

ARTIFICIAL INTELLIGENCE IN FOOD PROCESSING SYSTEMS: GLOBAL ISSUES

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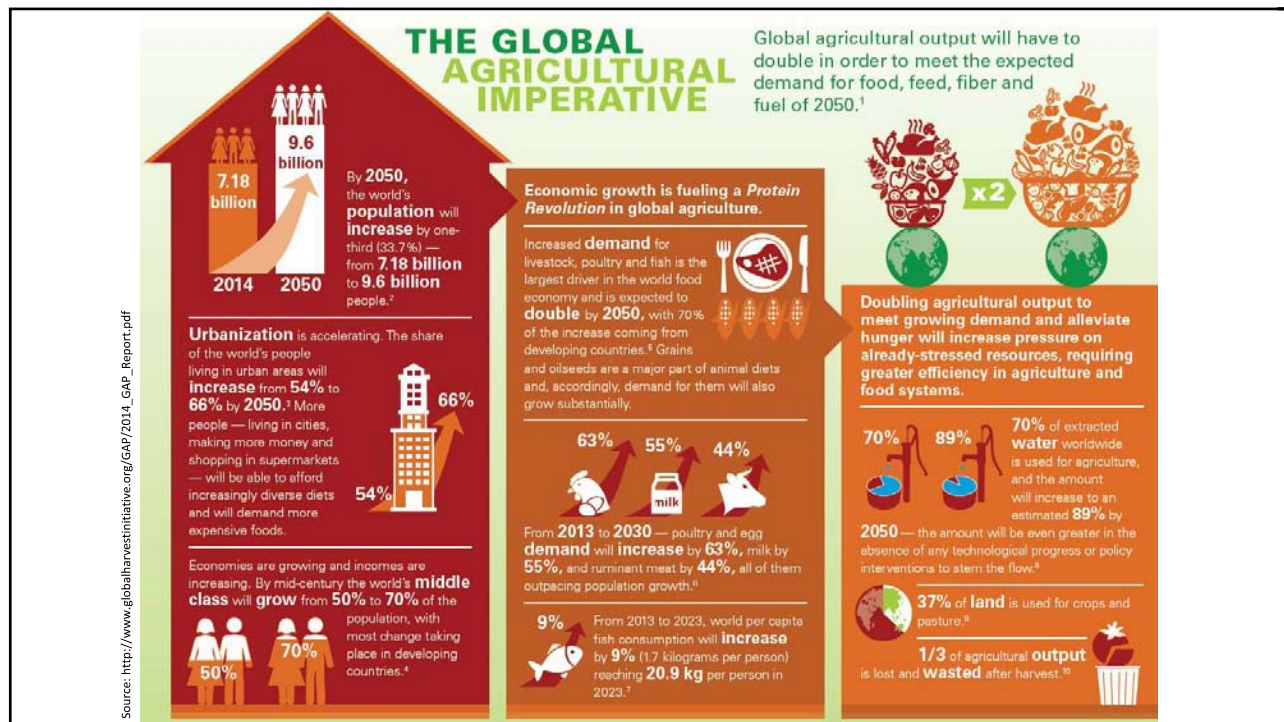
The image shows a robotic arm in a food processing environment. A large blue circle is on the left, and a yellow circle is in the center. The text is overlaid on a semi-transparent grey background.

The world is changing ...



SO ARE WE

The image shows a night view of city lights from an elevated perspective, with a large body of water in the foreground. The text is overlaid on the image.



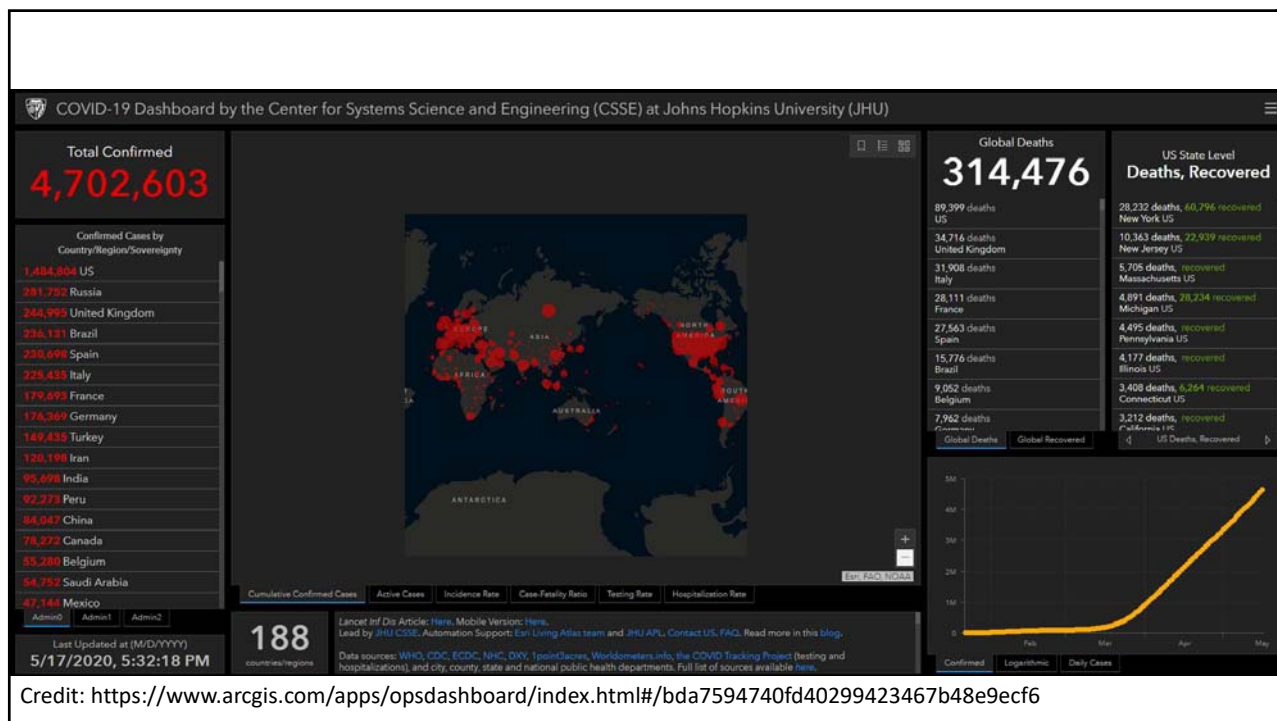
Current Challenges

Current systems do not provide enough nutritious food to feed the world's population in an environmentally sustainable way.

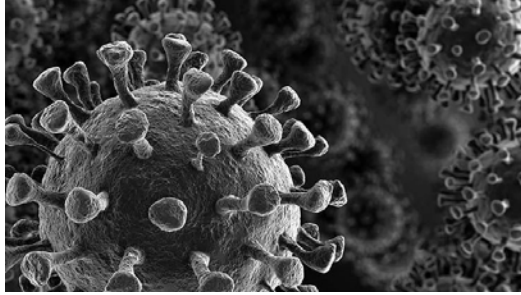
There are about 800 million undernourished people, 2 billion people are considered micronutrient-deficient and an additional 2 billion are overweight or obese.

Current food production, transport and processing along with their waste streams are placing enormous pressure on environmental resources.

Who Feeds the World in a Pandemic?



COVID-19 Food Crisis?



Lockdowns have led to decrease in demand for durable goods and discretionary services, but not food.

COVID-19 is amplifying the risk of a worldwide food-price spike, which would trigger crises in many developing countries.

World Food Programme

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Home > Publications > 2020 - Global Report on Food Crises

20 April 2020

2020 - Global Report on Food Crises

Publication type: Reports
Topics: Food security analysis (VAM)

The 2020 edition of The Global Report on Food Crises describes the scale of acute hunger in the world. It provides an analysis of the drivers that are contributing to food crises across the globe, and examines how the COVID-19 pandemic might contribute to their perpetuation or deterioration. The report is produced by the Global Network against Food Crises, an international alliance working to address the root causes of extreme hunger.

Download "Global Report on Food Crises 2020"

PDF | 7.09 MB

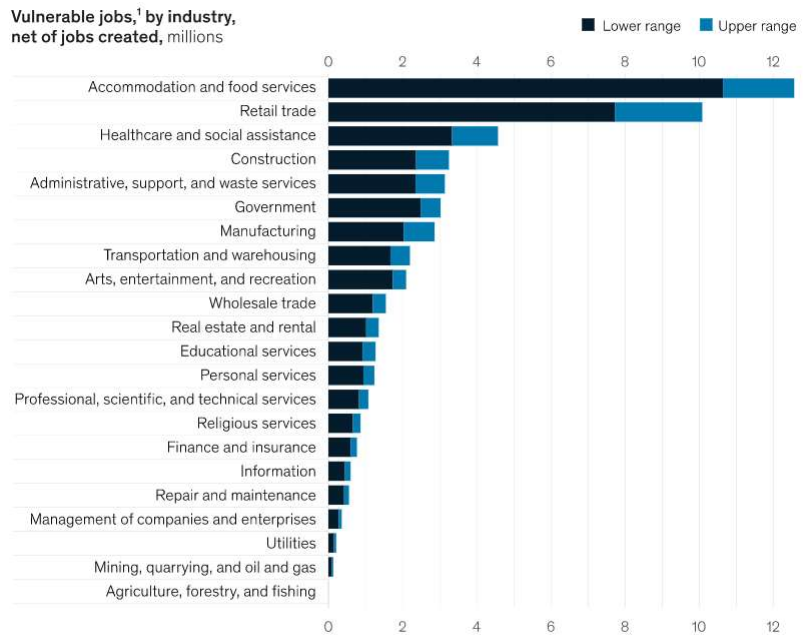
English

<https://www.wfp.org/publications/2020-global-report-food-crises>

COVID-19 will have significant impact in world economies.

In the USA, 44 to 57 million jobs are vulnerable in the short term.

Impact more muted in (primary) agriculture sector.

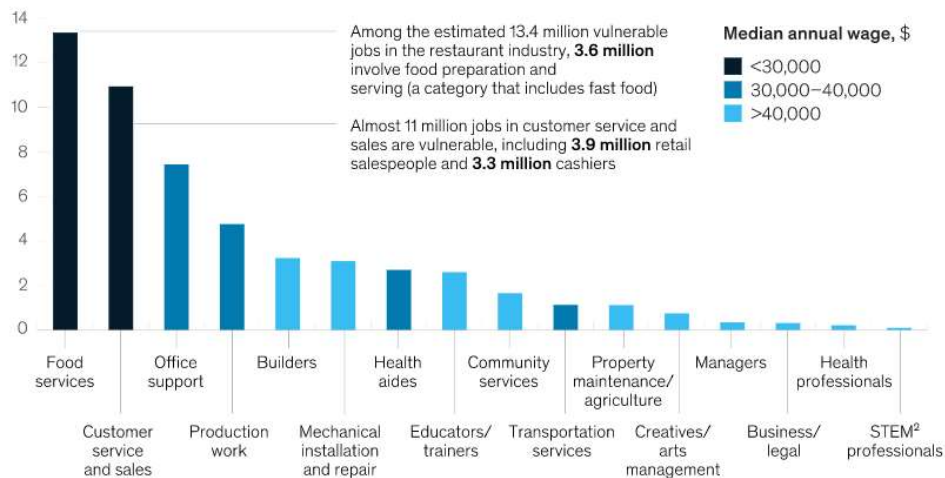


¹Vulnerable* jobs are subject to furloughs, layoffs, or being rendered unproductive (for example, workers kept on payroll but not working) during periods of high physical distancing.
 Source: LaborCube; McKinsey Global Institute analysis

Credit: <https://www.mckinsey.com/industries/public-sector/our-insights/lives-and-livelihoods-assessing-the-near-term-impact-of-covid-19-on-us-workers>

Forty-six percent of those vulnerable jobs are in the food service, customer service, and sales

Vulnerable jobs, net of jobs created, by occupation, millions



¹Vulnerable* jobs are subject to furloughs, layoffs, or being rendered unproductive (for example, workers kept on payroll but not working) during periods of high physical distancing.
²Science, technology, engineering, and mathematics.
 Source: LaborCube; McKinsey Global Institute analysis

Credit: <https://www.mckinsey.com/industries/public-sector/our-insights/lives-and-livelihoods-assessing-the-near-term-impact-of-covid-19-on-us-workers>

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Global Agenda | COVID-19 | Future of Food | Agriculture, Food and Beverage

Coronavirus could worsen hunger in the developing world



<https://www.weforum.org/agenda/2020/04/coronavirus-worsen-hunger-developing-world/>

School closures mean no school meals for millions in the global South. Image: REUTERS

COVID-19 Food Trends



How the Global Food and Beverage Sector Will Change Post COVID-19

- Growing demand for easy-to-prepare meals
- Increasing concerns over product safety
- Rising popularity of online buying

COVID-19 is changing how people eat, shop and think about food

New product development and packaging

Stress and disruption of food supply chains

 Recycling
 Consumers
 Retail
 Processing
 Transport
 Primary Sector
 Farm Inputs





Food Value Chains

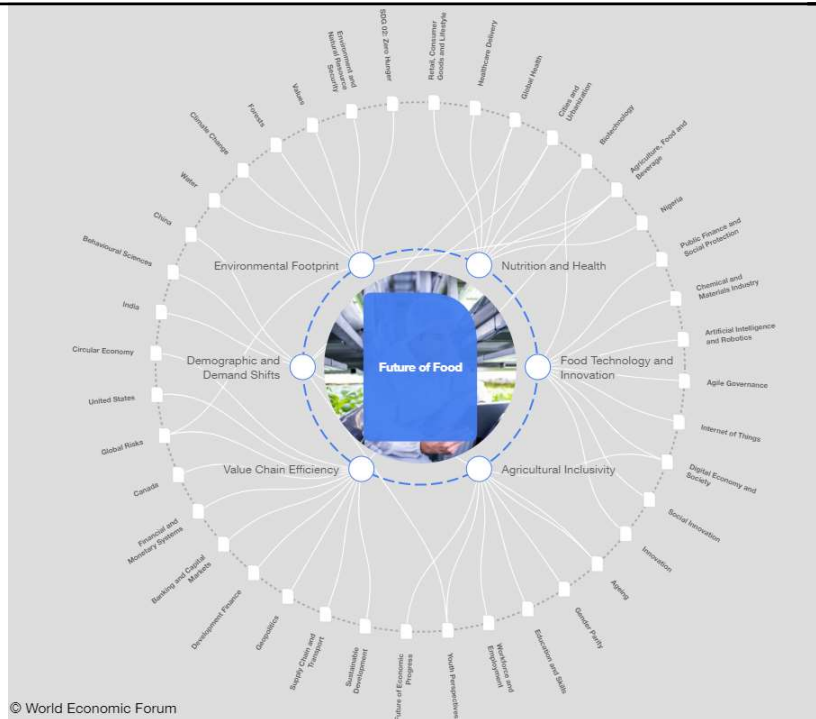
Food processing involves various activities; most labour intense

`Social Distancing` in the Food Plant?



The Future of Food

Watchout for what happens in USA, China, India and **Nigeria**.



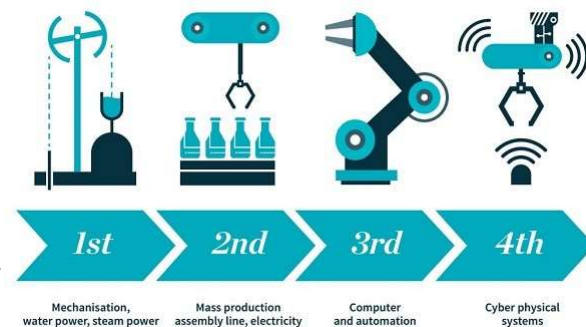
Industrial Revolution

In the latter half of the 18th century, industrial revolution transformed largely rural, agrarian societies in Europe and America into industrialized, urban ones.

1IR - mechanization, growth of industries

2IR - mass production, expansion of electricity, petroleum and steel

3IR - digitisation of manufacturing processes



Bold changes envisioned ...



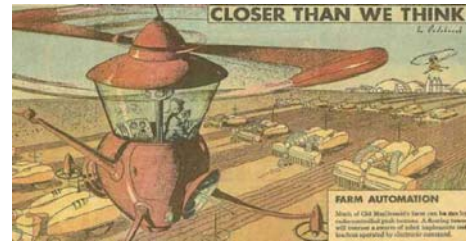
Colossal crops (1962)



Fat Plants and Meat-Beats (1958)



Factory Farm (1961)



Farm Automation (1958)

The future of technology in agriculture (2016) by the Netherlands Study Centre for Technology Trends is copyrighted as defined under the Creative Commons Attribution NonCommercial NoDerivatives 3.0 International licence.

New Industrial Revolution in the Food Sector

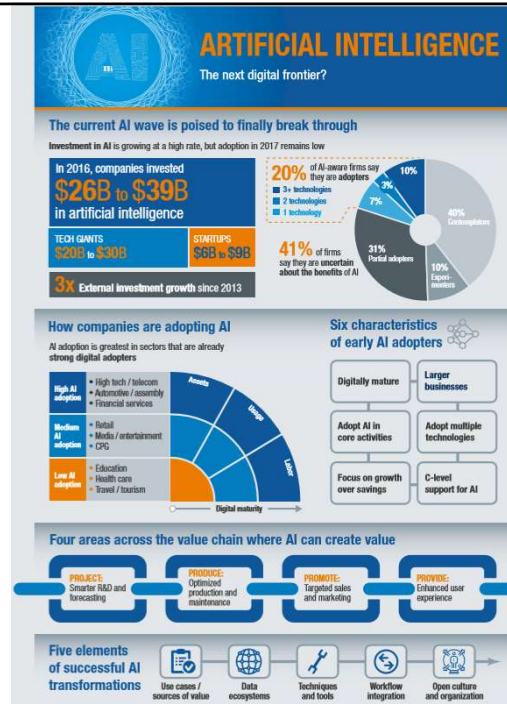
Radical innovations are required in the food sector to feed the growing population

4IR technologies such as artificial intelligence and computer vision robotics will be the tools for dealing with future demand for sustainable food supply.



Artificial intelligence (AI) is concerned with building smart machines capable of performing tasks that typically require human intelligence.

It combines a number of methods and phenomena, among which two major concepts called Neural Networks and Deep Learning are responsible for AI to attain such an outstanding advancement.



<https://www.mckinsey.com~/media/mckinsey/industries/advanced-robotics/our-research/how-ai-is-reshaping-ai-intelligence-discussion-paper.aspx>

Components of AI



Computer Vision



Computer vision deals with mimicking human visual system. It is widely used in pattern recognition, machine learning, computer graphics, 3D reconstructions, virtual reality, and augmented reality.

Techniques such as line detection, feature extractions, segmentations, feature matching and tracking are widely common.

AI IN HEALTHCARE

(Robotics, Computer vision, Machine learning)

- Robot-assisted Surgery
- Drug discovery
- Virtual Medical Assistant
- Data analytics and decision making

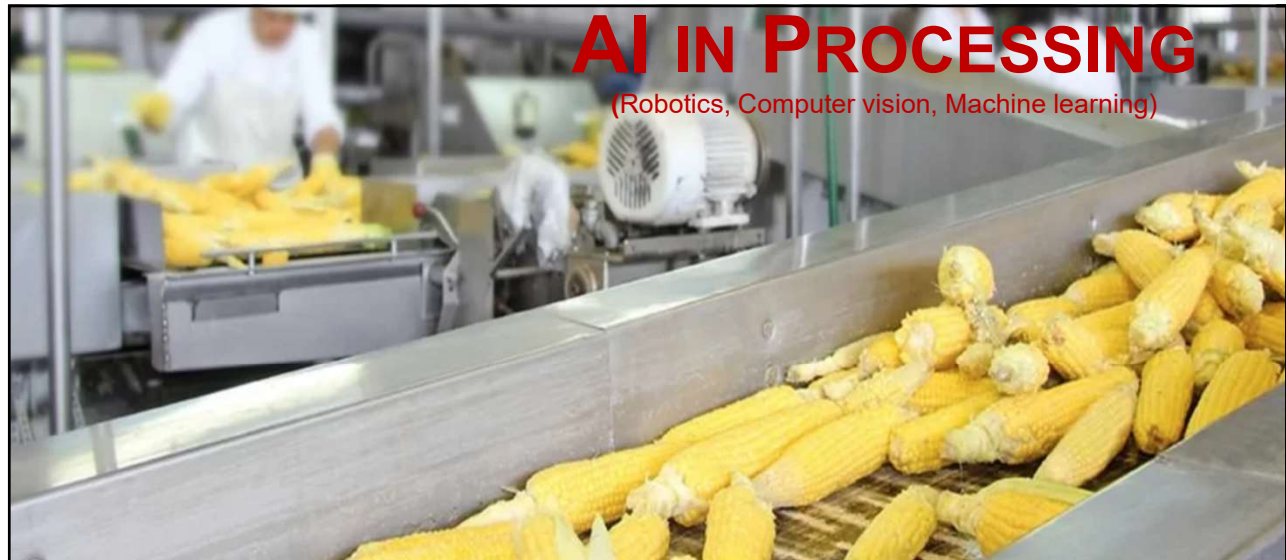




AI IN AGRICULTURE

(Robotics, Computer vision, Machine learning)

- Pest and disease detection and control
- Robotic harvesting and weed control
- Crop and soil health monitoring
- Yield monitoring and optimization
- Drones and Computer Vision for crop analysis & monitoring of farm animals



AI IN PROCESSING

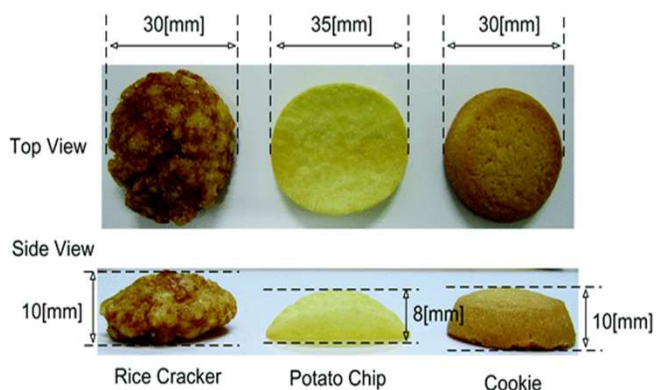
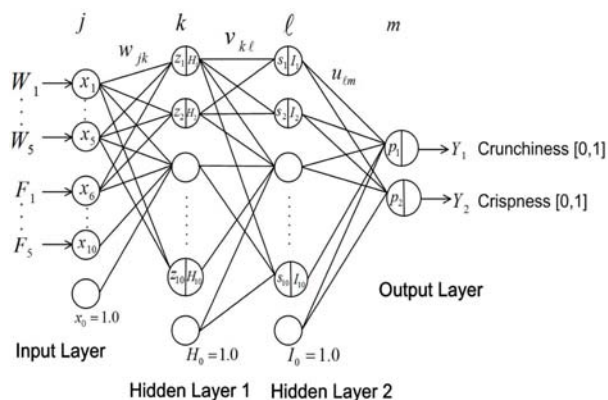
(Robotics, Computer vision, Machine learning)

Process automation to improve hygiene, improve sorting, detect anomaly, improve food quality to meet ever growing consumer demands.



AI IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Food Quality by AI



Crispiness and Crunchiness of food materials

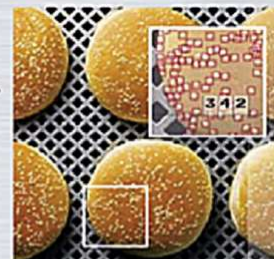
► HARVESTING

Automated harvesting reduces cost with less fatigue and can extend to produce grading and processing. Examples include carrot topping, vegetable and salad root removal and apple picking.



► QUALITY CONTROL

Ensuring food looks good is critical for premium brand foods. Vision based quality control can ensure distribution of pizza or bun toppings, colour of baked products and analysing the cell structure for breads.



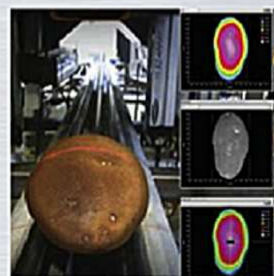
► PICKING & PACKING

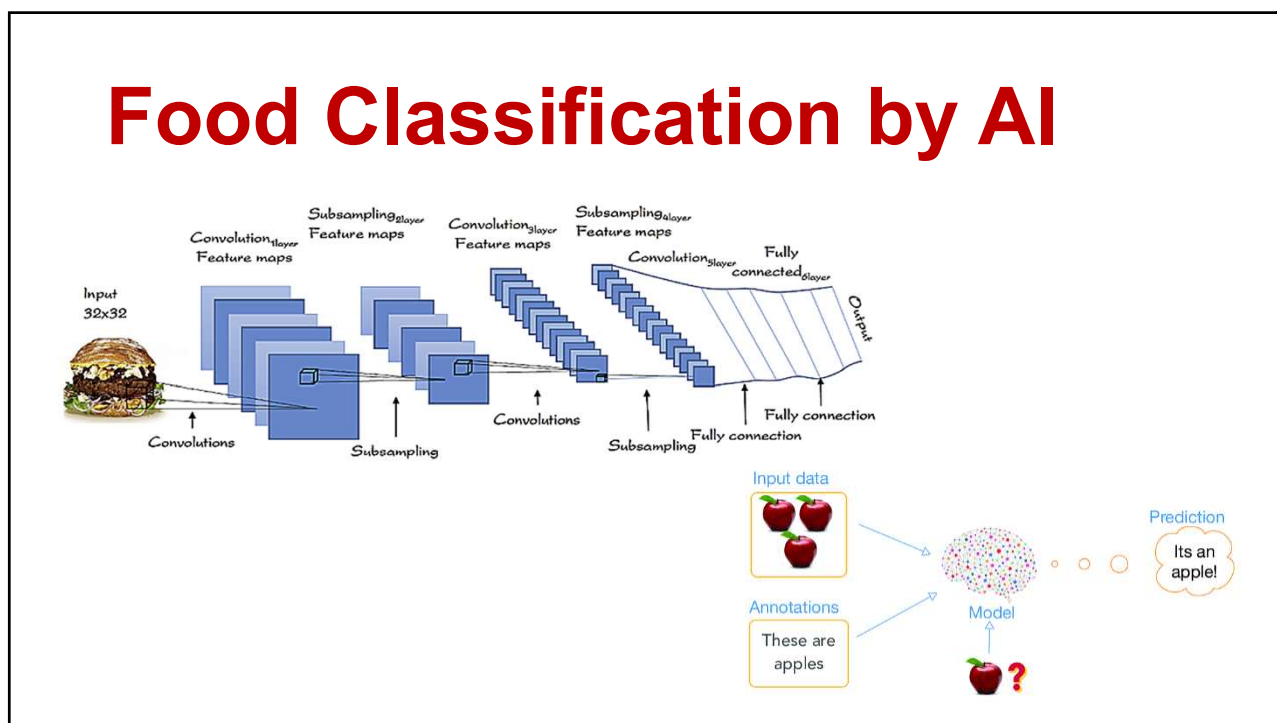
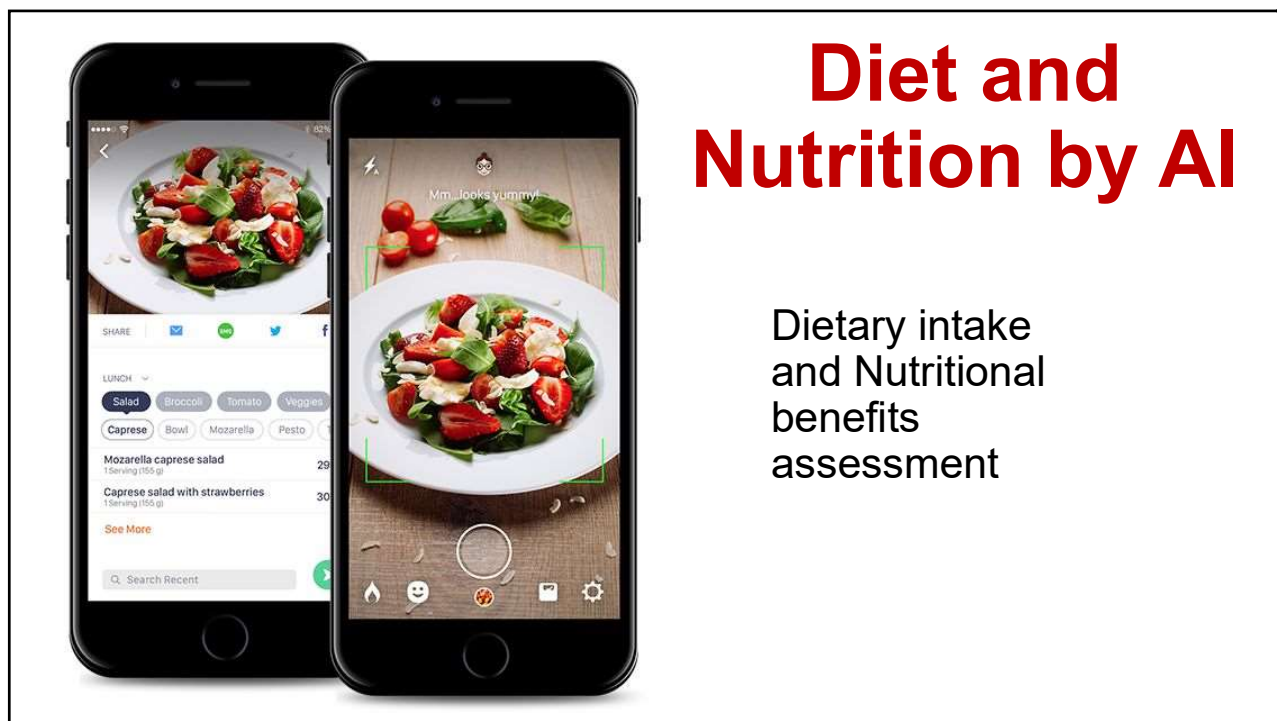
Vision working in conjunction with robotics allows consistent packaging even where multiple products are mixed in any orientation and can ensure the best cut is always on top.



► SORTING & GRADING

Maximise quality of bulk produce such as pulses and rice by removing contaminants while grading potatoes, fruit and meats ensures premium pricing for the best.





Looking into eggs



CANADIAN POULTRY

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MENU

Features > Research

Determining chick gender

Canadian research is moving forward on determining gender in-ovo.

In 2007, when Dr. Michael Ngadi at McGill University developed a way of predicting chicken egg hatchability using hyperspectral imaging with 95 percent accuracy, no one noticed.

"It's a testimony to funding early research," said Tim Nelson, CEO of the Livestock Research Innovation Corporation (LRIC), a Guelph-based organization that acts as a catalyst to enable cross-disciplinary and cross-sectorial research.

<https://www.canadianpoultrymag.com/determining-chick-gender-30008/>

Leveraging AI in Food Safety Compliance

上海市市场监督管理局天厨二店

摄像头1 摄像头2 摄像头3 摄像头4

报警 违规列表

警告 07-2011 星期一 22:08

设备ID: 温度 湿度

Camera 0

报警事件: 2017/09/15

报警编号: 07-1221

报警名称: 大肉柜故障

温度: 11°C

湿度: 12%

报警: 80%

报警处理完成: 75%

姓名: 魏德人

违规列表

Leveraging AI in other compliances



Other applications of AI

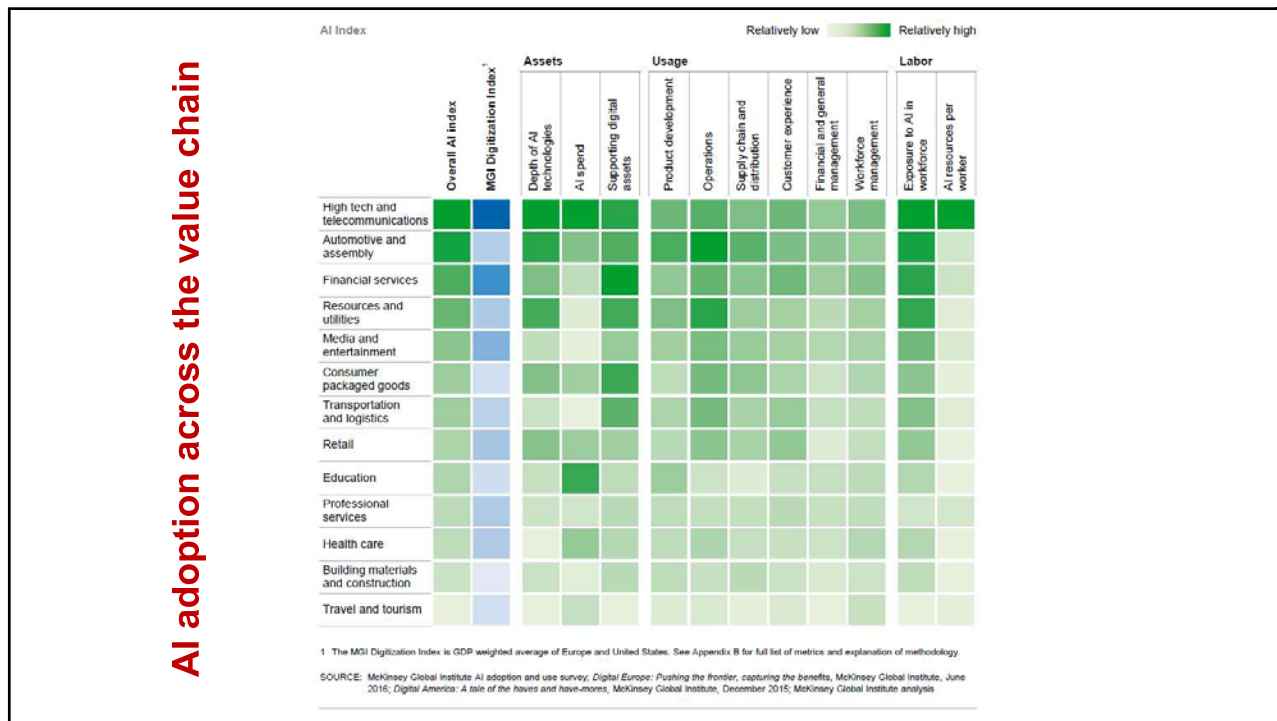
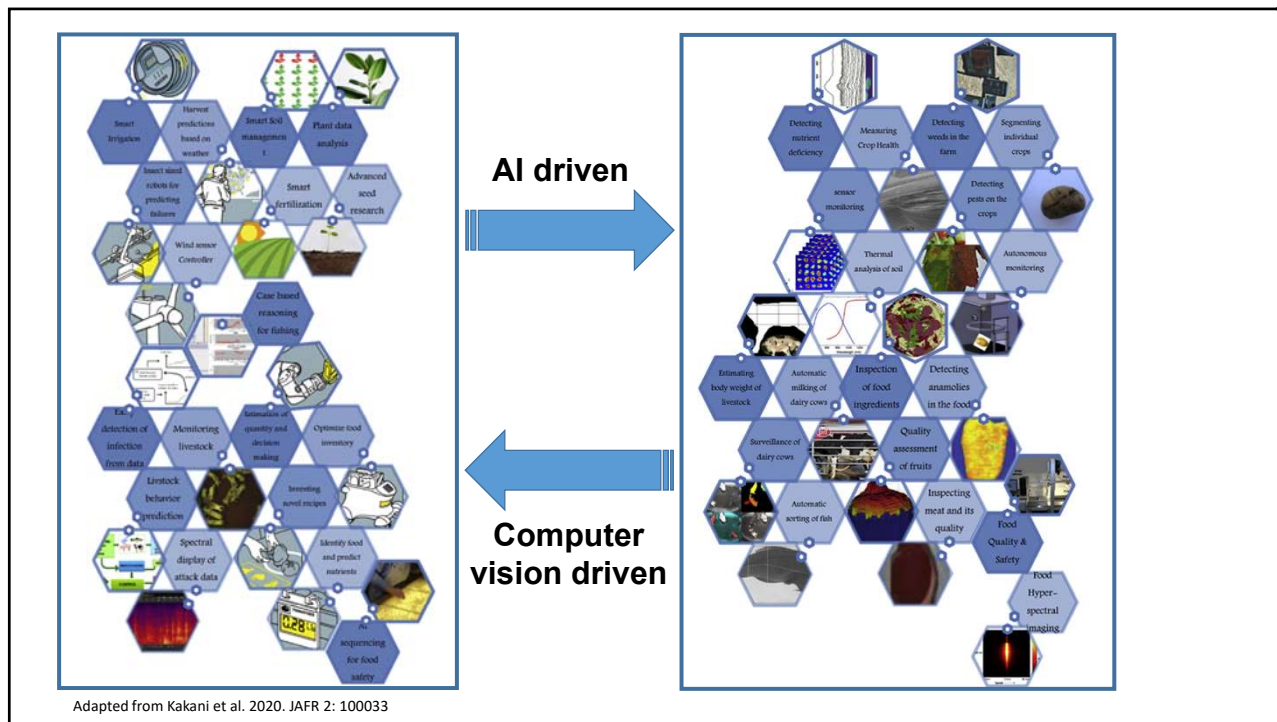
Recipe prediction from
food images

Packaging
Recommendation
System

New food product
development

AI-driven monitoring
and Cleansing system
for food Processing
Equipment

Food waste reduction
and Supply chain
optimization

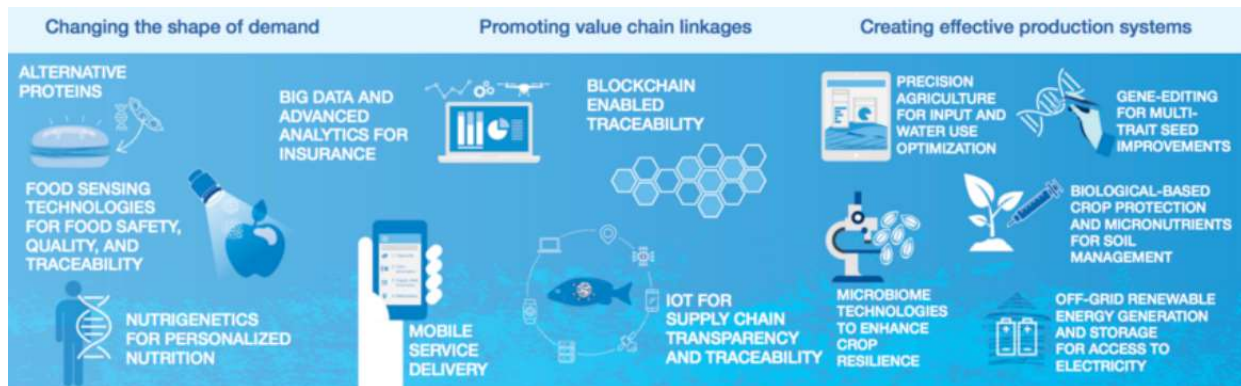


Creating value by AI

		Project	Produce	Promote	Provide
		Enlightened R&D, real-time forecasting, and smart sourcing	Operations with higher productivity, lower cost, and better efficiency	Products and services at the right price, with the right message, and to the right targets	Enriched, tailored, and convenient user experience
Retail	Applicable technologies	Anticipate demand trends, while optimizing and automating supplier negotiation and contracting	Automate warehouse and store operations; optimize merchandising, product assortment, and microspace	Optimize pricing, personalize promotions, and tailor website displays in real time	Personalize tips and suggestions, offer immediate assistance with virtual agents, automate in-store checkout, and complete last-mile delivery by drones
Electric utilities		Enhance demand and supply prediction, assess reliability of integrated generation assets, and automate demand-side response	Optimize preventive maintenance, improve electricity production yield, reduce energy waste, and prevent electricity theft	Optimize pricing with time-of-day and dynamic tariffing; match producers and consumers in real time	Automate supplier selection, provide consumption insights, automate customer service with virtual agents, and tailor usage to consumer's preferences
Manufacturing		Improve product design yield and efficiency, automate supplier assessment, and anticipate parts requirements	Improve processes by the task, automate assembly lines, reduce errors, limit product rework, and reduce material delivery time	Predict sales of maintenance services, optimize pricing, and refine sales-leads prioritization	Optimize flight planning and route and fleet allocation; enhance maintenance engineer and pilot training
Health care		Predict disease, identify high-risk patient groups, and launch prevention therapies	Automate and optimize hospital operations; automate diagnostic tests and make them faster and more accurate	Predict cost more accurately, focus on patients' risk reduction	Adapt therapies and drug formulations to patients, use virtual agents to help patients navigate their hospital journey
Education		Anticipate job market demand, identify new drivers of performance to assess students, and help graduates highlight their strengths	Automate teachers' routine tasks, identify early disengagement signs, and optimize group formation for learning objectives		Personalize learning, shift from stop-and-test model to continuous learning cadenced by virtual coaches and tutors, and build student self-awareness

¹ Machine learning for mutuse and nonspecific applications.
SOURCE: McKinsey Global Institute analysis

Impact of AI on the food industry



Bottlenecks to AI Adoption in Food Processing

Lack of quality and adequate data

Lack of technical expertise, technology and research

High cost of bandwidth and computing resources

Low awareness of AI capabilities in food processing

Problems with integration of AI into existing system of operation

Enhancing AI in Nigerian Food Processing Sector

Contribute to development of AI capacity among young food processing professionals

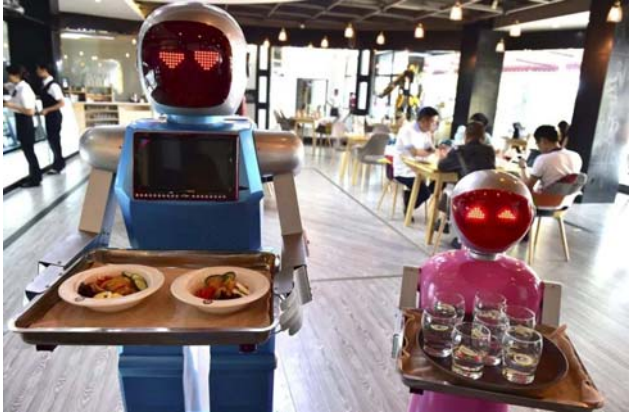
Partner with local and foreign AI organizations to facilitate development of AI enabled food processing technologies in Nigeria

Partner with universities and research institutes to facilitate AI-driven researches in food processing in Nigeria

Seek buy-in of relevant government stakeholders to setup National AI Strategy that will impact food processing industry

Organize nationwide AI competition geared towards solving food processing problems using AI

Concluding Comments



There are already many uses of AI and machine learning in the food industry. Some of the world's leading startups and enterprises are already using machine learning and deep learning in their operations.

Concluding Comments



The food industry has historically benefitted from technology.

The future is automated.

The next generation of food processors will rely heavily on emerging technologies such as AI in order to be competitive.

Concluding Comments



There is great opportunities for `smaller players` and developing countries to compete effectively with `big players.

The time is now to take action for the future.

THANK YOU

email: michael.ngadi@mcgill.ca