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Empowering Japanese agriculture for global impact

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Preface

Japan's agricultural sector is the ninth largest in the world (production volume base, 2013), and the country's cuisine is world renowned as exquisite, high quality, and healthy. At the same time, Japanese agriculture faces threats, including challenging producer demographics and inefficient infrastructure domestically, and intensifying global competition abroad. In this report, McKinsey examines the unique nature of Japan's agricultural sector against a changing global market environment. In addition, we identify opportunities for growth and consider innovative practices that could contribute to the industry's long-term viability and competitiveness.

This study brings together research and experience from McKinsey's Japan office and its global Agriculture Practice. The research team comprised Takeshi Kawanishi, Yunzhi Li, Shohei Naito, and Karl Tojic. We are also grateful for the advice and contributions of Anja Bühner-Blaschke and Victor Guzik.

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Introduction

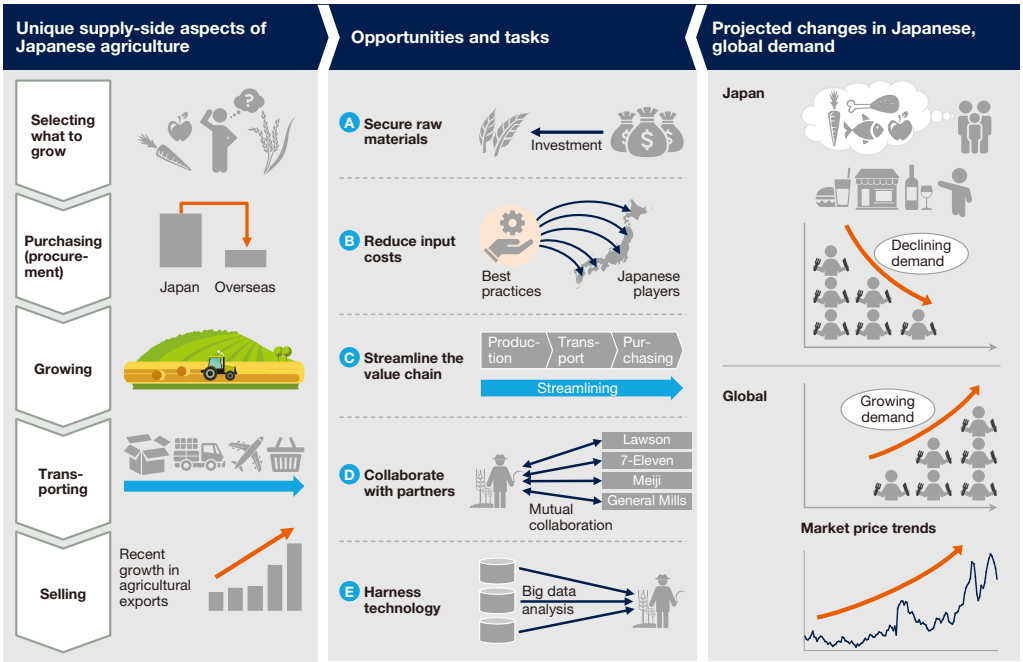
Japan is a global powerhouse across numerous industries, but to date the agricultural sector has been an exception. Japan boasts fertile land and ample water resources, but also faces far higher input costs than its Western peers. The country generates billions of dollars in exports from its traditional dietary cuisine, known as *washoku*, but export earnings from all agricultural products has remained flat for decades. Meanwhile, other advanced nations have achieved sustained export growth. Despite having the ninth largest agricultural sector in the world (agricultural production volume, 2013), Japan's agricultural GDP has been shrinking by about two percent a year. Those engaged in farming in Japan are getting older, and, unless action is taken, the challenges facing the agricultural sector are likely to grow.

Against this backdrop, clear opportunities are available for Japan to change the trajectory of its agricultural sector. Different approaches to sourcing that move away from a reliance on overseas suppliers, value creation achieved through big data analysis, and use of technology to improve the overall value chain, among other measures, could generate substantial impact on sector performance. Examining these options amid a global agricultural environment in which resources are increasingly constrained and demand is growing rapidly can help guide the actions Japan's agricultural sector can take to improve its overall health, both domestically and abroad.

The findings in this report are based on research by McKinsey & Company, which has more than 100 offices around the world and has worked to understand agricultural strategies, policies, and trends at the global, national, and corporate levels. In the first chapter, we focus on the unique aspects of the Japanese agricultural sector, particularly supply and comparisons with other advanced nations (Exhibit 1). Next, we look at the changing agricultural landscape more broadly and some key macroeconomic trends likely to affect the global industry. Finally, we examine specific opportunities available and innovative measures Japan could take to improve producer profitability and the overall health of the agricultural sector.

Exhibit 1

Framework for understanding the issues and opportunities facing Japanese agriculture



Unique supply-side aspects of Japanese agriculture

Agriculture is a major industry in Japan and has grown modestly over the past few decades. Japanese agricultural production grew from $12 billion in 1970 to $41 billion in 1985. By 2013, the latest data available, it had reached $58 billion, making the Japanese agricultural sector the ninth largest in the world. Nominal growth may skew the picture, however. In real terms, using 2005 prices as the base, production only grew from $72 billion to $77 billion between 1970 and 1985.

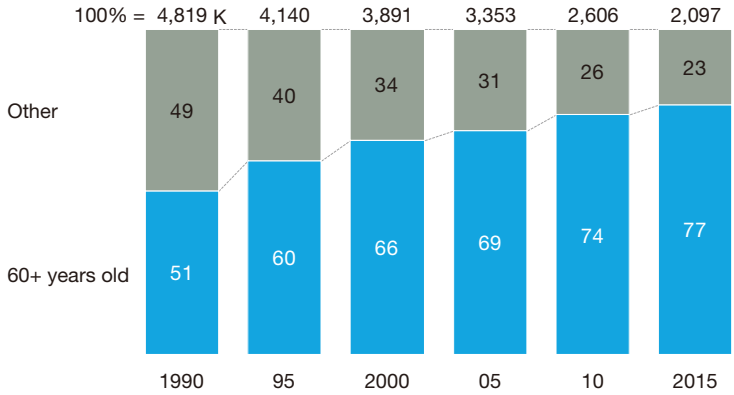
Japan's producer population is rapidly aging, and in coming years those aged 60 and up will comprise over 70 percent of all producers

Despite its size, the sector faces a number of challenges. Among these, domestic consumption is expected to decrease. The "Basic Plan for Food, Agriculture and Rural Areas" published by Japan's Ministry of Agriculture, Forestry and Fisheries forecasts that while domestic demand for fruit and vegetables will remain stable through 2025, demand for rice will fall an average of 1.1 percent a year over the period. In addition, a rapidly aging agricultural workforce is also concerning; Japan's producer population is rapidly aging, and in coming years those aged 60 and up will comprise over 70 percent of all producers (Exhibit 2).

Exhibit 2

Among the challenges facing Japanese agriculture is the rapidly aging workforce

Aging trend among Japanese farmers
Percent; agricultural producer population



SOURCE: "Agricultural census," Ministry of Agriculture, Forestry and Fisheries; McKinsey analysis

Beyond these external challenges, many characteristics within the agricultural sector itself contribute to the challenges at hand.

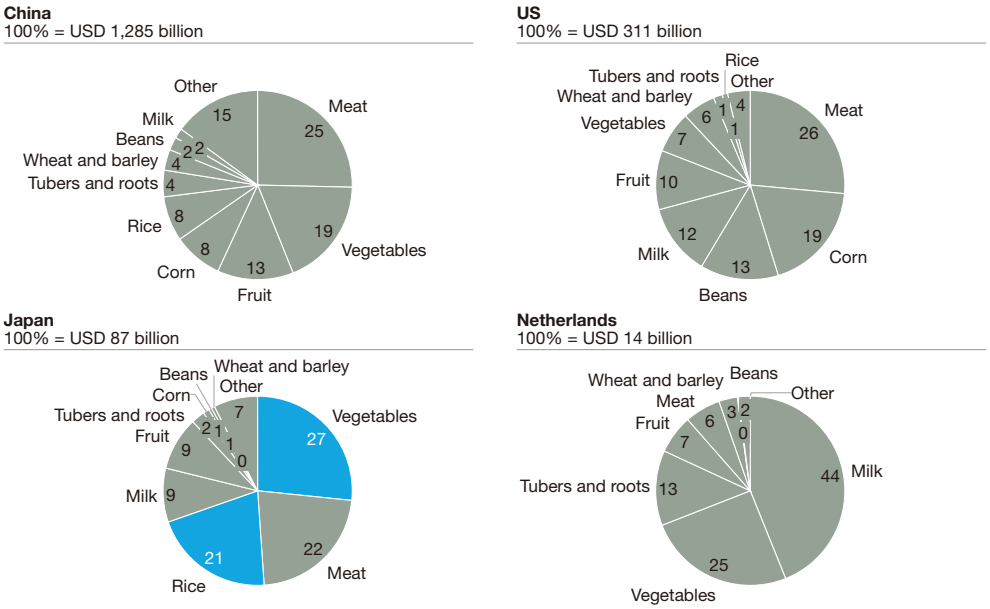
Heavy emphasis on rice and vegetable output

Agricultural production in Japan leans more heavily toward rice and vegetables than that of many of its peers (Exhibit 3). In 2013, rice and vegetables accounted for almost half of Japanese agricultural production, based on value, a share that dwarfs that seen in the Netherlands and the United States, and even surpasses the share of rice and vegetables grown in China.

Exhibit 3

Agricultural production value

Percent; 2013



SOURCE: FAOSTAT; US Department of Agriculture; Ministry of Agriculture, Forestry and Fisheries; McKinsey analysis

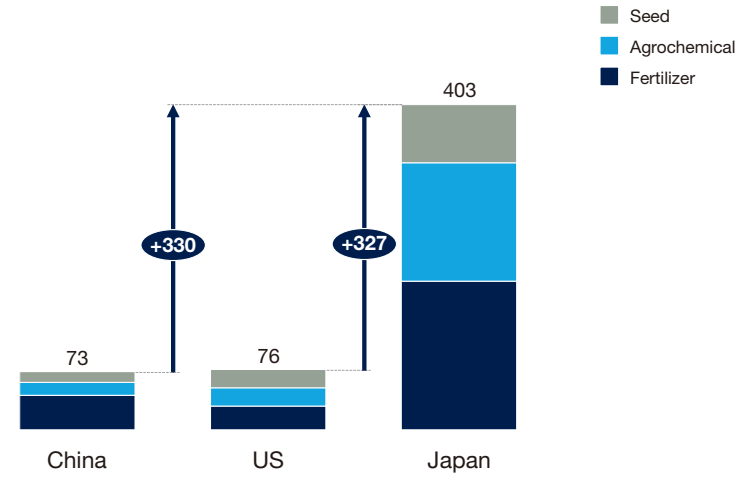
High procurement costs

The agricultural sector in Japan also pays more for inputs, such as fertilizer, chemicals, and seeds, which are usually procured from other countries. For example, in rice production the cost of these inputs in Japan are generally four times higher than the costs in China and the United States (Exhibit 4).

Exhibit 4

Rice input costs, such as fertilizer, agrochemicals, and seeds, are substantially higher in Japan than in other countries

Cost (USD) per ton; 2013



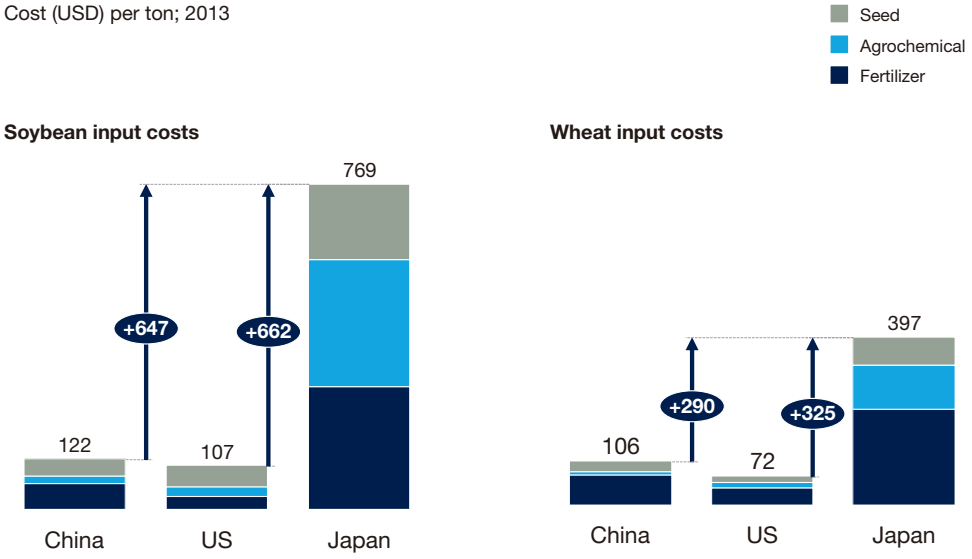
SOURCE: US Department of Agriculture; China NRDC; Ministry of Agriculture, Forestry and Fisheries; Phillips McDougall; World Bank; McKinsey analysis

Similar large cost discrepancies are seen for other products (Exhibit 5). Inputs for soybean production in Japan cost five times more than in China and the United States, and in wheat production, about three times more.

Exhibit 5

Agricultural input costs for soybeans and wheat are also higher in Japan than in other countries

Cost (USD) per ton; 2013



SOURCE: US Department of Agriculture; China NRDC; Ministry of Agriculture, Forestry and Fisheries; Phillips McDougall; World Bank; McKinsey analysis

The above disparity arises in part from structural factors at the time of purchase for agricultural inputs in Japan. Several important disparities emerge if we compare Japan's approach with the agricultural input purchase process in the neighboring market of Korea:

- Importer (e.g., trading company) leverage: Consolidation of the fertilizer and other industries in Korea is complete, and a handful of manufacturers deal directly with overseas procurement players for large lots. Margin is limited for other importers.
- Import shipping cost efficiency: Because Japanese ports are structurally shallow, payload per ship must be 10% lighter than shipments to Korean ports. The result is poor shipping cost efficiency when importing.
- Number of port stops: Because importers in Japan accept bundled orders from multiple companies, they must unload at multiple ports, and the port charge is relatively high. In Korea, each manufacturer orders through a centralized purchasing organization, which results in fewer port stops, and also keeps port charges down.
- Functional overlap at logistics players: In Korea, logistics players have eliminated (or curtailed) their reliance on functional overlap, while addressing the loss of margin through IT and automation.

The cost of inputs also varies widely across the Japanese agricultural sector. A 2016 survey by Japan's Agriculture and Forestry Committee showed that for about half the agricultural chemicals included in the study, prices paid by Japanese farmers varied by 20 percent or more.

Several factors contribute to the high, variable input costs, including:

- Regulations: Regulatory requirements can support higher input prices. For example, no legislation specifically addresses generic agricultural chemicals, which means companies producing generic chemicals must undergo the entire span of safety inspections, leading to high costs.
- Raw materials: Imported raw materials, such as the phosphorus and potassium needed to make fertilizer, generally cost more in Japan than in other countries.

Small, fragmented industry

The agricultural sector in Japan is very fragmented, with small farmers accounting for a large share for production. Farmers working up to two hectares of land make up about 80 percent of all producers (Exhibit 6). By contrast, in Portugal and Italy – European countries with about the same number of farming entities and similar landscapes – small farmers account for only about half of the producers.

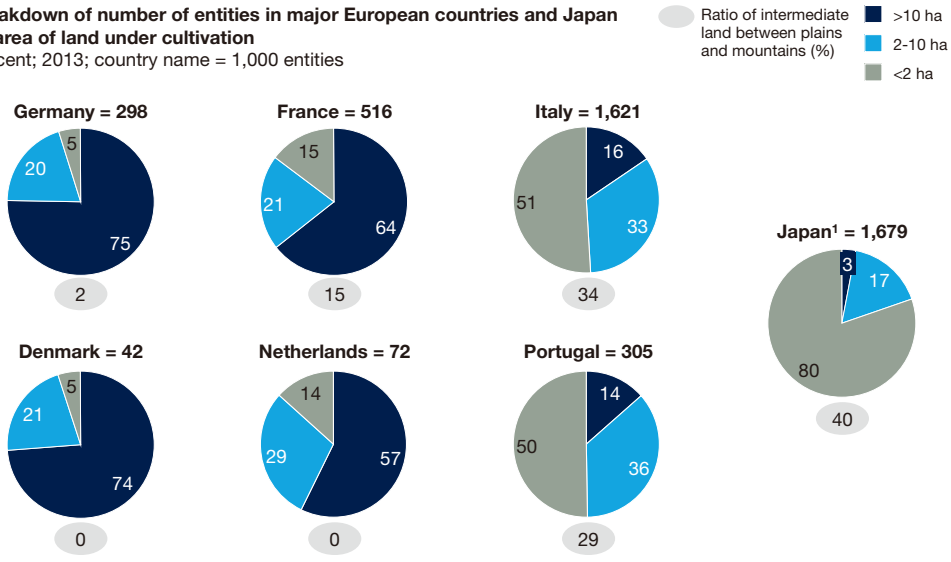
Farmers working up to two hectares of land make up about 80 percent of all producers

As would be expected, large farming enterprises in Japan also account for a disproportionately small share of producers. Farming companies working 10 hectares or more comprise just 3 percent of all producers in Japan, compared with 57 to 75 percent in Denmark, France, Germany, and the Netherlands. Because of this heavy fragmentation, producers in Japan face higher costs for cultivation and shipping than do other developed nations.

Exhibit 6

Japan has a high ratio of areas between plains and mountains, which results in small farm plots for individual entities

Breakdown of number of entities in major European countries and Japan by area of land under cultivation
Percent; 2013; country name = 1,000 entities



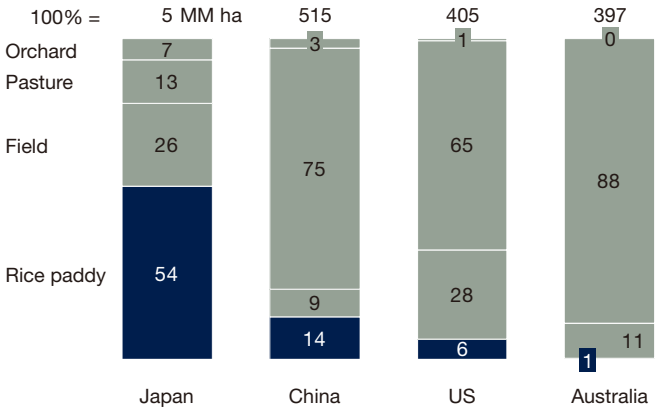
1 Data in 2010

SOURCE: Eurostat; the European commission; Ministry of Agriculture, Forestry and Fisheries; McKinsey analysis

Although plot sizes in Japan are relatively small, the land itself is very fertile. Rice paddies and fields, which require generous amounts of water, account for 80 percent of farmland in Japan, compared with 34 percent or less in Australia, China, and the United States, where pastures account for the bulk of farmland (Exhibit 7).

Exhibit 7

Farm plots in Japan are small, but comparatively fertile
Percent



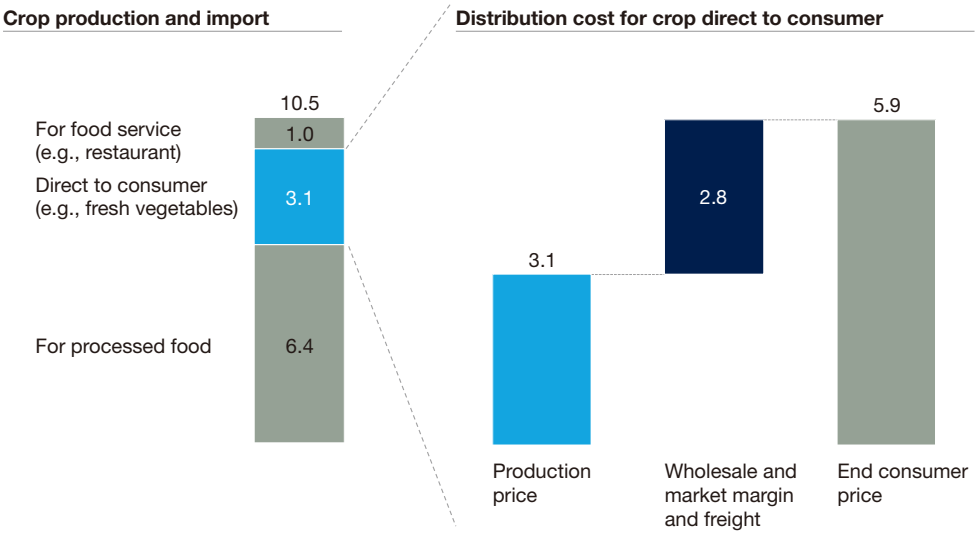
SOURCE: "Statistics on Cultivated Land and Planted Area," Ministry of Agriculture, Forestry and Fisheries; FAOSTAT; McKinsey analysis

Significant distribution costs

Getting food to consumers in Japan can be almost as expensive as producing it, and these high distribution costs place additional pressure on the agricultural sector. In 2011, for example, production and import costs for food sold directly to consumers was 3.1 trillion yen, but commissions, shipping, and other distribution costs added 2.8 trillion yen to the cost before it reached consumers (Exhibit 8).

Exhibit 8

Japan food value chain
JPY trillions; 2011



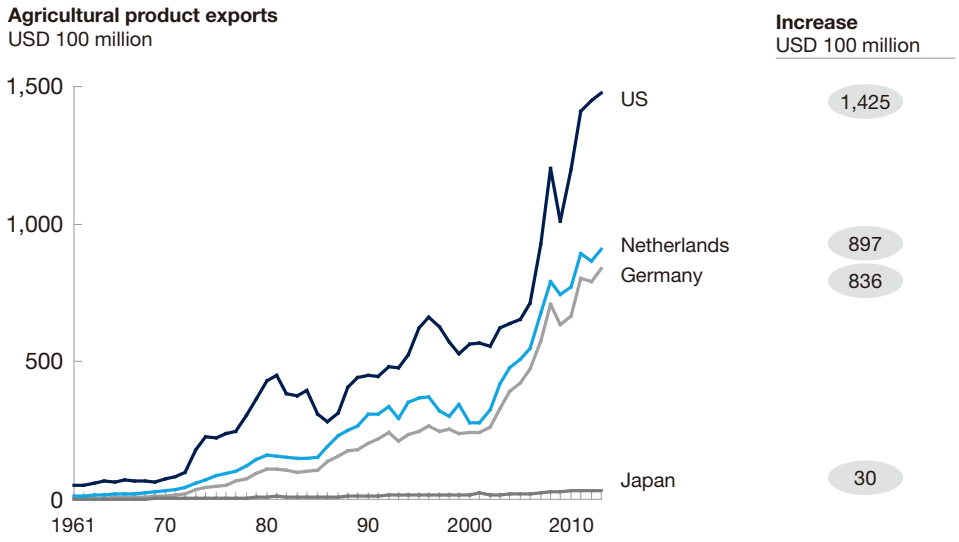
SOURCE: "Flow of agriculture, forestry, and fishery produce from production to final consumption of foods and beverages," Ministry of Agriculture, Forestry and Fisheries; McKinsey analysis

Agricultural export stagnation

Although Japan has the world's ninth largest agricultural sector, its food exports have generally remained flat since the 1960s, while other countries' exports have risen. Between 1960 and 2010, the value of food exports from Japan increased by roughly $3 billion, while those from Germany, the Netherlands, and the United States rose by almost $100 billion or more (Exhibit 9).

Exhibit 9

Major countries have increased their crop exports, while Japanese exports have stagnated since the 1960s



SOURCE: FAOSTAT; McKinsey analysis

Meanwhile, the value of food imports to Japan almost doubled from $36 billion in 1990 to $61 billion in 2013, rising on average 4.2 percent a year over the period, about two percentage points faster than domestic production.

Mandate for growth

Despite these challenges, the agricultural sector in Japan has a mandate – and perhaps more importantly an opportunity – to gain momentum on world markets. The government has set a goal of bringing annual agricultural exports to at least $10 billion by 2020 from more than $6 billion in 2015.

The global popularity of cuisine, produce, and ingredients unique to Japan, along with the country's reputation for quality, present clear opportunities to reach this goal. Indeed, in 2013, the United Nations Educational, Scientific, and Cultural Organization designated washoku, traditional Japanese cuisine, an Intangible Cultural Heritage of Humanity.

Projected changes in Japanese, global demand

Part of the opportunity offered Japan's agricultural sector comes from changes in global demand. Population growth and economic development are pushing demand higher, even as consumers in developed markets seek higher quality and heavier food. These trends create significant openings for Japan's agricultural sector.

Global demand rising as supply struggles

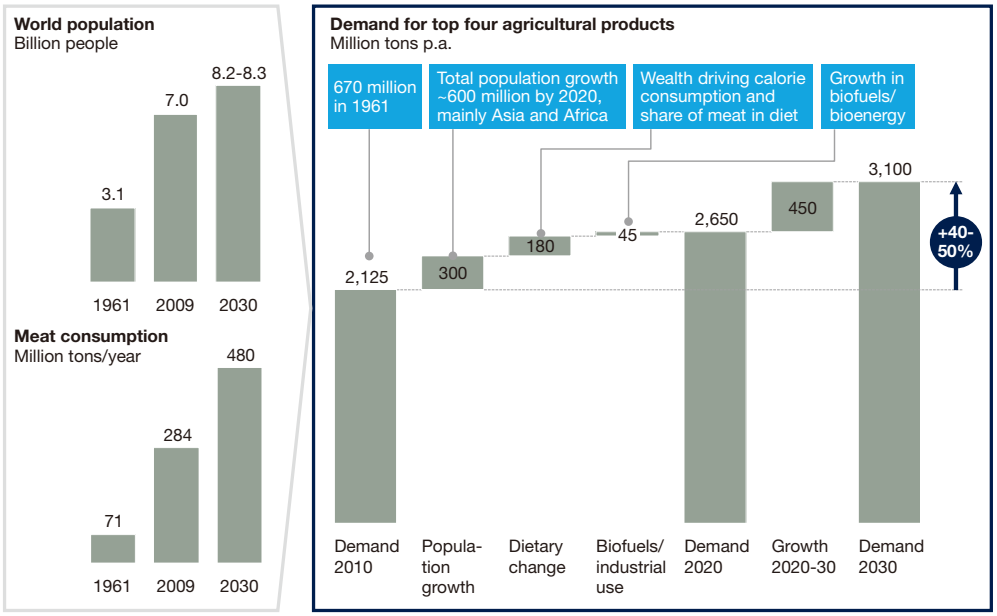
Globally, the demand for food is expected to continue to increase strongly, while supplies struggle to keep pace.

By 2030, the world's population will likely exceed 8 billion people, about 1 billion more than just two decades earlier. This ongoing increase in population will exert a large influence over food supply and demand, but changes in consumption patterns will also be significant. As standards of living increase, calorie intake per capita will also grow, especially among the more affluent.

Together, these trends will push substantial increases in food demand. For example, McKinsey forecasts that between 2009 and 2030, global meat consumption will grow by about 70 percent (Exhibit 10). Over roughly the same period, global demand for corn, wheat, rice, and soybeans – the largest agricultural products by volume – is projected to increase by 40 to 50 percent.

Exhibit 10

We will need a lot more food: an increase of 40 to 50 percent by 2030 is likely to be driven by growing populations and changing diets

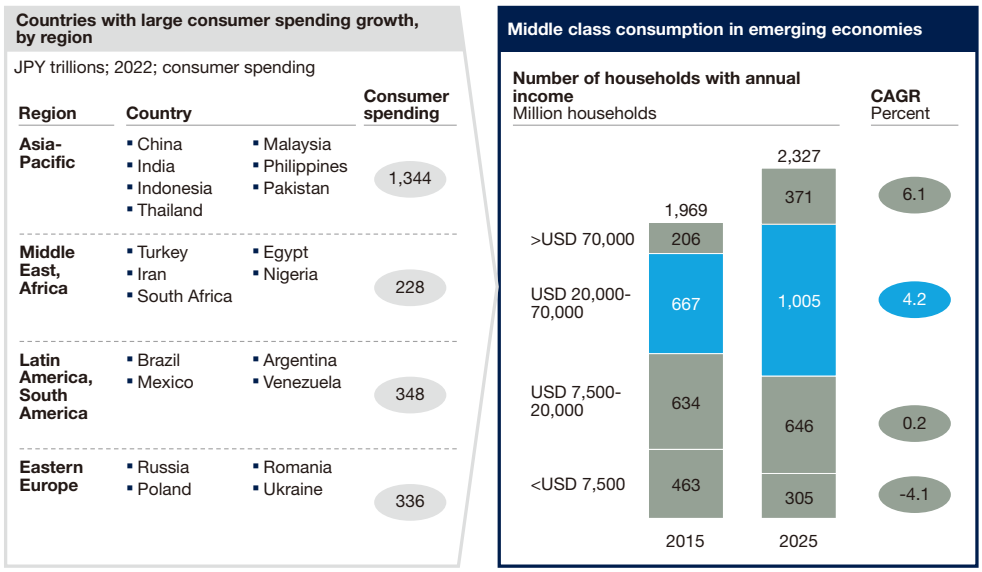


SOURCE: US Department of Agriculture; FAO; expert interviews; McKinsey analysis

A growing middle class will drive much of the growth in global food demand. Between 2015 and 2025, middle class households, those with annual income of between $20,000 and $70,000, will grow from about 670 million worldwide to more than one billion (Exhibit 11). Economic development and population growth are behind the expanding middle class, and as more households join this segment, food consumption will most likely continue to increase.

Exhibit 11

The middle class segment continues to grow in emerging economies



SOURCE: Global Insight; Cityscope database; McKinsey analysis

Whether food supply can keep pace with growing demand remains an open question. In a separate study, McKinsey estimated that global demand for food based on calorie intake is likely to increase as much as 70 percent between 2000 and 2050. Demand for milk products and meat could double during this period, and demand for grains is expected to increase by about 50 percent (Exhibit 12). However, productivity growth for major crops has fallen since the 1960s, and by 2010 growth rates were barely one percent a year.

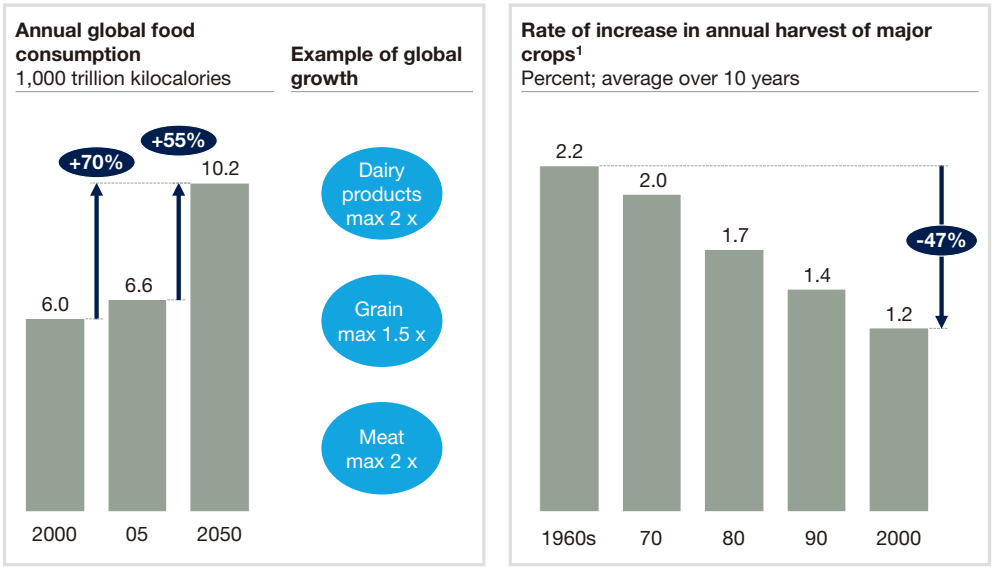
Twenty percent of the world's arable land has deteriorated to the point where it is unfit for agriculture

Resource scarcity might also hinder any efforts to improve agricultural productivity to meet growing demand. Already, 20 percent of the world's arable land has deteriorated to the point where it is unfit for agriculture, according to 2009 data from the Center for Sustainability and the Global Environment. In addition, by 2025 water demand might exceed supply by 27 percent (Exhibit 13).

Many of the factors that have led to the decline in arable lands, such as water depletion, greenhouse gas emissions, and soil degradation, are linked in part to intensive agriculture (Exhibit 14).

Exhibit 12

From 2000 to 2050, world food demand will grow by up to 70 percent, but productivity for major crops is unlikely to keep apace



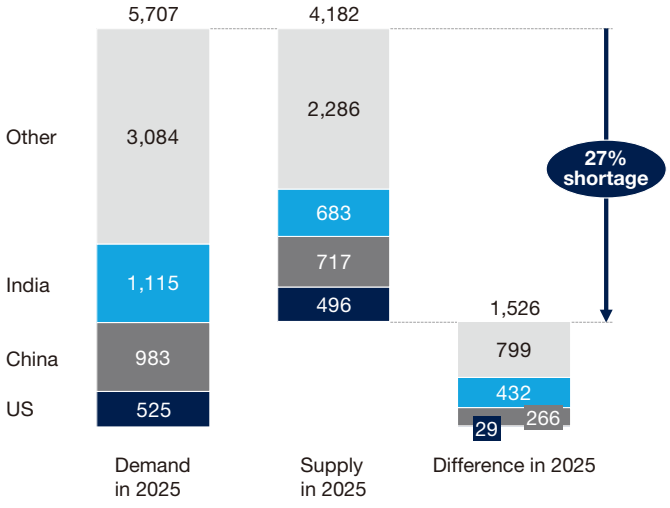
1 Includes grains, oilseeds, sugar crops, beans, root vegetables and tubers

SOURCE: FAO World Food and Agriculture to 2030/2050; FAO High-Level Expert Forum - How to Feed the World in 2050; McKinsey analysis

Exhibit 13

Supply-side growth has been slow due to a lack of natural resources – a 27% shortage in water is expected by 2025

Cubic kilometers



SOURCE: Firm Water Initiative; McKinsey analysis

Exhibit 14

Producing with less environmental impact: a growing number of problems are linked to intensive agriculture

	Description
Soil degradation	▪ **Roughly 20-30% of total land suitable for cultivation is affected** by some degree of degradation (e.g., erosion, loss of organic matter, desertification)
Land availability	▪ **Remaining available land for agriculture is limited,** and is located in countries with poor infrastructure and political instability
Water use and depletion	▪ **Agriculture consumes more than 2/3 of total available freshwater** through irrigation. Depletion of water reserves could cause a 40% supply gap by 2030
Greenhouse gas emissions	▪ **Agriculture is responsible for 1/3 of total GHG emissions** both directly and indirectly (through deforestation) due to farming practices and livestock management
Reduced biodiversity	▪ **Species are in decline and pathogens are increasing** due to clearing of natural habitats, monocultures, and use of pesticides
"Dead zones"	▪ **Large coastal areas are unsuitable for life** due to excessive fertilization causing run-offs of nitrogen fertilizers into rivers and lakes, which also affects fisheries

SOURCE: FAO; US Department of Agriculture; expert interviews; McKinsey

For these reasons, new agricultural approaches and innovations are taking into account the pressing need to preserve the environment. These include new land-use models, such as no-till farming and agro-silvopastoral systems that combine woodlands and pastures, and even models that do not rely on the availability of arable rural land, such as urban fields, rooftop farming, and vertical farms (Exhibit 15).

Exhibit 15

Alternatives for landless food production

Method	Pros	Cons
Urban fields ▪ Abandoned industrial areas converted into farmland ▪ Soil-based techniques	▪ Utilizes undesirable locations ▪ Improves visual appeal of cities	▪ Possible contamination of food with residual industrial toxins
Glass houses ▪ Rooftop locations to construct glass houses ▪ Hydroponics	▪ Leverages natural light and heat	▪ Hard to reach scale ▪ Many different groups control rooftops
Vertical farms ▪ Multistory farming buildings ▪ Hydroponics	▪ Easy to scale	▪ Requires significant capital and energy
Sea farming for food/feed	▪ No limitation for sea water production	▪ Technologies and practices not yet implemented at large or commercial scale

SOURCE: McKinsey

Also in response to these overarching trends, major seed and agricultural chemical suppliers, such as Monsanto and Syngenta, are working to increase food and agriculture productivity, particularly focusing on improving farm management and other processes by using data analytics and new technologies (Exhibit 16).

Exhibit 16

Major companies like Monsanto and Syngenta are developing data and software solutions to improve food and agriculture productivity

Effective maintenance of freshness in the supply chain: Microsoft collaboration with Linkfresh

- **Start of collaboration: Linkfresh became a Microsoft global ISV partner in 2013**
- **Linkfresh product details:**
  - ERP system specifically for the food supply chain business
  - Supports supply chain management, including forecasting, budgeting, and planning
  - Supports operations, including plant performance, food grading, labeling, and traceability

Farm robotics: Nileworks multi-copter to spray agrochemicals

- **Available from May 2016**
- **Product details:**
  - Drone for the purpose of aerially spraying agrochemicals on fields and paddies
  - Automatically flies to a location designated on a tablet
  - Provided on a rental basis that includes maintenance costs and cloud service fees

Big data and agriculture: Monsanto acquisition of The Climate Corporation

- **Acquisition price: $930 million**
- **Acquired: October 2013**
- **The Climate Corporation details:**
  - Expertise in data science
  - Uses a broad range of information to provide farmers with valuable insights and advice

Big data and agriculture: Syngenta acquisition of Ag Connections

- **Acquired: October 2015**
- **Ag Connections details:**
  - Provides software and solutions for farm management

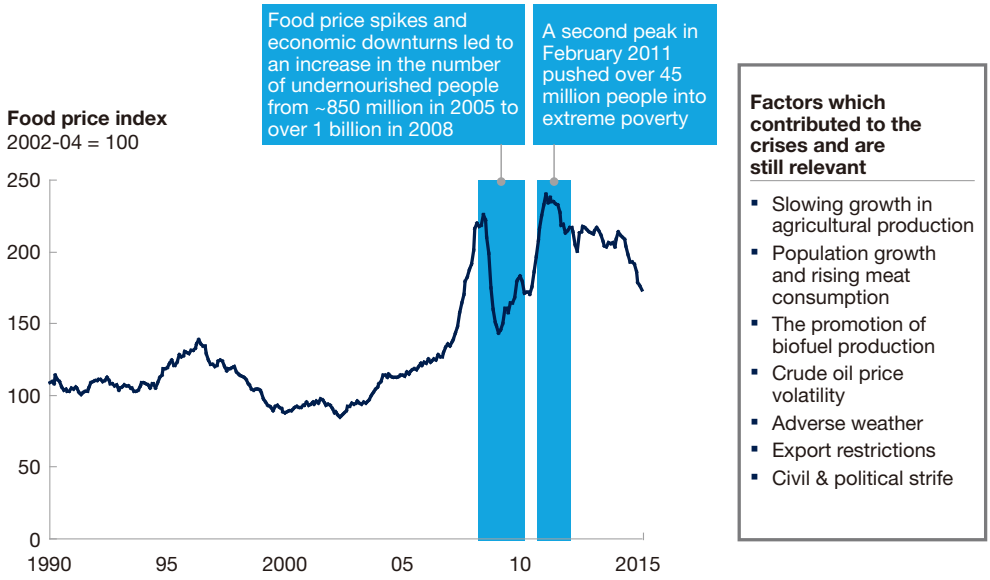
SOURCE: McKinsey

Supply shortfalls bringing sharp price increases

Expanding food demand and stagnating production globally have led to a sharp rise in food prices. Through the 1990s and into the new century, food prices were relatively steady, but then they soared upward, peaking in 2007-2008 and in 2011, triggering food crises that affected more than 100 million people (Exhibit 17). At the heights of these peaks, food prices were double those seen in 2002 to 2004.

Exhibit 17

The food crises in 2007-08 and 2011 may be a warning that we have entered a new era of extreme price volatility



SOURCE: FAO Food price index; Ronald Trostle, US Department of Agriculture; Peter Timmer, Centre for Global Development working paper 163, World Bank; McKinsey analysis

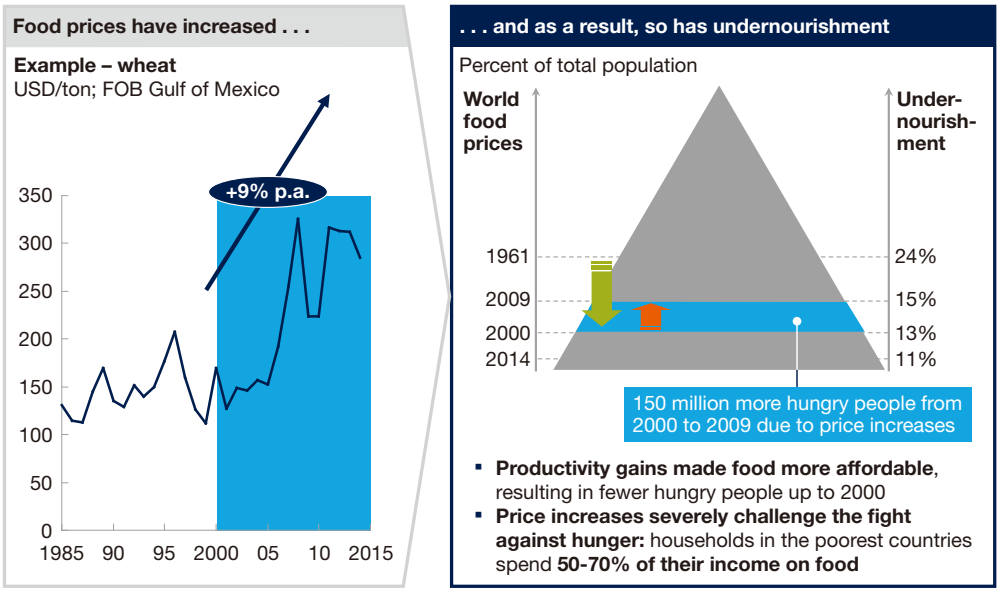
Although in 2016 prices were still trending downward from the 2011 peak, many of the supply and demand factors behind the surges remain, and additional price hikes appear imminent.

These price surges left an increasing number of people unable to secure enough food. In 2007-2008, for example, the number of people without sufficient nutrition worldwide grew to more than one billion. Higher farm productivity and lower prices had helped to reduce the number suffering from malnutrition globally until around 2000, when higher food prices reversed the trend and pushed 150 million additional people into starvation (Exhibit 18). In many of the poorest countries, 50 to 70 percent of household income goes toward food.

In 2007-2008, the number of people without sufficient nutrition worldwide grew to more than one billion

Exhibit 18

Growing affordable food: after decades of declining prices, more people are hungry today due to supply constraints and rising food prices



SOURCE: FAO; World Bank; De Hoyos, Lessem 2008; Grilli and Yang 1988; Pfaffenzeller 2007; International Monetary Fund; Organisation for Economic Co-operation and Development; UN Comtrade; McKinsey analysis

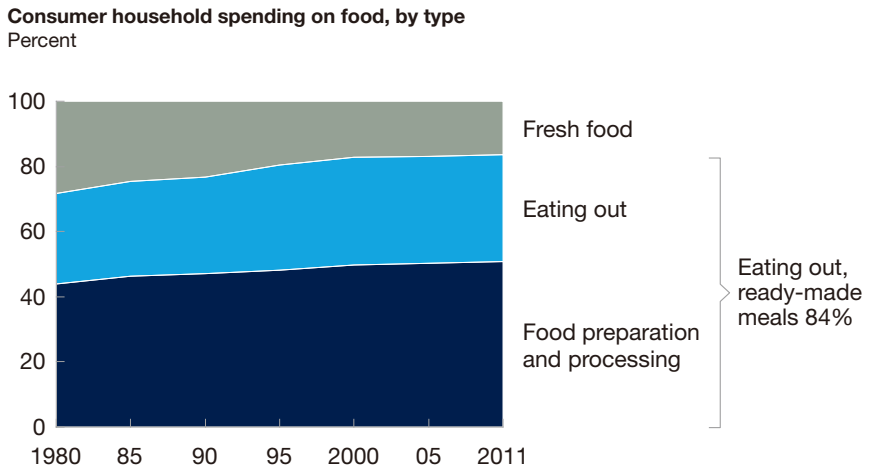
Quality demanded also changing

In addition to the increase in quantity of food demanded, the nature of the demand is also changing rapidly, largely because of shifting dietary habits in richer economies. These changes have a direct impact on the agricultural sector worldwide.

In many advanced economies, the traditional family practice of purchasing fresh produce and meats to cook at home is vanishing. As a result, a larger share of agricultural production is being sold to restaurants and food processors. In Japan, for example, the share of fresh food bought for home cooking dropped from about 30 percent in 1980 to 16 percent in 2011 (Exhibit 19).

Exhibit 19

In Japan, more people are eating out, and key agricultural product buyers today are restaurants, food processors, and preparation services



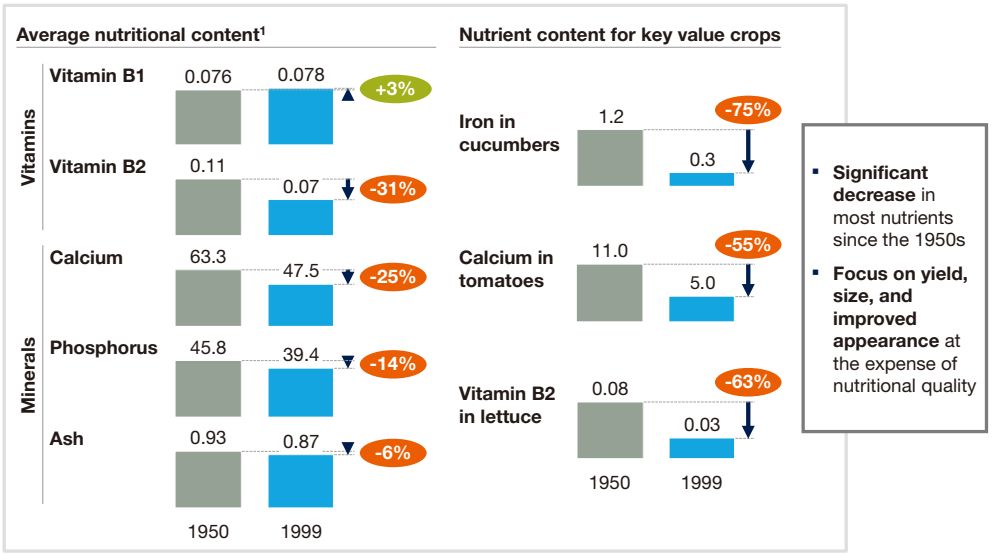
SOURCE: Ministry of Agriculture, Forestry and Fisheries; McKinsey analysis

Perhaps ironically, considering the recent rise in health-conscious consumerism, a focus on greater productivity and yields and improved appearance of produce in the second half of the 20th century brought a significant decline in the nutritional quality of agricultural products. One McKinsey study of 43 different crops found a near universal decline in quality between 1950 and 1999 (Exhibit 20). The iron content in cucumbers, for instance, fell by about 75 percent during the period, while calcium in tomatoes and vitamin B2 in lettuce both dropped by more than 50 percent.

Exhibit 20

Growing better food: the historic global focus on productivity has led directly to a significant decline in food quality

Change in nutritional content for 43 garden crops between 1950 and 1999; mg/100g



1 Average among a selection of 43 garden crops in the US, following the methodology of Davis, Epp and Riordan 2004

SOURCE: Davis, Epp and Riordan 2004; US Department of Agriculture; McKinsey analysis

Many modern consumers, however, are demanding healthier products, which could suggest growing pressure for higher quality in agricultural produce.

Although these trends could likely have a severe impact globally, the direct effect on the domestic market will probably be relatively small. However, they present Japanese agriculture with a tremendous opportunity to expand into the global market. To do so, however, the country must look into increasing output and satisfying global demands for quality and quantity, especially in light of its unique advantages and challenges.

The country must look into increasing output and satisfying global demands for quality and quantity, especially in light of its unique advantages and challenges

Opportunities and tasks

When Shinzo Abe took office as prime minister in 2012, Japan's government set high targets for food production and agriculture, many linked to increased exports. While these targets represent significant opportunities for the agricultural sector, they also help define tasks that need to be completed.

In one, the government wants to increase agricultural production from 50 million tons in 2013 to 54 million tons by 2025. Export targets for food and agricultural products account for a significant portion of this increase. Japan also wants to increase producer income by about 21 percent over the same period, bringing it from $29 billion to $35 billion by boosting agricultural output quantity and revenue, as well as cutting costs.

McKinsey's global experience suggests that to achieve the goals set by the Abe administration, as well as to contribute to eradicating world hunger, Japan's agricultural sector must complete five crucial tasks: Acquire raw materials, reduce input costs, streamline the value chain, collaborate with partners, and harness technology.

By pursuing measures that address each of these tasks, the government and industry can improve production, expand exports, and empower Japan's agricultural sector.

Secure raw materials

The supply of raw materials needed for agriculture – fertilizer, agrochemicals, seeds, and other products – is controlled largely by companies outside Japan. Acquiring interests in upstream suppliers could help the country secure inputs and reduce costs for these essential purchases.

The situation facing fertilizer suppliers offers an illustration of the challenge. Fertilizer is essential for agricultural production, and a handful of major manufacturers worldwide account for most product sales. Of the three primary nutrients in commercial fertilizer – nitrogen, phosphorus, and potassium – only nitrogen is commonly available (Exhibit 21). Mineral phosphate and sylvite, the main sources of phosphorus and potash (nutrient form of potassium), respectively, are rare resources produced in only a few nations. Because of the scarcity of these resources, countries are fighting to gain access.

Exhibit 21

Potash supply is consolidated due to geographical scarcity of ore, while nitrogen supply is fragmented due to global prevalence of natural gas

	Nitrogen	Phosphate	Potash
Predominant feedstock	Natural gas	Phosphate rock ore	Sylvite ore
No. of producing countries	~60	~40	**12**
Share of production traded	29%	43%	79%
Greenfield cost	~$2 billion 1 million tonnes of ammonia integrated with urea	~$2 billion 1 million tonne P_2O_5 plant, integrated with rock, acid, DAP	~$4 billion 2 million tonne KCl mine
Greenfield build time	3-4 years	3-4 years	7 years
Capacity share of top 5 players[1]	10%	27%	**65%**

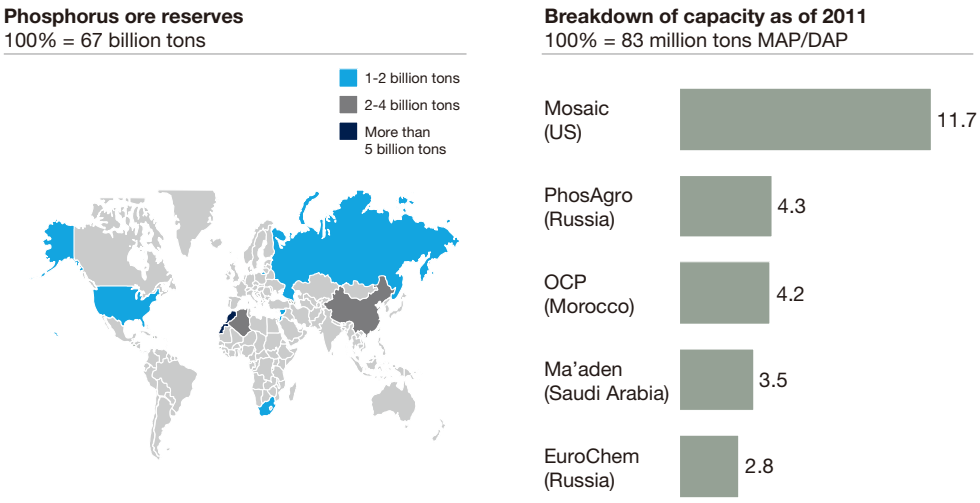
1 Urea used for nitrogen, ammonium phosphates for phosphate, potassium chloride for potassium

SOURCE: PotashCorp; IFDC; IHS Chemical SRI; McKinsey analysis

Deposits of mineral phosphate are found primarily in North Africa, China, Russia, and the United States, and the world's top producers of phosphorus fertilizers are active in these locations (Exhibit 22). For example, the Mosaic Company, the largest US producer of potash and phosphate fertilizer, was formed in 2004 by a merger of century-old IMC Global and the nutrition division of US agriculture giant Cargill. Other major producers include PhosAgro and EuroChem in Russia, Office Chérifien des Phosphates (OCP) in Morocco, and Ma'aden in Saudi Arabia.

Exhibit 22

Most phosphorus reserves are in North Africa, Russia, the US, and China, and the world's top players are located in North Africa, Russia, and the US

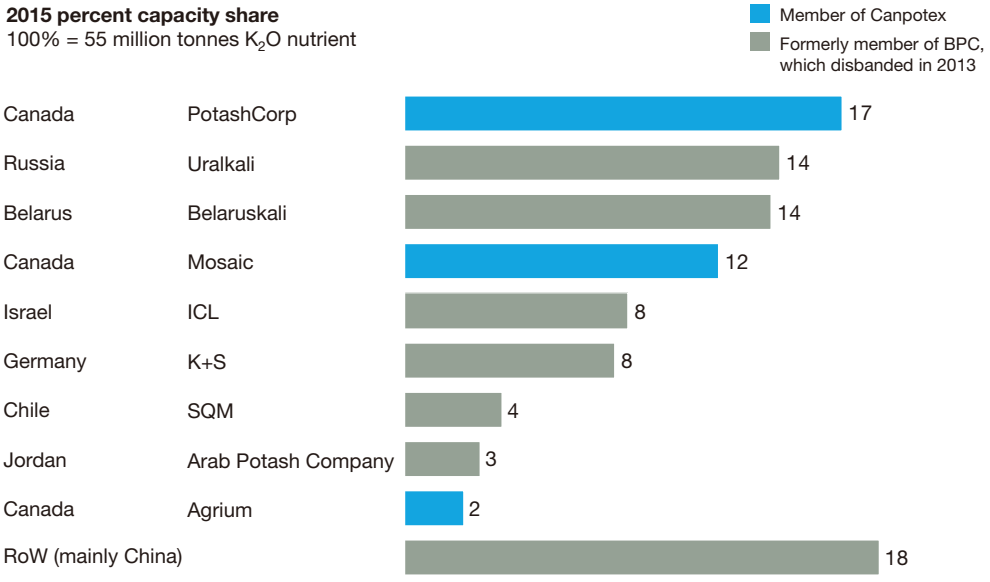


SOURCE: IFDC; PhosAgro; USGS; McKinsey analysis

Potassium producers have created "export groups" to increase their negotiating power, making it difficult for buyer nations like Japan to exert significant influence on the market. The largest of these is Canadian Potash Exporters, or Canpotex (Exhibit 23).

Exhibit 23

Scarcity of reserves led to a concentrated industry, which has further consolidated into "export groups" in recent years



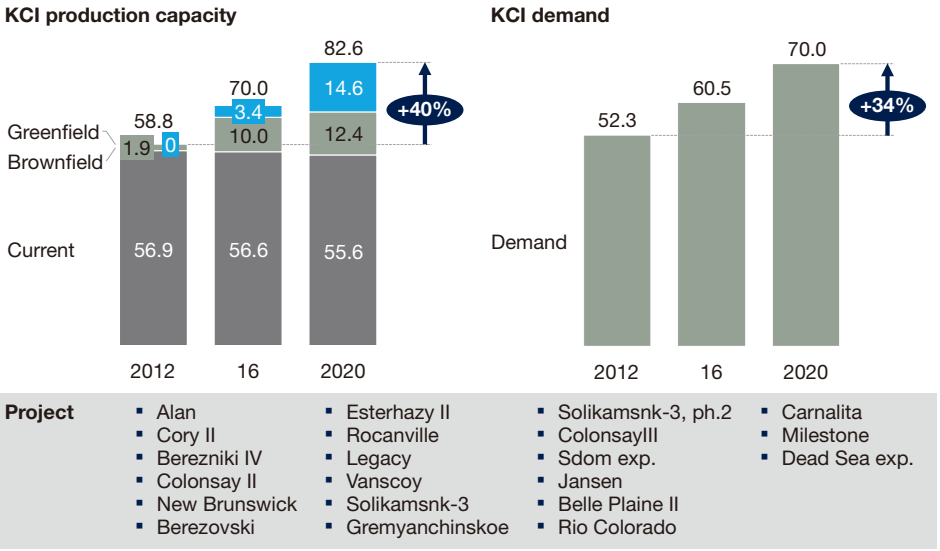
SOURCE: IHS Chemical SRI 2015; McKinsey analysis

New and expansion projects are in the pipeline to increase global potassium supply to meet expected demand (Exhibit 24). However, these projects could create a market glut. Between 2012 and 2020, potassium production capacity is expected to grow on average 4.3 percent a year, outpacing expected demand growth of about 3.5 percent a year. In addition, new players, such as BHP Billiton of Australia and Vale in Brazil, are likely to enter the market, particularly with prices having dropped from about $500 a ton to between $200 and $300 a ton in recent years.

Exhibit 24

Projects are underway for new development and expansion to increase potassium supply capacity

KCl (potassium chloride) capacity and demand forecast
Million tons; 2012-2020



SOURCE: Basic Materials Potassium Chloride Supply Model; McKinsey analysis

Some countries, such as China, are proactively working to secure reasonable access to these scarce agricultural materials. Many Chinese companies, for example, are buying upstream companies, especially seed, agrochemical, and grain suppliers (Exhibit 25). Despite the immediate likelihood of excess supply in the market, Japan's best chance to lock-in cost-effective raw material prices over the longer term is to follow China's lead and acquire its own upstream players.

Exhibit 25

China is increasingly investing in overseas agricultural markets to improve food security

Background and Chinese government mindset toward agriculture

- Food demand in China is constantly increasing, and investing in overseas agricultural assets can improve food security and resilience in the face of fluctuating commodity markets
- Investing in overseas companies can capitalize China's massive foreign currency reserves
- Acquiring foreign brands can also attract a price premium due to consumer perceptions of higher safety standards

Major deals involving Chinese companies in the ag field internationally

	Deal size USD MM	Acquired company	Acquiring company	Strategic reasoning	Announcement date
Syngenta (ag input)	48,018	Syngenta (100%)	ChemChina	Improve upstream food security	Feb 2016
Noble agri business (grain trading)	4,950	Noble (100%)	COFCO	Improve overseas trading assets	Sep 2014
Smithfield (pork)	4,700	Smithfield (100%)	Shuanghui	Meet rising demand for quality meat in China	May 2013
Nidera (grain trading)	2,840	Nidera (51%[1])	COFCO	Improve overseas trading assets	Oct 2014

China's ag investment overseas has been roughly $69.7 billion since 2011

1 On August 23, 2016, COFCO announced a definitive agreement to acquire the remaining minority stake of Nidera

SOURCE: Dealogic; McKinsey analysis

Reduce input costs

As noted, agricultural inputs in Japan can cost much more than those in other countries, and farms can work more aggressively to reduce these costs. Variable and fixed costs are both ripe for improvement.

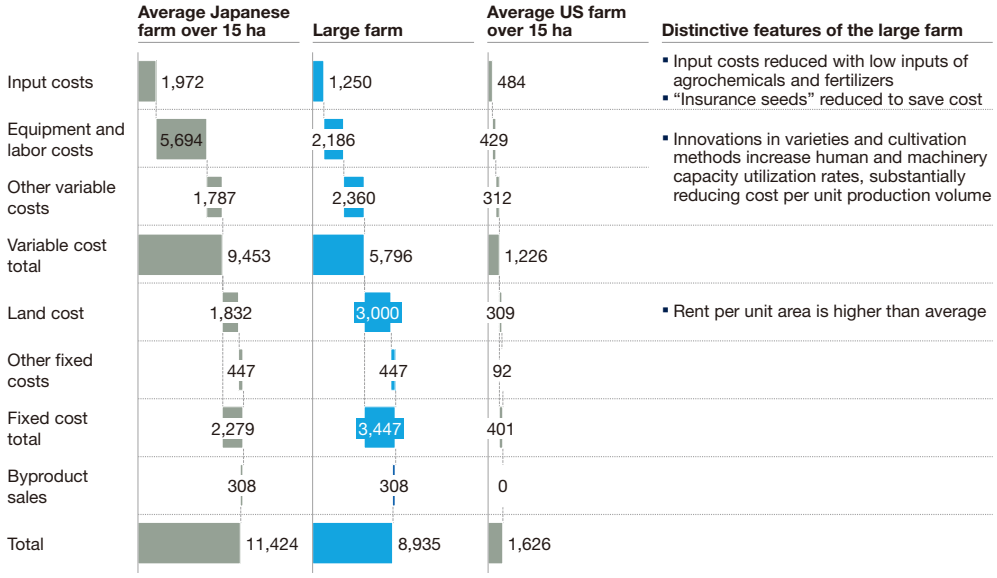
An examination of the success of one large farm illustrates some of the improvements that are possible. The farm, in eastern Japan, boasts variable costs that are about 40 percent below those of the typical large Japanese farm (Exhibit 26). Crucial cost-cutting measures employed included aggressive negotiations with suppliers and improved consumption management. Although this represents a clear improvement over standards in Japan, similar farms in the United States have variable costs that are almost 80 percent lower still.

The farm in eastern Japan boasts variable costs that are about 40 percent below those of the typical large Japanese farm

Exhibit 26

One large farm is able to achieve highly profitable production in Japan, but still nowhere near US profitability

JPY/60kg; 2013



SOURCE: Ministry of Agriculture, Forestry and Fisheries; expert interview; McKinsey analysis

Measures that could help reduce variable costs include negotiating more aggressively with suppliers. For example, farmers can obtain competitive quotes and volume discounts from competing distributors and wholesalers. They may even be able to order directly from manufacturers to eliminate intermediary costs. Such measures are especially useful for buying fertilizers, agrochemicals, and other materials, and larger farms with greater buying power would likely be more successful.

In addition, farms of all sizes can manage demand better, leading to added cost savings particularly for fertilizers and agrochemicals. For example, better soil analysis could indicate that fertilizers with less phosphorus and potassium would be sufficient. Phosphorus and potassium account for a large share of fertilizer costs, and changing formulas could lower costs.

Fixed costs – even for land – can also be addressed for longer term savings. In one example, the US company AeroFarms opened the world's largest vertical farm in 2015 (Exhibit 27). The farm, located in Newark, New Jersey, was built within a factory-like structure, and contains several levels of hydroponically cultivated plants. By some estimates, vertical farms use up to 95 percent less water and more than 90 percent less land, while producing 80 percent more per square meter.

Exhibit 27

The world's largest indoor vertical farm opened in the first half of 2015 in Newark, New Jersey

Elements of the AeroFarms system

Cloth medium	▪ Patented, reusable cloth medium for seeding, germinating, growing, and harvesting
LED lighting	▪ Specific wavelengths for more efficient photosynthesis and less energy consumption ▪ LEDs placed much closer to the plants, enabling greater vertical growing for even greater productivity per square foot
Aeroponics	▪ Hydroponic technology that grows plants in a mist providing roots with nutrients, hydration and oxygen ▪ Faster growing cycles and more biomass than other growing approaches ▪ Closed-looped system, recirculating the nutrient solution and using over 95% less water
Pesticide-free	▪ Breaks typical pest cycles of more than 21 days ▪ Pesticides unnecessary
Food safety and shelf-life	▪ Growing clean greens improves food safety ▪ Shelf life extended from 1-2 weeks to 3-4 weeks for many leafy greens

SOURCE: AeroFarms website; McKinsey

Japanese companies are active in vertical farming and other plant factory technologies, but must remain vigilant to keep pace with innovations. Globally, venture capital firms and other investors are driving research in the field and disruptive innovations are likely.

Streamline the value chain

Distribution costs can add 90 percent to the costs of food being prepared at home, and streamlining the value chain, especially by using data better, can deliver efficiencies that can benefit the entire agricultural sector. Digitization can lead to more efficient use of resources and improved overall productivity along the value chain. By leveraging big data, agriculture players can make decisions based on real-time market data.

In food processing, for example, collecting and analyzing data ahead of harvests could trigger value-creating adjustments to downstream processes. Analyzing data on weather conditions, for instance, could give processors advance notice of the quality and supply of ingredients and foodstuffs, allowing them to make any necessary changes from procurement to production schedules before they become urgent problems.

Data collected and analyzed at any point of the value chain can potentially create greater efficiencies throughout the sector. Data collected from disparate links in the chain should be integrated and made available to deliver these broad benefits.

Collaborate with partners

Major global companies in the agricultural sector and other industries routinely collaborate with partners all along their supply chains to improve production costs and create stable resource flows. In Japan, greater collaboration among producers, processors, logistics providers, and other stakeholders could help the industry improve efficiencies, eliminate waste, and respond more quickly to changes in domestic and foreign demand.

Two collaborative initiatives stand out as especially promising. The first is to aggregate suppliers into agricultural cooperatives and other joint collectives that allow members to share equipment and manage common resources. The second is to jointly manage production costs by, for example, consolidating procurement efforts for small farmers or optimizing the use of agricultural services.

These measures are already very common in other markets, such as among cocoa and coffee producers in many developing nations and wheat suppliers for major US beer companies. Starbucks, to take a single company example, has established Farmer Support Centers in Costa Rica and Rwanda, which provide resources and advice to local producers on topics that include cutting production costs, limiting fungal infections, improving coffee quality, and increasing premium bean production. It also provides funding for organizations that finance producers when needed.

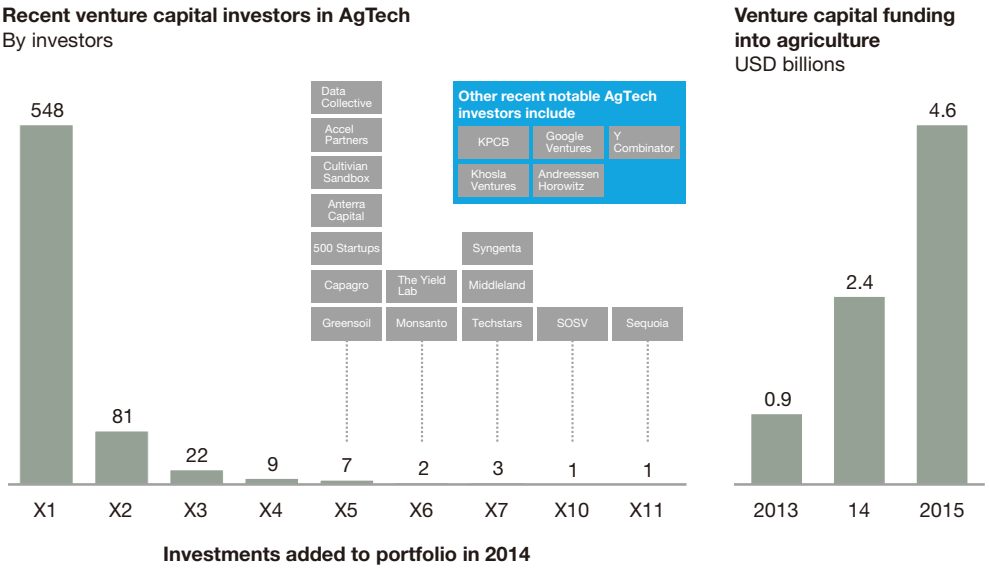
In another example, Cargill established more than 2,500 field schools that teach best practices in production management and sustainability to cocoa producers. In the Ivory Coast, the effort is credited with improving producer revenues by 53 percent. In 2013, the company opened the Cargill Coop Academy, which teaches higher level business management skills.

Harness technology

Agricultural technology is advancing rapidly, and harnessing these innovations could help Japan to achieve its goals for the sector. In one indication of the fast pace of technological development, venture capital funds are streaming into AgTech companies, technology companies focused on addressing challenges in the agricultural sector. Between 2013 and 2015, the amount of venture capital funding invested into the industry grew fivefold, from $900 million to $4.6 billion (Exhibit 28).

Exhibit 28

We are on the front end of the most innovative age in agriculture



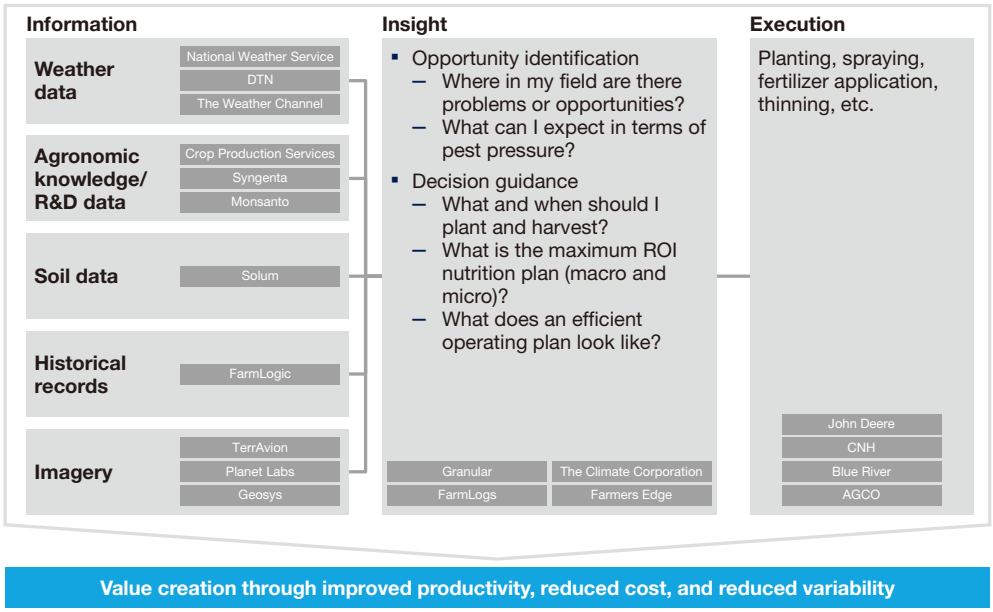
SOURCE: AgTech Investing Report 2015; McKinsey analysis

Agricultural technology is touching a broad range of processes, and leans heavily on data analysis to create savings and efficiencies. For example, producers can combine data on predicted weather, past weather patterns, soil conditions, and satellite imagery, along with experience, to help make optimal decisions on questions including which seeds to sow, which fertilizers to use, and the volume of agrochemicals needed (Exhibit 29).

Venture capital funds are streaming into AgTech companies and the amount of venture capital funding invested into the industry has grown to $4.6 billion

Exhibit 29

At the farm level, precision ag brings together information to make data driven decisions, executed at a subfield level



SOURCE: McKinsey

Technology opens myriad opportunities at all points along the value chain, with many beyond the farm gates (Exhibit 30). The agricultural sector in Japan must understand and pursue these opportunities to reshape the value chain from production to logistics.

Exhibit 30

The opportunity from digital expands beyond the farm gate as well

NOT EXHAUSTIVE

	Inputs	Input distribution	Farming and land	Trade and primary processing	Secondary processing	Retail and distribution
Description	Manufactured inputs and capital goods for agricultural production	Wholesale supply of inputs to farms	Production of crops and livestock	Storage and wholesale trade of crops and livestock	Preparation and processing for retail	
Examples of sub-sectors	▪ Machinery ▪ Seeds ▪ Fertilizers ▪ Pesticides ▪ Animal Health/ Nutrition	▪ Farm suppliers ▪ Machinery dealers	▪ Staple crops ▪ Fruit and vegetables ▪ Dairy ▪ Livestock	▪ Cold storage ▪ Commodity trading ▪ Agriculture wholesale ▪ Packaging	▪ Biofuels ▪ Meat and dairy products ▪ Fruit products ▪ Cereals, flours	▪ Food wholesalers ▪ Groceries ▪ Food retailers ▪ QSRs and casual dining ▪ Foodservice
Application of weather data/ analytics	1 Input logistics (e.g., fertilizer shipping)			6 Supply chain logistics/ trading information	7 Processing (e.g., moisture outlook for operating efficiency)	8 Sales planning and staffing
	2 Precision agriculture: agronomic advice/algorithms on planting, chemical application/pest management, harvesting, input choices, and machine use					9 Distribution logistics
	3 Product planning (e.g., which region will need to be drought tolerant this season)		4 Operations planning and execution			
			5 Forward estimate of grain prices/yields			
	10 Insurance and finance products					

SOURCE: McKinsey

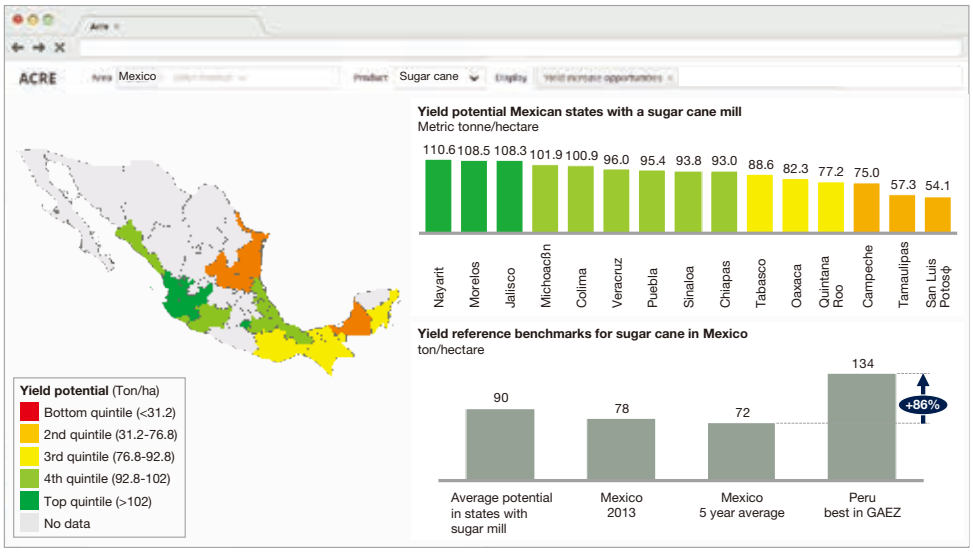
The AutoTrac and Farmsight IT systems developed by John Deere, the world's biggest maker of agricultural equipment, offer an example of the power of advanced agricultural technology. AutoTrac automatically drives tractors across optimal routes, while Farmsight IT analyzes information such as yield to build simulations for applying fertilizer and planting seeds. Used together, these technologies can lead to optimal cultivation, with tractors automatically driving across a plotted route, applying the right amount and type of fertilizer, and planting seeds most effectively.

Used together, these technologies can lead to optimal cultivation, with tractors automatically driving across a plotted route, applying the right amount and type of fertilizer, and planting seeds most effectively

Another example is to optimize production efficiency using tools to analyze big data. McKinsey's proprietary tool ACRE, for instance, utilizes weather, soil, and moisture data collected by satellites to predict the most productive crop to grow in the area, along with potential productivity yields. Tools such as these could be leveraged to improve farming productivity (Exhibit 31).

Exhibit 31

High yield production is about selecting the right land and closing the gap to full biological potential



SOURCE: McKinsey

Conclusion

The Japanese agricultural sector has room to catch up with international best practice and the opportunity help satisfy a growing global demand for food. Five actions can help the country capture these opportunities, achieve its objectives for the industry, and help alleviate global hunger:

- Draft strategies to secure upstream agricultural resources, such as raw materials, to support quality, self-sufficiency, and cost competitiveness.
- Reduce agricultural production costs, which are higher than international benchmarks, by implementing best practices, starting with specifically designated agricultural zones.
- Cut overall costs by implementing basic technologies already used in other countries and optimizing the agricultural supply chain.
- Eliminate waste by matching demand and supply on domestic and foreign markets by encouraging greater collaboration among producers, processors, logistics operators, and other stakeholders.
- Invest in innovation and technology at home and abroad across the entire value chain.

While the first imperative focuses on upstream resources and may require a broad alliance of public and private leaders, the others extract value all along the value chain.

Pursuing such a program would require an incremental approach, for instance beginning with targeted pilot programs rather than attempting to implement new measures across several regions at once. More specifically, players in Japan's agricultural sector could designate specific pilot regions and enact decisively high-productivity best practices. As the pilot projects produce success stories, the practices can be spread to more regions, focusing on producers that are most willing to make needed changes in their processes.

A broader range of stakeholders, including universities and research institutions, should also be brought into the effort to achieve the greatest success

Agricultural improvements go beyond better cooperation among farmers, co-ops, and regulators. A broader range of stakeholders, including universities and research institutions, should also be brought into the effort to achieve the greatest success.

In the Netherlands, for example, Wageningen University, a top agricultural school, has launched a project that focuses on technological innovation. The project centers on Veenkoloniën, a northeastern region reliant on agriculture. About 2,000 farmers manage 100,000 hectares in Veenkoloniën, growing primarily potatoes, wheat, and beets. Many food processors also have plants in the region.

The project includes the Knowledge Centre for Arable Farming in the Netherlands (KANON), which brings together farmers, researchers, agribusinesses, and educational institutions to collaborate and share knowledge. Among its initiatives, in 2014 KANON studied strategies for crop protection, yield optimization, precision farming, storage, and other issues with 61 project groups participating. The center organized all processes, from theoretical research to field trials, and shared findings with farmers in the region using onsite demonstrations, workshops, and other communication strategies. KANON also quickly identifies current problems facing the region's farmers and reflects these in its ongoing activities. Similar cooperative engagements are seen in the United States and other major markets.

Examples from other markets can provide guidance, but ultimately stakeholders in Japan's agricultural sector – regulators, producers, processers, distributors, and others – must find their own path to success based on a clear understanding of the domestic market and international opportunities. By following a carefully considered approach to generating efficiencies and seizing opportunities such as those outlined in this report, Japan's agricultural sector can extract greater profits and build a stronger industry.

McKinsey Japan
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