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Hello.

Today, according to the United Nations Food and Agriculture Organization, one third of all food produced for human consumption is lost or wasted.

At the same time almost 800 million people in the world haven’t got enough food to lead a healthy active life.

According to current estimates, the human population will grow from 7.2 billion today to 9 billion in 2040 and this increasing population will need to be fed.

200 years ago, British economist Thomas Malthus had predicted that population growth would be limited by our ability to produce enough food.

This prediction turned out to be partially wrong so far, due to the invention of chemical fertilizers, and a variety of other technologies which allow to radically increase the agricultural yield.

However, the Malthusian challenge didn’t go away completely, and global food security remains a challenge.

However, this is only one side of the problem: industrial-era agriculture involving intensive use of pesticides and fertilizers as well as deforestation, have a severe impact on climate and the environment;

The paradox is that these technologies, while they increase immediate agricultural output, also tend to jeopardize the future capacity to generate food.

Sustainable agriculture requires innovative solutions to improve efficacy, while preserving the assets for future production, for example by minimizing loss of soils, loss of biodiversity or pollution of water and air.

Yet another important fact is that agriculture is the single largest employer in the world, providing livelihoods for 40 per cent of today’s global population. As a consequence, the link with economic development or poverty is obvious.

In order to understand the influence of technology in this field, we need to explain the so called *food value chain framework*.

But before we get there, let me give you some important definitions.

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Inadequate nutrition in general is called Malnutrition, it is a pervasive problem as around 40% of the worlds population is malnourished in one way or another. Ending malnutrition is our Sustainable development goal number 2.

Malnutrition comes in three different manifestations.

First we have Undernourishment which is an insufficient access to calories and proteins. It is also called chronic hunger.

Effects of undernourishment include stunting and wasting in children.

Stunting is when children are shorter than they should be due to food deprivation.

Wasting is when the child’s weight is too low for their height.

The second manifestation is Micronutrient deficiency, which is sometimes called “hidden hunger”.

It is a condition where calories and proteins may be sufficient but where essential micronutrients such as vitamin A, iron or iodine are missing.

Finally, obesity is a condition affecting not only rich countries but also increasingly people in developing countries, as a consequence of the poor moving to urban areas and adopting more sedentary lifestyles.

Now let us look in more details at the so called food value chain, in order to understand where technologies could be put to use for reducing malnutrition.

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The value chain is shown here.

It starts at the bottom with producers who can be farmers who grow crops or cattle, or fishermen who exploit the sea or lakes.

These producers need inputs such as tools, machinery, fertilizers and seeds to be able to grow their product.

For example, recent technologies have allowed to make seeds resistant to pests or drought, which is a great advantage in an industry that is very exposed to such threats.

However, the cost of those seeds is also a growing financial burden for small farmers who have no real alternative but to purchase them annually.

There are of course legitimate ethical concerns about genetic manipulations of crops or cattle which we don’t want to discuss here.

As I have mentioned, fertilizers and pesticides have had a huge effect on the productivity and have been a cornerstone of the green revolution in the 20th century.

Unfortunately, these technologies also come with a downside which is their negative impact on ecosystems and biodiversity.

For example, through the increasing use of nitrogen fertilizer, Nitrous Oxyde, which is a greenhouse gas, is released which contributes heavily to global warming.

Producers use a variety of other important technologies such as harvesting machines and irrigation technologies.

We will discuss one of these later in this video.

Yet another domain is related to Veterinarian technologies such as vaccines, and various drugs which are also very important to maintain the livestock healthy and productive.

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The next step is aggregation.

According to the United Nations, there are 500 million small farms worldwide, which provide up to 80 per cent of food consumed in a large part of the developing world.

The production of those small farms are either consumed directly, sold on markets or sold to aggregators.

The high fragmentation and dispersion of smallholder producers makes the aggregation step especially challenging in developing countries.

The aggregation function can be taken on by producer groups such as cooperatives, by intermediaries specialized in aggregation, or by food processors themselves.

At this stage, technologies related to adequately packaging, transporting and storing the food are especially important.

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Processors are involved in both the preparation of fresh foods as well as prepared food.

As such, food processing is composed of a variety of companies processing products at different stages: for example slaughtering and meat processing, fruit and vegetable preserving, grain and oilseed milling, seafood product preparation, sugar and confectionery, bakery, dairy, and other food product manufacturing. Each of these will use specific technologies such as milling machines, cooking ovens, presses and so forth.

For food processors, product quality is crucial and any failure in these regards will have severe consequences.

There is a variety of technologies which allow to assess food quality and to monitor safety all along the complete value chain.

Food preservation methods and technologies are also very important for processors.

These sometimes involve chemical compounds which may have a negative impact on consumer health.

Sustainable product packaging is a challenge which is intimately connected to generation of waste and product conservation.

The level of food waste in this processing step is more than 30 percent, and thus any new technology which can reduce it is essential.

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Distribution is usually assured by wholesalers and retailers.

This is a highly competitive industry in both mature and developing markets. Quality, especially in fresh food, plays a key role in consumer choice.

Distributors are thus extremely sensitive to this aspect of quality and look of the product.

Stock management solutions and technologies are especially important here in order to minimize surplus or out-of-stock situations.

For example active product labels based on Radio Frequency identification or simply on barcodes are of key importance not only for stock management but also for product traceability.

Packaging is also of outmost importance as it has been shown to have a large influence on purchase decisions by customers.

Unfortunately, packaging is also a great contributor to waste generation, which brings us back to the sustainability and environmental issues already mentioned.

One should also mention some recent technological progresses, whereby consumers can now order food through the internet; some retailers are even considering drones for delivering the products to their customers.

At the end of the day, we as consumers have a huge influence on the whole chain, and our purchase decisions influence which technologies can or cannot be proposed as part of the value chain.

Now that we have seen the food value chain, let us have a look at how efficient it currently is at providing a global access to food for everyone.

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Sadly as we can see on this map there is a great problem with global malnutrition.

Strangely as it might appear, often times it is not so much the quantity of food produced which the problem, but rather the access to it.

Take for example the well known link between war and famine: conflict is a feature of many African famines.

It prevents access to food and causes long term devastation of vital agricultural assets.

It is also quite evident from this map that there is a link between hunger and politics.

Under dictatorial regimes, the countries tend to fall into protracted hunger crises as a consequence of corruption, lack of accountability, mismanagement and international isolation.

It is today widely accepted that all contemporary famines are political.

This of course shall not discourage us from trying to come up with more efficient and more sustainable food and agriculture technologies!

The good news is that undernourishment has fallen globally in the last two decades.

By contrast however, micronutrient deficiency has not fallen at all: today about 2 billion people suffer from micronutrient deficiency.

As we can see, there is a great need for new solutions to fight malnutrition while preserving the planet.

Let us look at one such innovative technologies.

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At EPFL, there is a project called Info4Dourou2.0 which aims to help small famers to secure crops and improve irrigation in dry areas.

The project involves measuring the soil humidity, temperature and other climatic parameters.

The technology then gives the farmer real-time information -via an alarm sent by text messaging- about the need for irrigation.

This allows to make sure the plants get water at the exact moment when it is needed.

The technology improves the chances of having a successful harvest, which is vital for the farmers.

It provides also an important contribution to sustainable water use as it avoids useless watering.

An series of successful experiments were conducted in Burkina Faso.

In one case it was shown that the crop yield was improved by up to 37 percent, while the water consumption was reduced by as much as 20 percent.

The system developed at EPFL’s Cooperation and Development Center, is solar powered and has a rugged design.

It is intended as a solution for cooperatives and individual farms.

Currently the technology is being transferred to the local private sector.

In particular local manufacturing solutions will be implemented to reduce costs and to provide sustainable access to the technology for local producers.

We hope that you will now have plenty of new projects ideas in this very important essential technology.

Good bye.