



المجلس العالمي WORLD MAJLIS

# WORLD MAJLIS REPORT

# FOOD, AGRICULTURE, AND LIVELIHOODS WEEK

17<sup>th</sup> to 23<sup>rd</sup> February 2022

What if we could feed the next billion people and support our planet?



Download the report or watch the full World Majlis session at: virtualexpodubai.com/about-history/detail/world-majlis

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Deeply rooted in the traditions of the UAE, the majlis is one of the cornerstones of Emirati society, a space that welcomes friends and strangers to share news and ideas.

The Expo 2020 Dubai World Majlis is an inclusive, open and informal conversation space, physical and digital; one that brings together diverse voices from all over the world to reflect on complex challenges for the wellbeing of people and planet.



Between 17th and 23rd February 2022, Expo 2020 hosted five World Majlis to explore the theme of Food through the lenses of digitisation, gender equality and sustainability.

## **1** Farms of the Future

Feeding the Planet with Technology Co-curated with Australia What future innovations will help farms be more productive to feed the additional 2 billion people by 2050 and reduce their environmental impact?

## 2 The Value of Food

Rethinking the Cycle of Food Waste

Co-curated with New Zealand

How can we innovate and invest to make supply chains more efficient and reduce waste? How can we make the most of the food that is produced before it is gone?

## **3** You are What You Eat

Considering Food as a Lifestyle

In collaboration with the Expo School Programme

How will the youth eat tomorrow? What options will they make? How self-sufficient will they be?

## **4** From Farmer to Boss Lady

Developing a Gender-equitable Agricultural Sector In collaboration with the Women's Pavilion Co-curated with the USA

How can we explore the impact that gender-inclusive agriculture has on ending hunger and poverty and promoting sustainable development?

## **5** Food for Thought

How will We Eat in the Future?

Co-curated with Italy

As we venture into the future, with a growing population, one must imagine what the world's diet in the future will look like? What innovations in the way we grow and consume food will define diet and nutrition in the coming decades?



## Farms of the Future

## Feeding the Planet with Technology

Co-curated with Australia



Australia Pavilion 17th February 2022

#### HE Fernando Mattos Costa

Minister of Livestock, Agriculture, and Fisheries of Uruguay

#### Andrew Cox

Manager, International Markets for Meat & Livestock Australia

#### Kelvin Wickham

Rod A. Wing

Chief Executive Officer AMENA (Africa, Middle East, Europe, North Asia and the Americas), Fonterra, New Zealand

Professor, Plant Science: Director,

Center for Desert Agriculture, King

Abdullah University of Science

and Technology, KSA

Matthew Atkins General Manager, Bega Foods International, Australia

Professor Dr Vesna Bengin Co-founder and Scientific Advisor, BioSense Institute, Republic of Serbia

#### Dr Selima Hauber

Agricultural Education and Outreach Officer, The One Eleuthera Foundation's Centre for Training & Innovation, Bahamas

#### Professor Andrew Lowe

Professor, Plant Conservation Biology, University of Adelaide, Australia

#### Sally Mousa (Moderator) International Speaker and Presenter, UAE



## The Value of Food

Reducing Food Waste and Loss for a Healthier Planet

Co-curated with New Zealand



**Terra – the Sustainability Pavilion** 20th February 2022

#### Sheikh Rashid bin Khalifa Al-Khalifa

General Manager of Peninsula Farms, Bahrain

## Jo Churchill MP

Parliamentary Under Secretary of State, Department for Environment, Food and Rural Affairs, Government of UK

Katy Barfield Founder & CEO, Yume Food, Australia

#### Professor Miranda Mirosa

Associate Professor, Department of Food Science, Otago University of New Zealand Jessica Quietsch Chef and Founder, Farm2Table, UAE

**Meiny Prins** 

the Netherlands

CEO and Co-owner, Priva,

#### Nishchint Bhatia

Vice President and Head – Agronomy, Africa Middle East and South Asia, PepsiCo International, UAE

#### Louise Nash

Founder and CEO, Circularity, New Zealand Sally Mousa (Moderator) International Speaker and Presenter, UAE



## You Are What You Eat

Next Gen World Majlis: The Role of Food in Our Lives

In collaboration with the Expo School Programme



**Terra – the Sustainability Pavilion** 21st February 2022

Hawraa Ahmed Adan Al Nahda National School for Girls, Abu Dhabi Mohammed Marwan Ghazali Sharjah American International School, Dubai **Aryan Saboo** Cambridge International School, Dubai

**Yi-jin Chang** Dwight School, Dubai **Mobin Karimi** Adab Iranian Private School for Boys, Dubai Fatima Al Shennawy Al Mawakeb School – Al Garhoud, Dubai

Emerald Choi Cortez Domingo Apple International School, Dubai Raneem Fadi Mobarrak AlMaaref Private School, Dubai **Ross Burrill** (Moderator) Radio presenter and producer



## From Farmer to Boss Lady

Women's World Majlis: Developing a Gender-equitable Agricultural Sector

Co-curated with the USA



Women's Pavilion 21st February 2022

**Jamie Beyer** Farmer and Female Leader, USA Silvia Cruz-Vargas Director of International Programs, PepsiCo Foundation, USA Dr Suzie Newman (Moderator) Head - International Development, Institute for Plant & Food Research, New Zealand

Dr Varsha Bhagat-Ganguli Professor, Nirma University and Lal Bahadur Shastri Academy

**Elizabeth Nsimadala** President of Eastern Africa Farmers Federation, Uganda

## Dr Marie Lisa M. Dacanay

of Administration, India

Founding President, Institute for Social Entrepreneurship in Asia (ISEA), Philippines

#### Lauren M. Phillips

Deputy Director, Inclusive Rural Transformation and Gender Equality, United Nations Food and Agriculture Organization (FAO), Italy



# **Food for Thought**

## How will We Eat in the Future?

Co-curated with Italy



**Italy Pavilion** 22nd February 2022

**Dr Brent Clothier** Principal Scientist with Plant & Food Research Institute, New Zealand

#### Amin Emadi

Consultant, Food and Agriculture Organization, Switzerland **Chef Coco Reinarhz** International Chef and Restaurateur

Professor Michelle Colgrave Professor of Food and Agricultural Proteomics, Edith Cowan University, Australia Minister Charlie McConalogue Minister for Agriculture, Food, and Marine, Government of Ireland Michele Pontecorvo Ricciardi Vice President, Ferrarelle Società Benefit, Italy

**Quang Ngo Dinh** Chief Executive Officer, Olivetti (TIM Group), Italy **Dr Celso Moretti** CEO, EMBRAPA, Brazil **Eithne Treanor** (Moderator) Managing Director, E Treanor Media



# SUGGESTED ACTIONS AND INITIATIVES

## **For Government**

Put in place the right policy levers for coordinated, mission approach to transform the future of agriculture towards a more sustainable model [p53, 55, 59]

Ensure small producers have the same opportunities as large farmers to access technologies to help deal with climate conditions. This should be supplemented with financial programs, and technical training to programs **[p18, 31, 33, 48, 63, 69]** 

Create disincentives such as imposing higher taxes on food waste going to landfills [p47, 49, 53, 55]

Give businesses targets around for example reducing food waste and reducing food that goes into landfills [p22, 53, 55]

Government can play an enormous role in R&D. It can both stimulate change, but can also create an environment where change can happen [p22, 34-35, 56, 68-70]

Develop rural areas to improve economic opportunities there, including specifically, in the agricultural sector [p20, 22, 53]

Support farmers to increase their knowledge, especially as climate change transforms agricultural conditions [p34, 35]

Formally integrate women in the food safety and agricultural sector [p38, 45]

#### World Majlis Food, Agriculture, and Livelihoods Week

## **Educational Solutions**

Work with food industry and farmers to share the latest research and innovations on food production [p33, 34, 59, 67, 63]

Develop curricula that engages youth from a young age to promote awareness and engage them producing food, this could include interdisciplinary curricula using plants to teach students other subjects including math, biology, genetics, etc. **[p39, 48, 49]** 

## **For Businesses**

Work with interdisciplinary professionals—farmers, designers, strategists, sustainability professionals to radically redesign the food system to address challenges of food waste and circularity [p34, 35, 68]

Share knowledge and roll out best practices to farmers [p45, 55-56, 69-71]

Develop technologies in consultation with the farmers  $\cite{[p59, 68, 69]}$ 

Develop and apply accounting that captures the true cost of food and food was [p53]

Connecting the ideas from 20 thought leaders from 14 countries has sparked new lines of inquiry for future conversations and research. Can we continue to produce enough food for the world while staying within the planetary boundaries?

Can we tap into farmers' knowledge to build innovations to feed the world?

> How can farmers continue to farm effectively when climate is changing their environment and their knowledge is becoming obsolete?

How do we create a new generation of farmers?

What version of farming can help stop urban flight of young people? Can it safeguard the future of agriculture and alleviate poverty?

Do the new technologies of Agriculture 4.0 hold the promise of helping food production scale up while safeguarding humanity's well-being as well as the planet's?

Will low-tech and no-tech solutions also play role?

How can agricultural systems behave more like ecosystem and bring the benefits back into the systems? How do we deal with the food waste and loss cycle?

## Context

What if we could feed the next billion people and support our planet?

People's well-being, social progress, and the health of our planet are interlinked with how we grow food. Ironically, the very food that gives us sustenance and connects us socially is now at the heart of environmental degradation and the existential crisis we currently face.

## Thriving in balance with the planet

Modern food-production is an energy, water and knowledge-intensive process. As global population increases and consumption patterns change, agricultural markets will shift in unprecedented ways, placing enormous strain on the planet. At this critical juncture, we face a difficult question: do we need to produce more or waste less?

To increase food production, farmers around the world will need to improve crop production either by expanding agricultural land or by embracing new methods like precision and data-enhanced farming. On the other hand, we have many opportunities to reimagine and reduce food waste to ensure that agricultural systems are agile, adapt to climate change, and become significant contributors to the circular economy.

## A tale of two scales

Modern agriculture is a tale of two scales: One of a highyield agricultural system, and the other of smallholder farms in the global south.

The triumph of modern food production is its enormous expanse and reach. Mechanisation, chemical inputs, biotechnology and mobility have led to higher yields and a intricately connected food system. As industrialised nations have became production-oriented since the mid-twentieth century, agriculture has become more complex.

On the other hand, small-scale farms account for a third of the world's food production. Most are in Asia and Africa, and are owned and operated by families. With less than two hectares of land, smallholder farms often lack access to modern resources and require different strategies for increasing yields and feeding their communities.

## **Diet inequity**

Today, more people are over nourished. The average person in Australia and North America, for instance, consumes six times the recommended amount of proteins. Africans, on the other hand, consume seven to eight times as much starchy vegetables in their diet.

As incomes rise around the world, the demand for red meat has skyrocketed. With more dispensable incomes, families can afford to move towards diets rich in animal protein, placing greater demands on planetary systems and widening the impact on global ecosystems and climate.

Creating more balanced diets, including encouraging the consumption of a wider range of foods, as well as drawing on indigenous and locally-sourced proteins, will help us alleviate stresses on the system and improve well-being.

## Farms of the future

Farms of the future will be radically different by adapting to climate change and scarcity of resources while increasing productivity, profit and sustainability. The challenge for future farmers is to grow nutritious, healthy and affordable food for while reviving ecosystems.

While large-scale farms can benefit from the technologies of the Fourth Industrial Revolution, small-scale farms require low-tech, or even no -tech, solutions to become more efficient.

## Where are the next-gen farmers?

An alarming trend in agriculture is a shortage of successors to farmers. Producing nearly 80 percent of the world's food, many family-owned farms have no one from the next generation to carry forward the honourable tradition of growing food.

With fewer inheritors, the wisdom of aging farmers their wealth of knowledge and years of experience—is at risk of eroding, much like the land on which the farms are built. A big part of the solution will be improving rural infrastructures, educating a new generation to the value of food-production, and encouraging young people to feel a strong emotional bond to growing food.

## With whom we eat

Eating is not just a necessary function to supply our body with energy. It is a social and communal moment that helps pass knowledge through generations, including knowledge of food systems. Current lifestyles are often limiting the ability of making food an important experience that connects generations and knowledge.

## THINKING DIFFERENTLY ABOUT THE WORLD'S FOOD

We need to reimagine how we produce food as we adapt to climate change, enter the circular economy, upcycle waste, and embrace innovations.

## A world of waste

We face a profound global tension between the need to produce more to feed the planet, while significant amounts of food are being lost or wasted. Every year, one-third of the world's food is lost or thrown away. Some of it is lost between along the food supply chain between harvest and before it gets to the market or stores. A significant quantity is discarded in retail and at the time of consumption. In a world where almost a billion people are starving, this is unconscionable. Saving just a quarter of the food that is lost or thrown away could be enough to end world hunger.

# Every year, one-third of the world's food is lost or thrown away

#### Creating a safe operating space

Agriculture is a practice which we have inherited over centuries. Until recently, our ability to grow food evolved closely with local climates, in synchrony with the seasons and local geographies. Today, large-scale food production has created a crisis, pushing several planetary boundaries beyond the safe operating space within which humans and other species can thrive. The challenge for the next 30 years will be to supply the most nutrient-dense protein with the correct nutritional composition, while reducing stresses on agriculture's intense dependence on water and energy. Feeding the next three billion requires us to reimagine how we produce food for more people with fewer resources, while living in balance with the planet.

## Nurturing the next generation of farmers

To address the gap in knowledge transfer from today's aging generation of farmers to the next generation of food producers will require new ways to stem—or even reverse the tide—of urban flight from rural areas. Or, alternatively, by making urban areas places for thriving agricultural practices. Young people can be encouraged to explore the challenges of agriculture through curiosity-driven, hands-on, and experiential learning. Through urban and rural initiatives, young people can begin to appreciate farming as an opportunity for creating entrepreneurship, developing professionally, and building a robust, profitable, and future-looking careers.

## Turning food waste in a resource

Something is wrong when a third of the food we produce is wasted and ends up in the landfill. Mapping waste flows in the food supply chain and stemming the flow of waste at the source will be critical. Finding ways to redistribute wasted food is also an important part of the strategy. Food can be upcycled into highly valuable products and can generate new industries as well, for example soap and beauty products. Rather than just rotting in the field, food waste could actually be processed into useful products. Upcycling food can be tied to national research and development agendas (R&D) to create innovative, high value products that can support a circular economy, heal the land, and revitalise our planet.

## The future of farming

Agriculture's next major trends include the use of big data, precision agriculture, artificial intelligence, and the Internet of Things (IoT). Emerging technologies have the potential to transform how we produce food and the scale at which we do it. When supporting farmers with technology, the context is important—there is no one-size-fits-all solution, and optimal solutions will be determined by the geographical location, farm size, as well as the cultural, economic and environmental ecosystem that surrounds the farmer.



We need to give back more than we take. That's the honourable harvest that we need to encourage from our retailers, from our supermarkets, from our brands. What we're asking of our growers needs to be an honourable harvest needs to return more than we take.

- Louise Nash



We have crossed six of the nine olanetary boundaries as a result of human activity, partly as a result of food production

## THE PRESSURE COOKER

The scale of modern agriculture has supported economic growth for many countries by creating an abundance of food and the ability to export widely. However, modern agriculture is unsustainable with cracks showing in land degradation, greenhouse gas emissions and other stresses on the planet.

#### Pushing the planetary boundaries

Today, the world's food supply chain is a marvel of engineering and logistics, comprised of numerous sectors and processes ranging from seed production to livestock husbandry, from packaging to waste disposal.

Thanks to advances in transportation, logistics, and the cold chain, it is now feasible to move food around the world faster and more safely than ever before. Yet, our vast food-production systems are now buckling under the triple pressure of population growth, increased consumption, and environmental changes.

We generate enormous quantities of food loss and waste throughout the food supply chain, yet hunger and undernutrition continue to rise in many parts of the world.

We grow massive amounts of crops, yet our harvests provide less nutrient-dense foods due to soil depletion and climate change.

We have better, more energy-efficient machinery, yet we spew out more greenhouse gases than ever before.



"This time we have also the big challenge of climate change. We are not in the same situation as we were 10 or 20 years ago. We have more extreme problems with the weather. We sometime later we have droughts, and we have strong winds. And it is different and the climate is a big challenge for the natural open production." **HE Fernando Mattos Costa** 

**WATER** - Worldwide, groundwater is being drained, while rivers and lakes dry up as freshwater is diverted for irrigation. At the same time, agriculture remains among the main pollutants of water through fertiliser and pesticide runoff as well as livestock effluent.

ago. We have more extreme problems with the weather. We have intensive rainfalls, sometime later we have droughts, and we have strong winds

**HARVEST FAILURE** - Climate change is causing harvest failure, leaving farmers unable to cover their production costs and putting their livelihoods in jeopardy. Insecure incomes put additional strains on variables like education and health for communities around the world, affecting our ability to meet the Sustainable Development Goals.

#### Food-water-energy nexus

Food production is inextricably linked to water and energy consumption. Managing the food-water-energy nexus is critical for sustainable development, as impacts in one area will invariably affect the others.

By 2050, we will need an additional 50 percent of freshwater withdrawals. With the rising demand for animal protein worldwide, additional stresses on the food-water-energy nexus can be expected.

The challenge for the next 30 years will be to supply the most nutrient-dense protein with the correct amino acid composition, while reducing stresses on agriculture's intense dependence on water and energy.

griculture is the largest consumer of freshwater resources, accounting for 70 percent of global use. Along with global food supply chain, agriculture uses nearly a third of the world's energy, 70 percent of which is beyond the farm gate.



THE PRESSURE COOKER

"There are so many things that plea for going back to the knowledge of the local farmers experimenting with their own seeds again, creating new value from them." Meiny Prins

"The more we educate ourselves, the more we have access to knowledge and technology and experience and experiential knowledge. We have to optimise it in a way that is going to be more healthy for us, but it's sustainable for our planet." Amin Emadi

## Tapping into local knowledge

It is fundamental to listen to the farmers to build on their extensive knowledge. Innovations can build on the local knowledge of farmers and the generational wealth of information that they carry.

Of the many areas where we can draw from farmer's knowledge is experimenting with new seeds. Our current monoculture is the result of an emphasis on long-lasting food crops. This has diminished biodiversity and produced foods deficient in nutrients.

"I think of East Africa. And how we can we build up the ugali maize porridge to feed these new mouths that are coming along? If we can improve the maize production, we can have more maize ugali porridge, and that's what the traditional food is. And it's fantastic, by the way. And even here in the Emirates the role that dates played in the culture and the heritage, if we can better use water to maintain that date production, it will preserve that cultural heritage." Dr Brent Clothier

We propose as a radical redesign of it to work with nature, not against it, to think about how we enable our food, the nutrients to flow through in a circular fashion, just like in nature. There's no waste in nature. Why are we not designing our food system, not around the end consumer and the abundance that we deliver to them, but on how natural nature's systems operate? Listen to the growers, listen to the farmers. They know the land. They know what works. Enable them to experiment with what's possible. We have the most incredible living systems to operate in for our businesses. I think we've just been in denial of their magic.

– Louise Nash

## **Transforming food systems**

Our food system is a legacy model, a product of market-driven choices that favours profit through scale and high-yield. The system is fragmented and has evolved over the years with little cooperation across policymakers, farmers and communities.

The time is now to pivot our food production model towards combatting hunger, increasing equity, promoting sustainability and ensuring food security for future generations. By supporting smallholder farmers, increasing the efficiency of agricultural production and restoring and reusing farmland, we can reduce the impact on the environment and safeguard the livelihoods of millions.

Tackling challenges in the global food system will require a whole-of-system approach. No single component can totally move the dial until we can make the system work as a whole. To accomplish this, all sectors must work together government, industry, farmers, and communities all play a part to increase efficiencies within the food supply chain, reimaging the future of food, while protecting the planet.

# Emerging questions for future conversations

Can we continue to produce enough food for the world while staying within the planetary boundaries?

Can we tap into farmers' knowledge to build innovations to feed the world?

## FEEDING THE NEXT THREE BILLION

Today, while more people are fed than ever before, there are three billion people who are expected to join Planet Earth by 2050. Global food production will need to be stepped up by at least 70 percent in the next 30 years.

## **Nurturing farmers**

Most of the world's farms are in rural areas, and are owned and operated by families in the global south. Responsible for more than a third of the world's food production, many smallholder farmers are poor and themselves food insecure. They have limited access to markets and services. Most of the farmers are not farmers by choice, but by necessity, and they are generally ill-equipped to deal with the complexities of farming, now made more challenging by rapid land and water conditions.

Farming is an extremely challenging business. The skills required to run a farm are rapidly evolving and growing more complex for both smallholder and larger-scale farms. Advances in agricultural production systems have made farming less labour-intensive than in earlier decades, which is why food in developed countries is available tat relatively affordable prices. However, this does not mean that farming has become simpler or less difficult.

Indeed, climate change has made farming a far more difficult task. Farmers' skills and knowledge are being eroded as climate patterns shift. The majority of the risks associated with agricultural production are weather-related. Farmers' knolwedge—particularly smallholder farmers—must be updated on a regular basis to ensure that they can continue to work and produce food in the face of these changing conditions.

<sup>11</sup>Agriculture, the way it was done. It's hard, it's really hard and it's really risky.

- Vesna Bengin

## **Food security**

Supporting farmers is a crucial component of a comprehensive national food security plan. Governments, in collaboration with industry partners—must assist small farmers in gaining access to the same technology and know-how as large farms. Farmers should also be better integrated into the agricultural value chain as stakeholders through enhancing their access to technology, infrastructure and market connections.

## Knowledge-sharing for food-production

Knowledge has become a fundamental part of farming. Even very small-scale farmers have shown a willingness to pay for knowledge and technologies that would allow them to farm more efficiently.

Good agricultural extension programmes for sharing best practices are a useful model for bringing best practices to farmers. Through the guidance, information, and other resources they provide to farms they bring best practices to helping farmers boost crop yields and improve their crop yields. Rolling out best practices and helping farmers innovate, requires a close collaboration of the farmers with the research community. This in turn calls for enabling environments to ensure that knowledge and best practices reach the farmer in the field. "We are not in the same situation of 10 or 20 years ago. We have more extreme problems with the weather. We have intensive rainfalls, we have droughts and we have strong winds and is different, and the climate is a big challenge for natural open production." HE Fernando Mattos Costa We asked farmers, small farmers, what they expect from the government. And my first guess would be money, right? They always need subsidies and support. But actually, the answer was knowledge. They understood that they needed to deploy new technologies. They understood the value of those technologies. They were ready to pay for them. They just didn't know how to choose and what to choose. And they relied on researchers and academia and on the government to provide this knowledge to them.

– Vesna Bengin

"But the benefits of course are not just about getting better yields and productivity, it's the livelihoods of the people that are farming the communities. We need to look at the whole value chain from the farm right through to the consumer on the shelf." Kelvin Wickham


#### Can we meet SDG 2: Zero Hunger?

Even though the number of people who are undernourished has fallen by about half since the beginning of the century, without significant changes in how we produce food, we cannot meet Sustainable Development Goal (SDG)2 for Zero Hunger.

Extreme hunger and malnutrition is on the rise and continues to be a major impediment to development in many countries. As of 2017, 821 million people were chronically undernourished. This was often as a direct result of environmental degradation, drought, and biodiversity loss. Hunger and undernourishment have knock-on effects for all the other SDGs including education and health. And, hunger has a strong gender component as women account for 60% of the world's chronically hungry. "We need a mix of policies that are national, empowering women at the individual and community level, to enhance their participation and processes. We need training. We need all sorts of formal and informal institutions and norms to change, to include women, to build programs and projects which really focus on making sure that women are advocating for themselves sitting at the table and included in processes of economic transformation." Lauren Phillips

#### Women help feed the world

Women make up little under 40 percent of agricultural labour overall, and more than 50 percent in low-income countries. Women are traditionally considered unpaid household labour in the agricultural sector. They also have significantly less access to inputs, technologies, markets, and land than men. Women also make up a significantly lower percentage of agricultural enterprises, and therefore capture much less of the value they create. Countries can make significant strides in production and reduce hunger by better integrating women farmers in the value chain

#### Urban farms are part of the solution

As the globe gets more and more urbanised, food demand will primarily come from city dwellers. In addition, the poverty is projected to shift from rural to urban areas. Food security is something that urban and peri-urban areas will have to play a significant part in, particularly as green belts around these areas are disappearing with no clear successors.

We need to encourage a new generation of farmers in urban areas as well as new technologies and attitudes by consumers prepared to adopt to city-grown food varieties and new means of food production. "Women need to have control over seeds. I think that's a very important aspect of food security because right now what's available in the market are high valued are actually hybrid seeds that deteriorate in terms of quality over time. And access to these seeds is affected, of course, by global value chains that are disrupted like during the pandemic. And women need to have control over seeds. They need to be seed growers of open pollinated varieties of seed." Marie Lisa Dacanay

"I like to look at those mega cities or the big cities, or the urban areas where people live. And you have those green belts around it with the small farms, and they have no successor. So that's disappearing. So how can you find those entrepreneurs close to those urban areas where food needs to be produced and you have to make it more tech, of course." Meiny Prins

#### Placing seeds in the hands of the next generation

Due to the difficulty and labour intensity of farming, as well as the fact that most farms are not lucrative, young people are not drawn to farming. The rural-to-urban exodus of young people is accelerating this dangerous trend that potentially threatens the future of agriculture.

More resources for young farmers might be a powerful lever to keep them in rural regions and contribute to the cohesion, growth and prosperity of rural areas.

'Eighty per cent of the world's food production is actually made by farmers that are about 60 years of age. I think we've got an ageing population that we need to have a look at as well." Mathew Atkins "Farming is hard. I think maybe that's a little bit why there's an ageing population. Some of the work needs to be done from an industry perspective to support perhaps some of the governance initiatives.' **Kelvin Wickham** ("CHECK") "Educating this generation will help. Educating them from, teaching them how it affects their physical health, mental health, how it affects society and the environment, and I think they'll apply it on their on the next generation too." Fatima Al Shennawy

a role. Industry has a role. Farmers have a role and parents and carers have a role. But actually, I don't, my personal view is that it's not as easy as sticking an allotment in a schoolyard that helps educate our children. It helps them when they look at a green thing grow, it's broccoli." **MP Jo Churchill** 



المجلس العالمي WORLD MAJLIS

During a previous World Majlis—Urban and Rural Development Week—the challenge of rural-urban flight was discussed. The need of developing rural areas alongside urban areas was highlighted, in order to ensure that people who live in rural areas had incentives and opportunities to stay in rural areas. "What we see in the majority of the developed world is that young people are leaving, actually already left villages. Majority of population lives in urban areas, and in order to bring them back or to motivate the young people that in the rural areas to stay and to work in farming we see the answer in digital technologies." Vesna Bengin "The Irish farming model is still based on the family farm, usually passed from one generation to the next. This model is something that I really want to protect, as it helps to maintain rural communities, rural employment and social cohesion." Charlie McConalogue When you put a seed in a kid's hand, you're making them a promise that that's going to grow just like them. And every person in this room probably remembers the first time that they plant a seed in kindergarten and really felt really cool about it.

– Steven Ritz

"When you move children from being consumers to producers you change everything. So that's the game changer right there." Steven Ritz "We've got to stop treating our kids as epicentres of profit too. You know we've celebritised food, we've monetised food in ways that is really we want to get them as young as we can and we want to keep them. So we've got to move away from that model and really empower kids that when you grow food, you grow justice. You know, food justice is racial justice, is economic justice." Steven Ritz Everybody wants to see big returns on their investment, but at some point, you know, the greatest investment we have is our children. This is the first generation of children, despite all the technology that we have that will not outlive their parents simply because of what they're eating. And that's collectively our fault. And we've got to own up to that.

– Steven Ritz

"I also really want to challenge big corporations because when bottled water is more expensive in communities like mine than soda. And that's unacceptable." Steven Ritz

And when I see my grandkids with their mother, they eat more consciously than what we used to do. What is the more importantly is the choice, the choices that we are making today from what we're eating tomorrow and the day after and make sure we are sustainable as a species." Chef Coco Reinarhz

#### Choosing foods for the environment

We are witnessing that preference around food are shifting. With growing awareness, particularly younger generations, are making food choices that align with their own values, whether it be their dietary nutrition or sustainability. Choosing what to eat can have profound impact on our impact on the planet. From reducing greenhouse gases to energy consumption, consumer choices can influence the entire food supply chain.

"I see a new generation of consumers which are much more interested about what they are consuming and which impacts their consumption they have on the environment and health." Michele Pontecorvo Ricciardi 'The pandemic did something, though, and we have to take advantage of it. It made a lot of people home chefs, and they're all looking to buy local." Sheikh Rashid Bin Khalifa Al-Khalifa There's a big job to do here in demonstrating why these products are worth paying more for educating people about our supply chain sustainability production. You know where food comes from? Not from the supermarket, but from a farm. So that's a really global message as well. And I think that's absolutely key. Moving forward farmers should be able to tell their story using media technology et cetera.

– Andrew Cox

FEEDING THE NEXT THREE BILLION

"We also need to start building for the future by encouraging communities to grow their own food. And with that food, what can you make of it? Making bread. Or turning a small, lonely carrot into something incredibly tasty on a plate." Chef Jessica Quietsch

"A pizza can be healthy when you make it yourself. Making your own pizzas without the additives, without, the sugar, without all these shelf-life lasting ingredients that that are really ruining our systems." Chef Jessica Quietsch

#### Cooking for health and the environment

Learning to prepare sustainable meals at home can also lower impact on the environment, can be prepared with nutrition in mind. Shopping locally, supporting local farmers, and preparing meals rich in fruits and vegetables can be healthier for humans as well as the planet. Preparing meals at home also minimises food packaging and waste.

#### An appetite for orphan crops.

Although there are over 50,000 edible plants, we only use a small fraction of them. Corn, rice, and wheat make up over 50 percent of global calorie consumption and the developed world relies heavily on these three plants. In developing countries more varied traditional diets are being abandoned in favour of western diets and these three crops. This is leading to a decrease in micronutrients in diets globally. Reviving local food production to tap into the wealth of underutilised, neglected or orphan crops may have potential to improve food and nutritional security.

"When you grow a lot locally, especially here in the UAE, they are producing a wonderful variety and a wonderful range. And there's not a lot of genetically modified foods here for the moment, with the local artisanal farms, the smaller farms. They are using the proper seeds and they're using seeds that are going to create fruit and vegetables that are not modified. There are certain countries that are really pumping out millions of tons of fruits and vegetables. But in the UAE when you find local sustainable farms that are smaller farms creating these wonderful products organically under the sun of the UAE, they really create wonderful the quality." Chef Jessica Quietsch

## // In Australia, out of the top 250 global crop species, none of those come from Australia and we have a massively underutilised under explored crop basis within Australia. We've seen it in Africa as well. This project is called the Orphan Foods, the orphan crop program within Africa, which is highlighting the top **100 underutilised** crops there.

- Andrew Lowe

## **Best practice**

#### Women's Economic Empowerment in Agricultural Value Chains

Despite their substantial contribution to agriculture in poor countries, women are considered unpaid family labour. The 'Benchmarks for Transformational Partnerships and Women's Economic Empowerment and Agricultural Value Chains' is guidepost for policymakers. Principles include advocating for small-holder farmers—women and men—to be recognised as stakeholders in the value chain, so that they can capture a more substantive portion of the value they create, including having access to knowhow, technology and innovations operations and support for entrepreneurship.

#### Circular economy

Bega launched a pilot program with KPMG and Rabobank to develop a genuinely circular economy in the region. The initiative brings in talent and technology to re-use waste and put it back onto farms: salty whey from their cheese production goes into asparagus production. And the asparagus is used as feed for the cows to reduce methane. There is also knowledge hub and tourism schools are invited to demonstrate the circular production.

#### Edible Schoolyard

An innovative program called Edible Schoolyard teaches youngsters about sustainable agriculture by producing food on campus. This program's purpose is to offer a sustainable meal for all K-12 students in California.

King Abdullah University of Science and Technology (KAUST) in Saudi Arabia recently funded a similar program. By cultivating their own food, the initiative will enhance students diets and appreciation of the value of food. Children learn about culture, mathematics, science, chemistry, and genetics through the study of plants.

# Emerging questions for future conversations

How can farmers continue to farm effectively when climate change is making their knowledge of their environment obsolete?

How do we create a new generation of farmers?

What version of farming can help stop urban flight of young people? Can it safeguard the future of agriculture and alleviate poverty?

## FOOD LOST OR BINNED

"Food is being wasted everywhere. It's being wasted right across that supply chain. Nearly half of fruit and vegetables and fruit crops are wasted, 30 percent of cereals and 20 percent of meat and dairy. So, it is everything, everywhere, which, of course, means it's everybody's responsibility. And to flip that to a more positive note means that we all pay a part in being part of the solution." **Professor Miranda Mirosa** 

Alongside solutions to produce more food for more people, there is an opportunity to consider how much we can gain when we recycle.

#### **Complexity of food waste**

One out of every nine people is malnourished, but one-third of all food produced on the earth is lost through inefficiencies or thrown away. We already produce enough food to feed the entire planet as well as an additional two billion people. Food loss and waste account for about 8 percent of worldwide CO2 emissions, and the economic losses of food loss are estimated to be \$1 trillion per year.

Food waste is a complex problem. With food lost at every stage of the food system, it is not a simple matter of just taking food waste from where it is occurring to address food insecurity. Farmers, food processors, retailers, food outlets, and households all contribute to the global problem of food waste, and are therefore integral to the solution. What is the true cost of food loss and waste? Where is the waste and where are the solutions? How can everyone participating in the food cycle, from farm to fork, help reduce food loss and waste? "People in subsistence farming infrastructures are challenged. Large amounts of food never even reach the market yard, and is wasted before it can reach kitchen or a table." Nishchint Bhatia

"I feel like we also have to look to our families and friends, also to the restaurants who serve open buffets, huge portions for one meal. I feel like this is a crisis." Fatima Al Shennawy

#### The where of food waste

Food is wasted in both developed and developing countries, but in very different ways.

In the developed world, 60 percent of food is wasted in the supermarkets and at homes and restaurants. Because of supply chain efficiencies in industrialised nations, only about 5 to 13 percent of food gets wasted in the supply chain: This can be due to excess stock, or forecasting that has gone awry, or it can be cancelled promotions by retailers. The waste is more front end, and can be tackled with behavioural changes and consumer awareness and education.

In Africa and Asia, 76 percent of food waste occurs lower down the food supply chain, primarily at the farms, because of the lack of ability to move food effectively to the markets. Smallholder farmers in the developing countries, like those in West Bengal or Bangladesh, face very different challenges than farmers in the global north. If the farmer harvests six or seven tonnes of a produce, over 10 percent of it will generally be of poor quality and unfit for sale, so it is never loaded onto trucks, resulting in waste on the field.

Stock that is loaded onto vehicles face long journeys with no refrigeration. Then, because there is no market linkage, the farmers themselves look for buyers, spending their day in the market, further degrading the produce. What remains is then stored—usually in a room with inadequate infrastructure to keep the produce fresh. So, if the produce has not already rotted, much of it will in storage.

"The system we're operating in is inherently broken. When we have that amount of food waste coming out of it, something's wrong."

- Louise Nash

"We have to create more awareness, more education. We have to work with the educational system to show the people what's healthy and what's not healthy because looking for the perfect fruit, we are contaminating much more." HE Fernando Mattos Costa

"The supermodel carrot, right? It's disconnection between those growers in that end, consumer between the supply chain and those retailers. And I think the most amazing thing that we can do is rebuild those connections."

#### It's not a beauty pageant

Retailers' relentless quest for perfect-looking tomato or carrot in the supermarket are one manifestation of consumer choice and demand. People seek beautiful, glossy, unblemished produce. Responding to consumer choices, supermarkets prefer not to stock misshapen fruit or vegetables or toss the rejected produce into the bin.

This search for perfection places a significant stressor on agricultural systems, and results in untold waste. The food industry applies more agrochemicals to avoid blemishes, causing damage to the environment and potentially to human health.

The problem is not with the produce, but with our own cultural preferences shaped by marketing as well as our modern disconnection from the food production process.

Retailers, who have significant influence on the supply chain, can take responsibility for reducing food waste. Many shops across the world are now encouraging customers to consume misshapen fruits and vegetables by promoting their sale, with some shops having specific lines for such produce.

We need to change people's attitudes and help them to understand that nature is as diverse as we are? How do we think differently about the food that we see in the supermarket? How do we change attitudes about what is fit to eat, what is nutritious, what we should be coveting? How can customer awareness be raised so that people understand how their actions impact food waste?

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### Connecting to where food comes from

The abundance of food in our society has resulted in an irony: A complete mismatch between our understanding of where food comes from and how valuable it is.

#### Upcycling foods

Wasted food can be highly valuable and potentially generate new industries as well. Rather than just rotting in the field, food waste could actually be processed into useful products.

For example, tomatoes that would otherwise be wasted can be purified for lycopene that can go into nutraceuticals. Some food waste can be used to manufacture cosmetics. Vegetable fibres can be repurposed into building materials, transformed into biofuels, or modified into animal feed. Food waste can be composted and taken back into the farm where it can serve to energise the soil and retain moisture, closing the food cycle loop.

Upcycling food waste is adding value to something that would have ended up in a landfill and turning it into a resource. As awareness about food waste and its impact on the environment is increasing, consumer choices are beginning to change: There is now international demand for upcycled products and top food trends include upcycled products. Such consumer-driven trends enable upcycled products to be scalable and economically sustainable.

While climate change is affecting the quality and quantity of food production globally, upcycled food waste products can also play a key role in mitigating climate change by being a source of renewable energy and enable the reduction of fossil fuels throughout the agri-food chain.

"If you fall in love with this problem [of circularity], you start to ask start to design better practices, and that just keeps going and going. You might land on educating children about food and where that's growing, but you also might land on another amazing opportunity of how to store and protect food that is better for the environment. That's better for people. So fall in love with this problem. It's worth it. It's absolutely worth it." Louise Nash

#### **Expo 2020 Dubai** Food, Agriculture, and Livelihoods Week





#### No more landfills

Solving the landfill problem requires a series of steps along the way, having the right policy frameworks and incentives from the farmer to consumer. It is also important to keep food out of landfill because the methane caused by this is 27 times more polluting than the greenhouse gases from food production. A comprehensive national-level strategy may be needed to deal with the problem effectively.

#### Accounting the true cost of food

Quantifying the true cost of food and the true cost of waste is the first step toward a better understanding of the global food system. It allows us to close gaps in the supply chain and reduce waste while also improving sustainability and food security.

Food has become so cheap relative to what it costs to produce it. A growing number of farmers, producers, shops, wholesalers, cafes, restaurants and supermarkets work on true pricing. A true price is the market price plus the social and environmental costs of a product—generally hidden behind the term externalities.

True Cost Accounting or the "triple bottom line" takes into account environmental, economic and social impacts. It considers greenhouse gas emissions, increased water scarcity, soil erosion, nutrient loss, biodiversity loss and the like, as well as the social costs of producing the item.

Applying the triple bottom line to quantify the economic costs of food waste is important in understanding the scale of the problem. Globally, food waste is estimated at almost \$1 trillion per year. Yet, the true costs are substantially higher since food that is produced but never consumed still has an impact on the environment and society. The true cost of wasted food is estimated to be many times higher than the economic cost of \$1 trillion per year.

Governments can start imposing stronger taxes on food waste going to landfill because beyond carbon, the methane released by food waste in landfills is actually 27 times worse.

– MP Jo Churchill

"We need to sort of

understand the prob-

lem and understand

that cost: What is

the value of food

of food waste." Professor Miranda Mirosa

and what is the value



## **Best practice**

"It's an opportunity to not just reinvent the front end with the cuisine, but also the back end with how we deal with these issues. There will be no more landfills. But then what are we going to do? Because there is a great deal of food waste." Jo Churchill,

"As people are wanting to be part of the solution, in addition to growing food and using leftovers and all those other things that we've been talking about, this is a market based way that that people can participate in in reducing food waste." Professor Miranda Mirosa

"I think desirability is a real lever in our toolkit. Let's have those conversations with consumers around what good food looks like." Louise Nash

#### A national strategy to deal with food waste

In the United Kingdom there has been a big shift in the last few years in terms using public money for public good, taking a systemic approach to sustainable farming initiatives. A food strategy will be published that takes into account the whole system including nutrition in the home.

Most food waste in the UK is created at home, and it has considerable environmental impact. Food waste diverted from landfills saves a tremendous amount of methane by diverting the food waste. Going forward the UK has legislation not to throw food in landfills.

#### Certification for Upcycled Food Products

There's a new certification for upcycled food by an organization called the Upcycled Food Association, which is based in the US. This is just the beginning of a trend towards much more activity in this space as as public awareness around food waste increases.

#### The Odd Bunch

Retailers in Australia and New Zealand are marketing perfectly edible, but misshapen produce such as capsicums and tomatoes, branded as the 'Odd Bunch'. The brand offers customers taste and value and it keeps millions of tons of fruit and vegetables from going to waste.

#### Spearheading UAE's local food movement

Farm2table, a farm-to-table concept is at the forefront of the local food movement in the UAE promotes locally sourced, sustainable, and organic food by sourcing from smaller artisanal farms. In order to broaden the diversity, the company is pushing the envelope to see what else can be cultivated in the UAE. They have direct access to local farmers' produce and are able to access a growing variety of local produce and offer it to their customers.

#### Second Bite

SecondBite takes a completely fresh approach to the problem of food waste and food insecurity. It is a large scale national-level food rescue organization that saves food from waste from producers and retailers and redistributes it to charities in Australia. By reusing and redirecting food that would otherwise wind up in landfills it helps the environment, and makes a significant contribution to hunger alleviation in the country.

Because of the scale and scope of the food waste problem, SecondBite has innovated on technology to facilitate the connections enabling redistribution of food waste.

#### Transforming waste into innovative high-value products

The Fight Food Waste Cooperative Research Centre (CRC) in Australia takes an industry-wide approach to reduce food waste throughout the supply chain by converting it into high-value, innovative products, and is aligned with the country's research and development (R&D) priorities.

## **FIXING A BROKEN SYSTEM**

"I think there are the two basic drivers that we're going to see within food production over the next 10 to 20 years. The first one extensification is really around the sustainability brief, and we will see premium products being maintained within that. But the second one is really a drive around food production volumes. But there's also the opportunity to produce and really focus on foods that are not iust going to provide calories, but are also going to provide a balanced nutritional profile." **Professor Andrew Lowe** 

Even though we are in the midst of the Fourth Industrial Revolution (4IR), we have yet to fully leverage the new technologies to address the challenges of population growth and food production while protecting the planet.

#### New models of food production

Agriculture today is a product of an outdated legacy system that is no longer serving us well. A new vision for food production must grapple with both extensification—creating more farmland—and intensification—producing more food on the farms we currently have, while safeguarding the environment. Working within the safe operating space of the planetary boundaries, we are in a position to today to leverage the vast technological possibilities, ranging from low-tech to hi-tech, to produce more food with fewer resources.

In this new vision of how we will feed the planet, there are at least two primary drivers that may shape food production over the next few years. The first one is the repair of existing systems. The world is seeing declining productivity and declining fertility of farming systems. There are some basic and low-tech solutions available to mitigate these problems. Some of these revolve around putting carbon back into the soil, while others around re-establishing hedgerows to increase diversity.

Through these simple approaches, farms can gain ecosystem services and benefits. They are extensive applications of farming systems—they continue to allow production—but they also enable the repair of degraded lands that many of the more intensive agriculture systems have created.

2 The second driver focuses on intensifying production, particularly vertical farming, in order to feed the additional two to three billion people. These are high-tech farming systems capable of producing many seasons of food in a single year. These systems rely on far more advanced technologies, such as robotics, Internet of Things (IoT) systems that can sense the location of plants and food production systems.

I think what we've got to do right now is we in this radical transformation of our food systems probably the largest transformation we've seen. We've been through the Green Revolution where we've gone through these different stages and now we're actually looking at completely changing the way we produce food.

- Michelle Colgrave

#### Agriculture 4.0

Food production today is undergoing a transformation similar in scope to the Green Revolution of the twentieth century. The potential of Agriculture 4.0 is remarkable and promises to revolutionise the way we optimise farm operations and increase our food production.

In order to power agriculture using the latest tools we need to rely more on science and technology: big data, Internet of Things (IoT), digital sensors, nanotechnology, drones, robotics, mobile apps, and communication networks. By integrating these digital systems, we can measure everything we need to know about plants, soil and the environment to create precision agriculture while living within the safe operating zone of the planet.

At the forefront of the digital revolution, technology has the potential to make a substantial difference in monitoring, simplifying, and managing the use of resources on the farm to optimise food production and protect the environment. Sensors, for example, can control water leakage and aid in supplying water in smaller quantities and in a more targeted way, while substantially increasing productivity. Future systems can also enable us to replenish and regenerate the land, allowing extensive and intensive production of food, while repairing the land.

As global climates changes create unpredictable weather patterns, farmers' knowledge about how to plant in certain under specific climate conditions is being challenged. Digital technologies can stand in and provide additional intelligence to assist them in understanding their evolving environments and farm more effectively.

As technology becomes less expensive, increasing numbers of famers globally have an opportunity to tap into Agriculture 4.0 and benefit from its potential.







we do not neglect in soil methods of production in the name of progress alone. In the Bahamas, the majority of producers are smallholders with limited technical knowledge and very limited financial resources to advance their production systems beyond traditional methods of cultivation. The immediate future for smallholder farmers in the Bahamas and much of the developing world will still include in soil production and lower tech soil-less methods." Selima Campbell Halva

"It is imperative that

"Technology can enable the full traceability of the food. If we are able to trace everything about the food's origin and also allow production and distribution information, this is another lever to help the consumers to make the right choices." Quan Ngo Dinh

#### Middle-tech solutions cannot be ignored

With a wide range of technologies and systems available to us today to revolutionise food production on an unprecedented scale, it is sometimes easy to lose sight of lower-tech solutions that can be just as effective and perhaps more sustainable than high-tech solutions.

Middle-tech include analogue and simple digital approaches that are closer to traditional farming but utilize ways of growing based on current research and development. Middle-tech structures such as shaded or indoor farming protect crops from the unpredictability of external environments. Middle-tech solutions enable controlled delivery of resources including water, light, and nutrients, while providing optimal growing conditions under control environments.

#### Food transparency and traceability

Emerging technologies will also enable us to track the full supply chain from farm to table and give people the possibility to know where the food is being produced, how it is transported and its impact on the environment.

Consumers become more aware of provenance and demand transparency for the goods that land on their plates. They want to make sure that the food they buy has a small ecological footprint and is free of potentially detrimental ingredients-both to their own health and that of the planet. These technologies can be used by the food business to ensure that food we produce is both economically and environmentally sustainable.

Blockchain already provides the capability to trace the provenance of food stock of production. This gives consumers significant power to drive the whole industry to a more sustainable future.



FIXING A BROKEN SYSTEM

"Oryza is the name of the genus that contains one of the most important food crops, which is rice. And it turns out that there's about 700,000 different accessions of rice that have been grown and collected from around the world. These rice varieties. as well as the wild relatives, contain a virtually untapped reservoir of genes that can be used for crop improvement So one of the wild relatives of rice is an ancient species, but it's related to cultivated rice. It can grow in saltwater. So the idea is, can we domesticate this species? And if we can domesticate it, then that can be a huge solution to growing rice in in marginal environments or in salting environments." Professor Rod A. Wing

#### **Designer genes**

As climate change modifies our growing habitats and growth patterns around the world, biotechnology will allow us to grow in severe conditions such as deserts and salty environments. Designer genes will also aid in the reduction of methane emissions, mimic and taste and texture of meat protein without the need for animals.

For more than three decades, biotechnology has been dramatically altering agriculture. We are now at a point where gene editing technologies like CRISPR, genomics, proteomics, and mRNA have the potential to revolutionise and catapult us to a new level of production and sustainability.

Biotechnology will play a key role in mobilising microorganisms in our world to help develop better agriculture and more resilient farms on a more sustainable planet. From fighting pests and diseases, microorganisms powered by biotechnology will enable us to move towards regenerative agriculture, intense food production, and sustainable extensification.

As genetics evolves and we are able to unleash the rich diversity in our crops we will have access to much larger variety of food sources. Traditional and aboriginal food sources may offer exciting possibilities.

#### Democratising the future protein

The industrialised world gets 75 percent of its proteins from just five animals and plants. Meeting the increased global demand for protein democratise protein." will require us to expand our protein horizon and include a greater Michelle Colgrave diversity of plants and animals.

By tapping into global biodiversity and cultural traditions, new sources of protein can supplement traditional sources . In addition to plants and cattle, insects have now captured global attention as a source of protein. Insects, are extraordinarily diverse and efficient at taking things like food waste and upcycling it into new products like protein and enriched with vitamins and minerals ions and zinc.

Using biotechnology, we can develop proteins with specific health benefits or deliver specific functionality that is needed in our food systems. This includes the production of cultured meats, which are a significant step forward because they take the animal out of the equation and provide us with products that are not on our plates right now.

We've got an extra two billion mouths to feed by 2050. We need about 70 percent more food to address that. And so we can't just continue to increase the amount of land because we, you know, we don't have another planet we can occupy in this situation.

- Michelle Colgrave

"How can we use this kind of science and technology to

#### Technology can attract younger farmers

By placing technology in the hands of young people, we can perhaps begin to stem or even revers their flight into urban centres. What we see around the world is that young people are leaving villages and farms.

Digital technologies can make food-production an attractive career, moving it from a physically difficult and risky venture into a more innovative, creative, and more predictable enterprise. This makes farming a coveted profession for some as it transforms into a high-tech domain.

Technology can also support young people to explore food production in the cities to which they have migrated or in which they grew up. Building up local ecosystems with youth encourages them to grow food and turn their efforts into businesses. While cities are often perceived as food deserts, they have ample empty surfaces for young people to become engaged in growing food using novel techniques and innovative technologies.

<sup>II</sup> Three quarters of the food supply system consists of 12 crops and five livestock species. Nature produces so much more, let's work with it.

- Louise Nash

#### Mission-driven approach to food production

Technology is not a silver-bullet that will instantly produce more food and save the planet. Neither is there a single solution that fits all.

Additionally, plants that are grown quickly lack the density of nutrients necessary to thrive. This gives rise to a dilemma where we are growing plants on a massive scale, quickly, and under accelerated growth conditions, but they lack nutritional density to be robust sources of nourishment.

To address the complex array of challenges in the agricultural system will require mission-oriented approaches and coordination to address the environmental, social, economic and technological considerations that factor into the food production equation.

This calls for close collaboration between governments, farmers, the food industry, donors, researchers and communities, to find optimal solutions to local challenges with the right mix of high, middle and low-technologies appropriate for each context. Pivoting towards context driven systems that are culturally relevant and environmentally sustainable will allow us to balance the well-being of people and planet.

"In London, if you do the math on it, you can be self-sufficient in food production by almost 70 percent. Same for New York." Meiny Prins

"People tend to talk about vertical farming, hydroponics and urban farming. Those are all parts of the solution, but not one individual technology will provide the entire solution. And the same goes for big and small farms." Professor Vesna Bengin

## **Best practice**

#### Solutions in unlikely place

The Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia's national science agency, and its university found that biotechnology solutions can come from unlikely places: The project discovered that feeding red seaweed to the cattle reduces methane emissions by nine percent, and it boosts the animals' productivity.

#### Automation addressing labour shortages

Faced with labor shortages in New Zealand farms robotics and toher technologies have been used to harvest and pack kiwis and apples. a real push on things like robotics, kiwifruit harvesters and an apple These technologies can identify when the fruit is ripe it harvest, sort it into different bins, deliver it to the pack house and then drive themselves back to the field and starts harvesting again.

#### Bringing technology and training to transform small farms

The Consultative Group on International Agricultural Research (CGIAR) is among the world's largest agricultural innovation networks. It is a global partnership of research organisations to improve food security and the lives of the world's poor. Home to about 8,000 scientists, researchers, and technicians, the 15 CGIAR sites around the world facilitate research and innovation, bringing new methods for maximising the nutritional, environmental and economic potential of agriculture.

Farmers learn how to employ technology through training at these centres. This includes methods such as laser levelling their fields. Laser levelling alone—a very simple technology that uses a focused laser beam to level a field — can boost crop productivity by 10 to 20 percent. Water and nutrient uptake, and yield are all affected by uneven soil surfaces. But traditional land-levelling methods are cumbersome, time-consuming, and costly. Laser land levelling enhances fertilizer usage, water distribution, and conservation while being easy and effective to use, but small holder farmers often do not have access to these technologies and know-how.

#### Using AI to increase production

Recent research with Syngenta, a global leader in artificial intelligence demonstrated that by simply by using data-driven guidance and artificial algorithms, US soybean production could be enhanced by four to five percent with no additional costs. While five percent may seem insignificant, five percent of US produce could feed all of Mexico.

#### Extreme farming in salty water

With global water scarcity on the rise, scientists are focused on developing drought-tolerant rice varieties or accessions with the best adaptive traits of a drought-tolerant rice plant, while still producing a yield that is high and of good quality. Bangladesh is home to a particular rice species. It is currently farmed as Uri Don, but it has also wild properties, which it shatters its seed. It doesn't yield as much rice as a conventional rice plant would. Scientists are working on a process known as neo-domestication, in which they take a wild plant and use genome editing to change a few of its genes—four or five of them—to make it a little shorter, a little more robust, while still retaining the adaptive properties that allow it to grow in saltwater.

#### Tapping into biological systems

The Fall Armyworm is a major crop pest in Brazil. The insect is highly damaging, devouring large harvests in a matter of days. Researchers introduced another organism into the area as part of a biological management plan to combat the Fall Armyworm. The success of this approach has been acknowledged as a best technique for natural pest control. It has caught the interest of various agriculture ministries from across the world, who have conducted best practice trips to learn from Brazil's pest-control technique.

#### The middle ground solution

The One Eleuthera Foundation and the Centre for Training and Innovation hope to revolutionize Bahamian agricultural economy through a mid-tech solution for small-holder farmers. A large-scale production structure with a fully retractable roof is being developed. This structure provides control of the environment when conditions are unfavourable for optimal crop production. By taking away the vagaries and volatility of weather and climate change, the controlled environment structure allows farmers to produce a wide variety of vegetables, year-round. In addition to providing framers with previously unavailable controlled environment technology, they will now also benefit from agricultural training and skill development to spur local innovations and economic opportunities. "But the benefits of course is not just about getting better yields and productivity, it's the livelihoods of the people that are farming the communities. We need to look at the whole value chain from the farm right through to actually the consumer on the on the shelf." Kelvin Wickham

## **Best practice**

#### Tapping into the wisdom of indigenous plants

In Austria, genome biologists have sequenced genomes of indigenous rice varieties to understand the population genetics of these plants and how to use that information. There are two wild relatives of rice that are endemic to Australia. It's a rhizome ready analysis, which is very closely related to cultivated rice. There is also a species called Arisa Australiansis, and these are found in a lot of these varieties are found in native lands. They contain a virtually untapped resource genetic resource of valuable traits that are well adapted to the Australian environment. By studying these in more detail, there are opportunities to develop native food products that would come from the Aboriginal tribes.

#### Integrated beef production (EMPARAPA)

Brazil has been developing an integrated agriculture, livestock, and forestry system. It consists of a number of components, including maize, wheat, or soybean farming, as well as grass and beef cattle, all of which are farmed on the same plot. There is also a forestry component in the same region. This method was developed to regenerate degraded pastures, and 17 million hectares of degraded pastures have been revitalized as a result of the program.

Researchers are also working on generating carbon-neutral cattle through integrated farming practices, as well as building markets for carbon-neutral milk, coffee, and sugar cane. This is facilitated by sequestering carbon in a variety of crops, all of which are grown on the same plot.
## Emerging questions for future conversations

Do the new technologies of Agriculture 4.0 hold the promise of helping food production scale up while safeguarding humanity's well-being as well as the planet's?

Will low-tech and no-tech solutions also play role?

How can agricultural systems behave more like ecosystem and bring the benefits back into the systems?

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