enables them to adjust pricing based on quality and shelf life. Pilots at retailers have shown that quality-steered pricing increases sales of fresh produce categories, while requiring less inventory.
Big data helps food retailers create customer value

Retailers have access to vast amounts of consumer and other data, and leading retailers are finding new ways to create value from this data by optimising inventories and targeting assortments to customer preferences.

Food retailers are embracing big data as a source of value creation and are seeking to at least recover margins of 1% in the process.

Better predicting customer needs is a new driver of competitiveness. It can:

- Sharpen the customer value proposition
- Develop a more distinctive position
- Generate new income by selling customer data to suppliers

It’s an omni-channel world:

Customers want retailers to provide the same products, information and conditions—anywhere and anytime.

Walmart: using big data to better meet customer needs

Analysing customer and weather data optimises ordering and inventory, for distributors and retailers. For example:

- Ideal berry weather: temp. <27ºC, with low winds.
- People eat more steak when it’s warm and windy, but not raining.
- Ground beef and salads excel at higher temps, with low wind and sunny conditions.

Source: Walmart, Rabobank, 2015
What it will take
Three keys to building a smarter food system

The diversity of examples and the scale of productivity gains they can deliver demonstrates what is possible by building a smarter food system. But just because it is possible doesn’t mean it will be easy. Specific actions are needed to manage risks and secure investments in building a smarter food system.
**Achieve societal acceptance**

- Consumers tend to favour simplicity when it comes to food production, but simple approaches will not deliver all of the change that is needed in the global food system.
- It is important that any concerns consumers may have around change in the food system are understood and taken into account in the change process.
- In some cases, issues are not ‘black-and-white’ for consumers, and informed decisions require higher levels of engagement and education.

**Strengthen supply chains**

- In building a smarter food system, buyers and suppliers are taking on new risks in pursuit of new rewards.
- Strong supply chains are needed to share risk and reward between buyers and suppliers along the chain.
- Success depends on greater connectivity between buyers and suppliers, sharing data and making joint decisions in real time.

**Enable investment**

- New approaches and new technologies entail new areas of risk and opportunity.
- Investors and financiers need to back new projects, with appropriate mechanisms to manage risk and secure relevant risk-adjusted returns.
- Accelerating the commercialisation of new technologies, data capture and decision-making algorithms is particularly important.
The case for strengthening F&A supply chains

F&A companies face relentless pressure on supply chains. Successful responses require a shift in focus—from chasing price to adding value—and action in four growth areas.

Focus on delivering innovation as the litmus test for strong buyer-supplier relationships

Optimise inventory management so all partners contribute to and benefit from growth

Improve routes to market to get closer to buyers and consumer preferences

Manage complexity as supply chains shift from simple lines to more complex webs

Source: Rabobank, 2015
The best relationships are built on innovation

Collaborative supply chain relationships facilitate innovation—to reduce risk and production costs, and access new markets. If buyers and suppliers see value in working together, they will invest in innovation for mutual gain.

Buyers consistently say they depend on their suppliers to deliver innovation. So who is waiting for whom?

According to recent surveys of supply chain managers:

- 80% of companies are adopting collaborative business models with suppliers and customers to improve speed-to-market and lower innovation costs.
- 70% of companies see innovation as a critical path to growth.
- 60% of top companies are looking for suppliers to introduce new ideas and innovative thinking.
- 40% of top companies list supplier innovation among their top two business priorities.

Innovation is needed to access growth markets—for example, most growth in palm oil trade will be for certified and traceable supply.

The Roundtable on Sustainable Palm Oil (RSPO) offers multiple approaches to certification, with varying degrees of chain control.

The sharing of risk and reward along strong supply chains is an important pre-condition to increasing the focus on innovation. Buyers often control the sharing of risk and reward, so can readily signal the need for innovation to suppliers.

The trend to 2020 is for palm oil sourcing by branded food and personal care companies to focus on increasing supply chain control, which depends on innovation between buyers and suppliers.

Source: IBM, KPMG, RSPO, Rabobank, 2015
Building a smarter food system will need investment

New approaches require investment to capitalise on the opportunities. Investors are looking for an acceptable risk-adjusted return.

Investment and finance is needed in the three elements of a smarter food system:

- **Technology**
- **Big Data**
- **Algorithms**

- **Technology**
  
  Will the new technology, data capture and algorithms work as intended?

- **Market**
  
  Will the smarter food system be able to compete in the market and generate adequate returns?

- **Business**
  
  Can the technology, data and algorithms be implemented as intended and integrated into current business systems?

- **Regulatory**
  
  Does the smarter food system fit within current regulatory boundaries?

- **Reputational**
  
  Will the new approach raise public concern?

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Source: Rabobank, 2015
Market forces are essential to commercialising technologies

As new technologies mature, they depend on the pull of market forces towards commercialisation. Many can get lost in a ‘valley of death’ as market forces elude them, unless steps are taken to reduce risk.

Outside investors are looking for a profitable exit

- Angel Investor
- Seed Capital
- Venture Capital
- Early-Stage Investors
- Late-Stage Investors
- Growth Investors

F&A companies have a complementary role in investing to support commercialisation

Source: Rabobank, 2015
The idea of small-scale, ‘natural’ farming is inherently appealing, but is not the reality of modern farming in much of the world. In order to feed the world efficiently, change is needed, and society’s concerns also need to be taken into account. We cannot build a smarter food system, enhancing sustainability in the process, without public support.

**Food waste**

“They say we already produce enough food to feed the world, but losses and wastes prevent food from reaching everyone who needs it. How can this be? What should governments do to reduce waste? What about companies, and even us as consumers?”

**Nutrition**

“In developed countries, we eat too much fat and sugar, and we are facing big public health costs as a result. Should governments set limits on sugar and fat levels in food? Can the companies self-regulate, or do we use our own judgment as to what we eat and drink?”

**Genetic modification and cloning**

“Do we really need all technology options to improve sustainability in how we feed the world, or do some technologies cross a line? How do we decide where that line is set?”

**Animal welfare**

“We accept it’s OK to rear animals as human food, but animals need to be treated humanely. How do we set scientifically-based standards that also meet our expectations of humane treatment?”

**Who owns my big data?**

“We understand that big data and analytics offer scope to improve productivity in global F&A. But who owns the data, and what can they do with it? There’s a lot I don’t really know here, but I think I want to keep my data private.”

Source: Rabobank, 2015
Conclusions
Improving productivity, connectivity and sustainability

**A smarter food system offers enormous scope to improve the productivity of global food production.**

**Productivity gains of at least 5% are within reach across a number of sub-sectors, supply chain stages and regions.**

These gains may not appear spectacular when viewed as isolated cases, but once they are scaled up and rolled out across global F&A, the magnitude of potential change is transformational.

Change of this scope is not going to be straightforward—Rabobank believes a focus in three areas will be key to success:

- **Build and strengthen trust** in relationships along supply chains. Buyers and suppliers need to accept change, embrace innovation and recognise this is best achieved working collaboratively.

- **Invest for long-term success.** We need investors who recognise the importance of market pull in facilitating investment, appreciate the risks involved in change and are willing to invest in pursuing the opportunities.

- **Bringing society along for the journey.** Deeper engagement between global F&A and society—with open discussions and an exchange of perspectives—can lead to improved understanding on the need for and opportunities resulting from building a smarter food system.

**Rabobank is positive about building a smarter food system—yet realistic about the risks and opportunities involved in this change process.**

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Banking for Food is Rabobank’s vision on global food security and the role of the bank. As a consequence of a growing and wealthier global population, the demand for food is expected to rise considerably. The food and agri value chains have to produce more with fewer natural resources. As a leading international food and agri bank, Rabobank aims to support and facilitate in meeting this challenge—by providing access to finance, knowledge, and networks to clients and their communities.