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INSTITUTE FOR SUSTAINABILITY LEADERSHIP

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EXECUTIVE SUMMARY

FOOD SECURITY

Closing the food gap: opportunities for investment?

GROUPE BPCE

EXECUTIVE SUMMARY

A multidimensional issue

The Food and Agriculture Organization of the United Nations (FAO) and the World Health Organisation (WHO) define food security ***as a situation where 'all people, at all times, have physical social and economic access to sufficient, safe, and nutritious food to maintain a healthy and active life.'*** For Mirova, any interpretation of this concept in light of investing involves the additional dimension of sustainability: ensuring that the conditions necessary to produce foodstuffs do not deteriorate and jeopardise the food security of future generations.

The three main pillars of food security are commonly considered to be:

- **Availability** (domestic production and imports);
- **Access** (determined by income, purchasing power, and transport/market infrastructure);
- **Use** (food safety, supply chain processes, dietary habits).

However, while food security is conceptually fairly easy to grasp, it is extremely complex in practice, and the issues involved each have multiple dimensions: public/private, supply/demand, upstream/downstream, developed and developing countries.

Where are we today? Currently, the world's agricultural production of 8 billion tonnes in 2012 (FAO, 2012) would hypothetically suffice to feed the population of the planet. Yet undernutrition remains a serious problem in certain parts of the world, even as obesity rates skyrocket in both developed and developing countries.

Where will we be tomorrow? Independently of distribution issues, our research, based on OECD-FAO figures, suggests **that 1.5 billion tonnes of additional food will be needed over the next 10 years1 (equivalent to 2% CAGR for 2012-2022)** to ensure adequate supply for the expected population. This difference between current production and future need is known as the 'food gap'. Meeting this increased need will have to take place in the face of growing constraints as well.

Supply-side challenges ahead include:

- **Limited access to arable land** due to urbanisation and conflict over land resources;
- **Limitations on yields** caused by:
  - Climate change (fresh water scarcity, temperature variations, CO_2 levels),
  - Depletion of resources (erosion, soil depletion, biodiversity losses),
  - Biotic factors (pests such as fungi, insects, rodents, weeds).

In terms of demand, concerns revolve around the following issues.

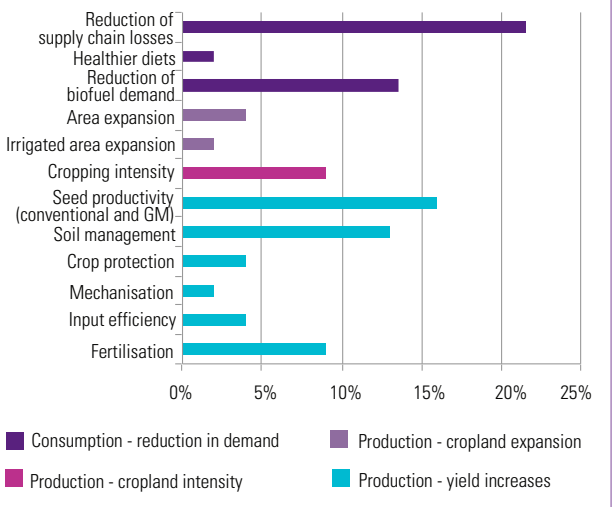
- **Population growth:** while demographic trends are expected to flatten, a population increase of approximately 1 billion is expected by 2025;
- **Shift in consumer diets:** a vast expansion of the middle class is already underway. This is accompanied by increased consumption of calories, especially resource-intensive animal proteins;
- **Increasing demand for crops** destined for non-food uses.

Closing the food gap: defining an approach and estimating needs

For the purpose of this study, we have limited our understanding of food security to the first two pillars of the definition, i.e. providing enough food to meet future requirements with constrained resources, leaving quality aspects aside.

Solutions for closing the food gap are likely to come from both production innovations and changes in consumption trends: on the one hand, it is essential that we increase the supply of food, while on the other, there is real potential for a reduction in demand for certain commodities. Based on an extensive review of key sources (Alexandratos & Bruinsma, 2012; FAO, 2013; Fuglie & Nin-Pratt, 2012; OECD-FAO, 2013; WRI, 2013), we have estimated a broad range of sources liable to provide additional growth in the next ten years. These have been aggregated in Figure i, details on pp. 15-16).

Figure i. Main sources of increased food availability for the next ten years identified by Mirova (percentages represent the relative contribution of each solution the estimated growth)



Source: Mirova, 2014.

1. While we acknowledge that food security will probably not be achieved within 10 years, we assume that the solutions proposed are also suitable for a longer horizon, and that 10 years is a reasonable time perspective for a long term investor.

According to our estimates, approximately 38% of the additional food needed to close the food gap will come from the consumption end, predominately from **avoidance of supply chain losses**, both close to the farm (postharvest, transport, and storage losses) and close to the fork (processing retail, shelf life). We also believe that reducing demand for biofuels that compete with food by **developing 2nd and 3rd generation biofuels** would, if implemented, contribute to closing the food gap. The balance of the food supply increase, or 62%, will have to come from the production side. A portion of this will be shouldered by **expansion of irrigation** designed to permit the cultivation of crops in areas previously not considered arable, and **expansion to areas not previously cultivated.** While the former solution involves water management infrastructure, the latter often entails deforestation and may require major infrastructure. According to our estimations, **yield increases will account for providing around 44% of the increases to available food needed to feed the world's population over the next 10 years.**

In terms of solutions that produce increased yields, **mechanisation** was the primary driver of the first 'Green Revolution,' however, we do not anticipate it to be highly important in further advances, except in developing countries that were previously passed over. **Soil fertility management,** however, is necessary both for improving yields in terms of weight and nutritional value, and for ensuring sustainability. While much has been made of biotechnology, we do not expect **genetically modified, or GM breeding** to make large contributions compared to **conventional seed productivity** improvements, but taken together, the improvement of plant traits is a significant factor. The broader deployment of crop protection methods, both **chemical pesticides and bioprotection**, is also expected to boost yields somewhat. Lastly, increasing the efficiency of inputs, including **rainwater harvesting,** better irrigation and **precision agriculture**, will likely go a small way toward meeting the agricultural production increases needed.

As a responsible investor, **investing in these sources of growth means honing in on potential private sector contributions to closing the 'food gap' while increasing agricultural sustainability and ensuring access.**

Our analysis therefore focuses on the solutions linked to these sources of growth, and provides a synopsis of the effectiveness, sustainability, and cost of implementing each one.

Private sector potential

Obviously, not every solution lends itself to private investment. Certain aspects of food security, for instance, are not treated here at all, notably issues linked to changing dietary habits at the consumption end or increasing crop rotation on the production side.

In this study, we highlight investment opportunities in the developing world, as this is currently where we see the highest value added from private investment, both in terms of closing the food gap, and realizing social and environmental benefits. According to the UNCTAD (United Nations Conference on Trade and Development), the annual investment gap for the 2015-2030 period is estimated at US$ 260 billion in the developing world.

The developed world has an important role to play, especially as concerns consumer efforts, but these are, in many instances, behavioural changes that are primarily the purview of the public sector.

Another upside of investing in developing countries is that they often promote investment in infrastructure that is beneficial for the population as a whole, as well as enabling significant knowledge transfers. But it is also important to weigh the sustainability of outcomes in making agricultural investments, and one of the most significant risks for local populations is environmental degradation, followed by dispossession of traditional land rights following large-scale land deals. As a first step towards evaluating private investment's impacts, the global community has established a framework for guiding investment in agriculture in the form of the **Principles for Responsible Agricultural Investment (PRAI**), which will be taken into account in our assessment of companies. These guidelines cover 10 areas : contribute to Food Security and Nutrition, contribute to sustainable and inclusive economic development and the eradication of poverty, foster gender equality and women's empowerment, engage and empower youth, respect tenure of land, fisheries, and forests, and access to wate, conserve and sustainably manage natural resources, increase resilience and reduce disaster risks, respect cultural heritage and traditional knowledge, and support diversity and innovation, promote safe and healthy agriculture and food systems, incorporate inclusive and transparent governance structures, processes and grievance mechanisms, assess and address impacts and promote accountability

Amongst the many innovations developed by the corporate sector that have been identified, which are likely to be the most cost-effective and sustainable in closing the food gap? **Our approach has been to monetise environmental and social benefits, and subtract these amounts from the estimated cost of implementing the solution itself.** Conversely, the estimated cost of environmental and social harm is added to the cost of implementation.

In a first cost curve, we thus examined the payoff, in terms of euros of food produced (using World Bank pricing), for each euro of investment in a particular solution, against a baseline of €1 to €1 parity. The conclusion was that a majority of the solutions identified are 'cost effective', and that yield increases provide the highest cost efficiency overall.

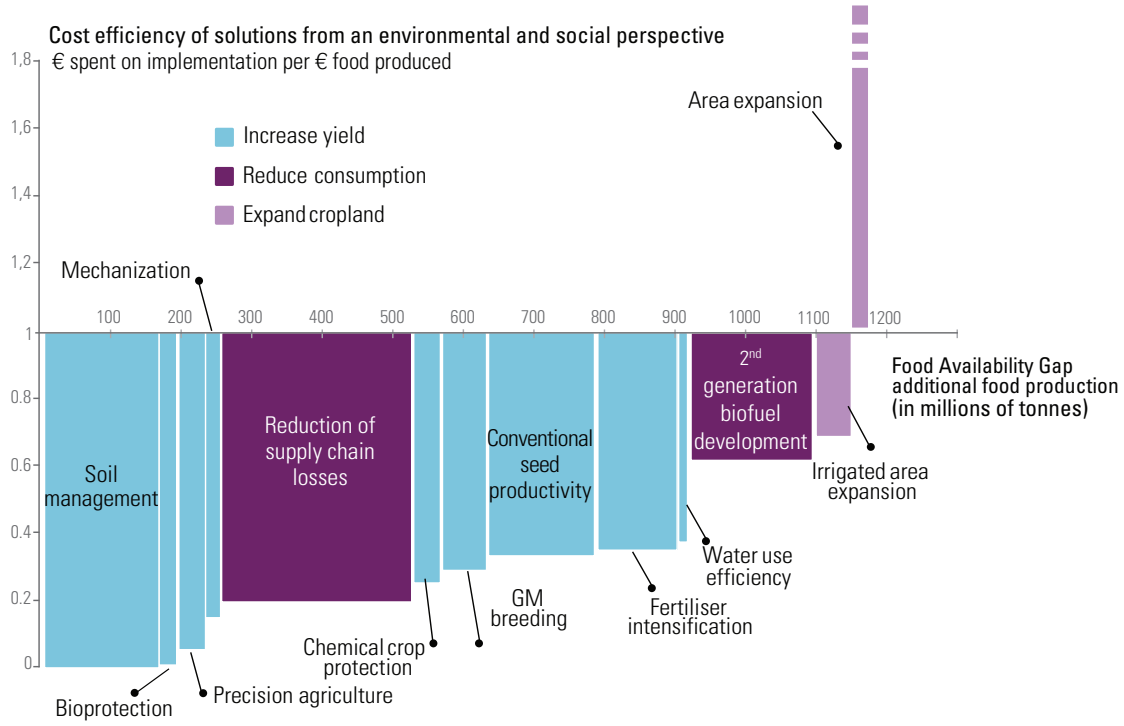
We then incorporated the monetised impact of social and environmental factors, based on the following proxys: price of CO_2 emissions, environmental costs for water use and value of pollination services provided by the ecosystem (see Figure ii).

In light of these calculations, certain solutions, such as soil fertility management and bioprotection, carry no cost at all, once the environmental benefits are calculated. Expanding the area under cultivation, on the other hand, tends to carry high costs once environmental externalities are taken into account, because of the destruction of CO_2 capture ecosystems and loss of biodiversity associated with deforestation.

With the exception of area expansion, the conclusion of our research is that all solutions have a role to play in closing the food gap by 2025. However, our attention will focus on

solutions that best take into account environmental and social externalities including responsible soil management (biofertilisation, low/no till seeding, organic farming, etc), bioprotection, precision agriculture, reduction of supply chain losses.

Figure ii. Cost curve for proposed solutions adjusted for environmental and social impacts



Source: Mirova 2014.

These cost curves, of course, represent a work in progress. The key to improving their accuracy and relevance lies in incorporating additional features (geographic distinctions, valuation of additional environmental externalities such as soil fertility, and social externalities such as life-expectancy and health issues).

Options for investing in listed equities

Having determined the highest-potential areas for private investment in solutions to closing the food gap with positive social and environmental impacts, we then turned to identifying specific companies significantly exposed to such solutions in which to invest. Bearing in mind that our investment scope is limited to listed equities, de facto excluding a large spectrum of potential investment opportunities (private or small companies, public-private partnerships, etc.), we screened a large universe of listed companies to identify those involved in these solutions. Selected companies present at least one of the following features:

- offer an environmentally-friendly alternative to conventional agriculture;
- provide current solutions to the problem of increasing food availability and access with a strong exposure to developing countries.

All companies were required to fit within our investor constraints.

The conclusion of our screening was that the choice of 'pure players' combining innovation, impact and sustainability, and fitting our investor constraints remains restricted on this theme. Innovative sustainable solutions that contribute to resolving the food security challenge are either developed within small divisions of large corporations involved in very diverse activities, or else by small (and often unlisted) enterprises.

Table i. Examples of companies offering sustainable food security solutions (within our investor constraints)

	Value Chain	Examples of companies offering sustainable solutions	Exposure
Improving food AVAILABILITY - Farming efficiency	**Farm inputs**		
	Seeds	VILMORIN ET CIE	Medium
	Other inputs (fertilisers, crop protection, etc.)	NOVOZYMES AS	High
	Farming equipment		
	Machinery	KUBOTA CORP.	High
		DEERE & CO.	Medium
		AGCO CORP.	Medium
	GPS and other technologies	TRIMBLE NAVIGATION LTD.	Medium
		TOPCON	Medium
	Irrigation	JAIN IRRIGATION SYSTEMS LTD.	High
		TORO	Medium
		VALMONT INDUSTRIES	Medium
		LINDSAY CORP.	Medium
Improving food ACCESS - Reducing food losses and waste	Packaging	MPACT LTD.	High
		MONDI	Medium

Source: Mirova 2014.

In light of this reality, it may be necessary to consider other feasible solutions if the food gap is to be closed. We therefore broadened our screening of companies to include more conventional solutions to closing the food gap, what we would consider business as usual solutions (BaU). Nevertheless, where solutions pose high environmental and/or social risks, a company's capacity and willingness to minimise and manage such risks must be meticulously analysed (see for example Mirova's previous study on palm oil).[2]

Table ii. Examples of companies offering BaU solutions contributing to food security (within our investor constraints)

	Value chain	Examples of companies
Improving food AVAILABILITY - Farming efficiency	**Farm inputs**	
	Seeds	KWS Saat AG
	Other inputs (fertilisers, crop protection, etc.)	The Mosaic Co., K+S AG
	Farming equipment	
	Machinery and other agricultural technologies	Bucher Industries, CNH, Exel industries, Titan International
	Production	
	Farms/Farming	Select Harvests Ltd, NBPO Ltd, Fresh Del Monte Produce Inc., China Modern Dairy, Adecoagro, SLS Agricola
Improving food ACCESS - Reducing food losses and waste	Storage / Transportation / Refrigeration	Canadian National Railway Co., Ag Growth International
	Packaging	Brambles, Mayr-Melnhof Karton AG, Winpak Ltd, Rock-Tenn Co., Packaging Corp. of America

Source: Mirova 2014.

A closer look

In addition to providing a list of companies we feel actively contribute to sustainable food security, this study investigates three categories of food security solutions that were selected to address issues that are prominent in debates today. Our focus on postharvest losses illustrates the differing profiles of solutions in developed and developing countries. Biotechnology, especially the area of GM seeds, is an issue that inspires confusion and hot debate. Water management was selected because it is closely tied to climate change, and critical to human health.

Postharvest losses

According to the UN, 1.3 billion tonnes, or nearly a third of food production, is wasted or lost each year. Food waste involves food that is fit for consumption but discarded at the retail or consumer level: this is largely a problem in the developed world. Food losses, on the other hand, refer to food that spills, spoils, is attacked by pests or incurs an abnormal reduction in quality such as bruising and wilting. This type of damage takes place primarily between the harvest and processing phases, and affects the developing world most deeply. Estimates suggest that 170kg/yr per capita could be saved by eliminating Postharvest losses (PHL) in Sub-Saharan Africa and Asia.

Solutions to focus on are then different for developing and developed countries.

From our review of the available options, **mechanisation, cooling and packaging** are the key solutions for tackling food losses in developing countries. Several technologies and practices have been identified as combating PHL in **developing countries**, including machinery (combined harvesters and threshers), Integrated Pest Management (IPM), humidity and temperature monitoring and control devices. Storage improvements entail extending the application of basic technologies such as containers that are pest-proof (plastic crates, hermetic polythene bags or metal silos). There is an especial need for companies offering transport containers designed to protect specific types of crops in transit, and for providing infrastructure (roads etc.); improvements in this area are particularly important for enabling development of the cold chain.

In developed countries, perishable food items are often transported considerable distances, while conventional standards require that fruits and vegetables show no signs of bruising or wilting. Several new technologies have emerged to reduce such damage and/or prolong shelf life. Modified atmosphere, which reduces cellular respiration, currently garners the most votes for potential effectiveness.

Technologies for maintaining a cold chain and packaging solutions (from hermetic seals in developing countries to more innovative modified atmosphere packaging or smart packaging in developed countries) have thus the potential to reduce Food Losses and Waste (FLW) at many stages of the food chain.

Biotechnologies

The topic of GM technology is not an easy one. The technology itself is fairly complicated and the environment surrounding it (regulation, public opinion) even more so. Nevertheless with seed companies spending a significant amount of their R&D into the area, it has become an issue for responsible investors.

In terms of food security, there is no question but that GM has a role to play. GM technologies present a wide variety of opportunities: increased food availability, more efficient use of natural resources, improved soil fertility management, increases in farmers' income. At the same time, GM solutions also present a broad array of potential risks. There remains considerable ignorance as to the long-term impact, both environmental and in terms of human health, of applying such technology on a large scale. Risks are largely similar to the problems associated with all monocultures, and include pest resistance, threats to biodiversity, and risk of reliance on very few varieties. Confusion and fear on the part of the public further make for a regulatory climate that augments risks associated with investment in biotechnologies, as there is little assurance that products will be permitted to market. Nearly all countries impose some kind of restriction on GM foodstuffs.

2. All the selected companies undergo further environmental, social and governance (ESG) risk reviews as well as an in-depth analysis of their economic and financial potential before entering our portfolios.

As a responsible investor, Mirova endeavours to integrate all these elements in its assessment of seed companies. While acknowledging the significant public mistrust surrounding GMOs and more broadly vegetal biotechnologies, it appears that these technologies have a role to play in providing for food security and nutrition which should not be overlooked. Given its capacity to permit more efficient plant breeding and offering possibilities which cannot be achieved by conventional breeding techniques, reliance on biotechnology should not be considered in and of itself a reason for exclusion. Biotechnology embraces a large number of techniques, some of which have been applied for decades. Some emerging technologies may raise concern, and scientific evidence of their innocuity must be produced. However, despite significant environmental and social issues linked to the current GM crops (mainly reliant on transgenesis), a direct link between the technique used and observed externalities over the last 15 years (resistance to pests, pollination issues, etc.) has not been clearly demonstrated by scientific research. In the absence of sufficient scientific conclusions regarding techniques, we seek to assess companies on the sustainability of the outcome where GM crops are concerned.

Essentially, GM is one solution that, properly employed, can find a place within sustainable food security, particularly when used to tailor seeds to local conditions, but is not a panacea. The focus needs to be on outcomes, including the full horizon of risks, particularly social risks associated with dependence on industrially controlled seed material.

As each GM crop is unique, a case-by-case analysis is needed. The following factors are to be considered when analysing and engaging with companies:

- Traits of the GM crop: bio-fortified crops, crops with enhanced medical traits (e.g. vaccine crops) and other crops that would allow significant social and environmental benefits will be favoured;
- For already available crops, a proven track record of improved agricultural performance while minimising environmental and human safety issues;
- Proven use of the precautionary principle when handling GM technologies;
- Transparency over the impacts of technologies used and scientific advances;
- Ability of the governments where the technology will be used to provide good governance over the technology;
- Transparency over labelling and traceability beyond legislation;
- Engagement with and educating stakeholders, particularly the farmers and consumers;
- Risk/benefit analysis compared with alternatives approaches.

Water management solutions for increasing yield

Water demand is expected to outstrip supply by 2030. Given that the agricultural sector is one of the biggest consumers of water (70% of total withdrawals), it will be sensitive to any changes in water supply. As such, if we are to ensure global food security, it is essential that we also secure the world's water supply.

The study focused on two main solutions, those aimed at **conserving water** and those which **provide alternative sources of water suitable for agriculture.** Solutions designed to conserve water include techniques such as **smart irrigation, water loss reduction strategies and conservation agriculture.** Those that make available alternative sources of water encompass technologies such as **desalinisation, wastewater treatment and water reservoirs.** Of the two categories, greater effort should be directed toward increasing water efficiency and promoting water conservation as these have a more direct impact on agriculture. While these solutions have already been available on the market for some time, adoption remains relatively low due to high initial investment costs, rarity of the skills needed to implement the technologies, and little or no incentive for farmers to adopt more efficient practices as water prices remain low. Consequently, improving education and increased awareness amongst farmers can and should play an important role in accelerating adoption of these solutions.

⊕ **Click here to read the complete study, also available at www.mirova.com**

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