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“For all of man’s supposed accomplishments, his continued existence is completely dependent on six inches of top soil and the fact that it rains.” (attr. Confucius)

Good afternoon

It is a privilege to be here today at Wageningen University. Wageningen has a storied past and has provided and must continue to provide a forum for serious, in-depth work to understand global challenges and opportunities facing agriculture. The challenge today, as I hope to explore in my remarks, is how to do so, understanding agriculture as an essential component in an ever more complex, global, food system.

That food system faces even greater challenge to providing nutrition for the world's growing population and sustaining livelihoods, in a world where climate change is changing development.

In development we have characterized the challenge as how to feed 9bn people by 2050. However, I want to focus our attention on a closer horizon - a potential "food cliff" in the next decade, and the converging factors that are driving us towards this dangerous precipice:

WHAT BRINGS US TO THE CLIFF

First, climate change and the weather-related stress it leads to, such as severe drought and floods, are expected to intensify, significantly diminishing crop yields, particularly in Africa, the most food-insecure region of the world.

The latest science indicates that under business as usual scenarios we can expect a 2°C warmer world by the 2030s. We can expect agricultural productivity to drop even further as weather patterns become more extreme. For each degree Celsius of warming, the potential grain crop yield loss is about 5 percent.

Second, the global fight against hunger and under nutrition continues. One in eight people suffer from chronic hunger. More than 1 billion people - the majority women and children - are undernourished. Under-nutrition is to blame for 1/3 of all child deaths.

Malnourishment stunts physical development and compromises the ability to learn and earn. At a time when we collectively face challenges we have not faced before as societies we are compromising the ability of the next generations to build and maintain the prosperity we need to break the cycle of poverty and hunger.

Third, food stocks have been declining as a percentage of what we now consume, partly due to the fact that larger amounts of food are being grown on areas that are more susceptible to weather volatility and crops have been suffering from higher losses. This has also led to higher food prices and periods of sustained market volatility.

Fourth, one billion people in the developing world rely on fish for their primary source of protein. Ocean acidification is hampering the development and growth of shellfish, corals and other marine organisms. Ocean temperature increase threatens the productivity of coastal waters and pelagic fish stocks may disappear, while others will be relocated thousands of kilometers away.

Fifth, changes in diet and consumption are driving a different demand. More people are consuming more calories, and increasingly those calories are to come from meat and dairy. Meat consumption in low and middle-income countries is projected to grow 75 percent from 2005 to 2050, reaching 30 kilograms per person per year. South Asia alone is expected to quadruple its meat consumption in that time period. And according to projections, each person will consume 3,070 calories per day in 2050, up from 2,750 in 2007.

This changing diet has a “multiplier” effect on food systems. For every one kilo of change in demand for meat, up to 10 kilos of additional feed are required. This is putting intense pressure on crop lands, forests and driving agricultural extensification.

Another aspect of this different demand was illuminated last week in new research from the International Centre for Tropical Agriculture (CIAT). Its report shows that over the last 50 years, the world food supply has grown increasingly dependent on a shrinking list of crops, such as wheat and maize, with major consequences for human nutrition and global food security. This raises questions about the wisdom of reliance on such a limited number of cereal crops, even while we seek to sustainably intensify production and boost nutrition content. It also raises questions about why we do not focus more effort, funds and research on other nutritious grains and food crops.

Sixth, urbanization, trade liberalization, improved commodity transport, multinational food industries, and food safety standardization play significant roles in shaping demand, supply and nutrition within the food system.

Seventh, waste. Our food system is broken if we can waste so much from farm to market because of no roads, no refrigeration, no storage, bad customs. Or where we can waste so much from market to home because of perversities in business models, regulation and consumer appetites, or where we can waste so much between our refrigerators and pantries and our forks because prices and attitudes do not reflect the fragility of our food system.

And so we require farmers to produce as much food in the next 40 years as they have over the past 8,000---and to do so with fewer resources and in the face of tightening constraints, including worsening water scarcity, land degradation, declining fish stocks, and rising costs for food, feed and fuel.

This constitutes a food cliff. How then do we back away from the edge. We need to agree first on the nature of the system's failure and take a systems approach to solutions.

SYSTEMS

Today we tend to see food production through the lens of agriculture, when the reality is that food is a product that comes from a complicated and integrated system. A system that involves finite resources - within a landscape, such as water, land and forests, industry, urbanization and “dynamic demand” created by population growth and changing diets.

We cannot achieve global food security, nor nutrition security, without preserving the ecosystem services that forests provide, and we can't sustain forests without thinking of how we will feed a growing population. And we can't grow food without enough water.

It is no longer sufficient to focus the response to the need to bolster food security by increasing investment in agricultural productivity. Nor is it sufficient to focus the response to the presence of hunger on targeted nutrition efforts alone.

To break the cycle of poverty and under nutrition, to sustain a food system that sustains us all, and to do so under pressure from the unprecedented threat of climate change means working with an integrated landscape approach. If we continue to fund crop expansion on the one hand and forest protection on the other, we are wasting money. We are also wasting time and opportunities to reduce the climate footprint of agriculture.

At the heart of the landscape are the people who produce our food, manage the forests and live from them. From the woman in the hillsides of western Kenya, widowed by HIV/AIDS, to the contract farmer in North Carolina, they have to be at the centre of the picture and the centre of policy and research objectives.

For many years the international community has increasingly focused on the nexus of energy, water and food. The holistic approach – tailored for individual countries – to addressing this nexus is urgently needed. One way to begin to ensure that the food piece of this nexus is properly understood is through work begun here in Wageningen, it as an approach we call

"Climate Smart Agriculture". It has the potential to increase productivity, improve nutrition outcomes, enhance resilience, and lower our footprint.

At the World Bank, we define CSA in the following way:

- Increasing productivity means increasing food and nutrition security by producing more food in way that does not come at the expense of the environment and while generating higher incomes.
- Enhanced resilience means reduced exposure to short-term risks and shocks - such as drought pests and disease; better capacity to adapt and develop in the face of longer term stresses like shortened seasons and erratic weather patterns; and building healthy ecosystems.
- A lower footprint means pursuing lower emissions for each calorie or kilo produced, avoiding deforestation from agriculture and sucking carbon out of the atmosphere.

CSA is not about a specific list of practices. What we are talking about is a fundamental paradigm shift in the way we manage landscapes. Yes, CSA is about increasing productivity, but it is about thinking more broadly and connecting dots across the entire landscape. We need to break the “yield” ceilings. Annual yield growth of 1.7 percent will not get us to where we need to be in 2050 given the climate volatility that we are going to be facing. This is simple math.

CSA is also about resilience. In the past five years, we have had multiple systemic food system shocks and the technology and science we have were left wanting – even in the agriculture superpower of the United States. Financial losses were catastrophic and led to global price

impacts, which affected those least able to cope with them – the world’s poorest and most vulnerable.

So what we need are seeds, technology, practices and support systems that enable us to deal with the types of weather variability that will increasingly be coming at us.

We need to invest heavily in research in order to generate the scientific, policy and technological innovations needed to increase agricultural productivity while safeguarding critical natural resources. Research is essential to delivering new products, generating evidence, and creating better access to safe and nutritious foods, especially for women and children.

We must also be honest with ourselves that agriculture and land use change are currently responsible for 30 percent of GHG emissions. Given the increases in production we will need by 2050, if we continue operating as we do today, emissions from agriculture are expected to rise dramatically – one estimate is up to 70 percent of total emissions.

Other sectors are doing something to become more efficient. It’s time for agriculture to get serious about climate change. But I’m not talking about mitigation at the cost of production. I am suggesting exactly the opposite. I am talking about increased efficiency that leads to lower emissions per calorie or kilo of food.

Let me underline that the politics of climate change and agriculture have been woeful. Too long we have allowed the global politics of production to prevent an honest reckoning of not just the impact of climate change on agriculture, but also agriculture's impact on climate change. This we need to end collectively.

Over the past several months, we have been asking a series of “what if” questions in an effort to better articulate the potential of an integrated approach like CSA to contribute to our goals of eradicating poverty, increasing prosperity and addressing climate change. What if we could make all livestock farmers as efficient as the top 10 percent? What if we spread agroforestry

across Africa? What if we applied alternate wetting and drying of rice – a major GHG producer – across the world?

The potential is enormous. FAO calculated that – for 2010 - if all livestock producers had become as efficient as the top 10 percent of producers, livestock emissions would have dropped by 1.8 gigatons in that one year. If we extrapolate that over the coming 40-years, given the expansion we expect in meat and dairy demand, we could see potential for a reduction in the range three gigaton, per year, by 2050.

A real world example of increased efficiency comes from Peru, where the Fondo de Credito para el desarrollo Agroforestal (FONCREAGO) improved the efficiency of dairy production through breeding programs, better pasture and manure management, decreasing the use of synthetic fertilizers, and improved veterinary services. As a result, milk production per cow increased by 25 percent – along with an improvement in milk quality; smaller herds put less pressure on the resource base and forests; and the smaller, more efficient herds produced less CO₂ emissions.

Another example of the potential of CSA comes in the form of agroforestry - which involves the integration of trees and shrubs with crop or livestock production. If this were adopted on 150 million hectares in Africa, we could see productivity increase by 44 million tons in highly food insecure areas, and there is potential for up to a 1 gigaton of carbon per year to be sequestered in the trees and soil, which would substantially contribute to a lower footprint. Resilience would be enhanced by reducing soil erosion and strengthening drought resistance through increased water storage.

Similarly, alternate wetting and drying (AWD) of rice paddies - during the growing period and application of rice straw to the fields in the off seasons has had impressive results. When

Oxfam teamed up with Vietnam's Plant Protection Department to implement AWD, average yields improved by 9 to 15 percent, and smallholder farmer incomes were boosted by US \$95 to \$260 per hectare. The crops required 33 percent less water, and GHG emission reductions ranged from 25 to 50 percent.

Support for CSA is growing, and for good reason. We now need to replicate successful approaches on a much larger scale.

To move away from the food cliff requires partnerships between business, science, government and NGOs, each bringing their comparative advantage. We need to encourage investment and market participation by a multitude of actors to achieve results on a meaningful scale.

Globally, the food system is worth over \$5 trillion annually and the vast majority of the investment and financing comes from the private sector. In this sector, the private sector holds the key to systemic change.

This is not about corporate social responsibility and it hasn't been for quite some time. It is about security of supply chains, ability to attract investors, to attract talent in a world of competition for a global work force, shareholder value, brand value and expanding markets at the bottom of the pyramid. The implications of climate change on established supply chains have become increasingly important and answering the question of "where will I be sourcing from in 10 years" now takes a new dimension in the agricultural context.

I am pleased to report that there is increasing support for a broad alliance on climate-smart agriculture. It is our hope that countries, companies and innovators will team up to ensure that climate smart agriculture has the transformative impact we need. I would call on you today to join this emerging alliance and to work together to achieve action on the ground at scale.

As we work to scale up productivity and resilience while lowering agriculture's footprint, we need to remember that it is not just about how much the poor eat, it also about the quality of what they eat. Ultimately, the joint focus must be on food and nutrition security.

To tackle the scourge of undernutrition, we need to develop crops that are rich in key vitamins and minerals, and then make it a top priority to ensure that these highly nutritious foods are affordable and accessible to the poor.

The potential to improve nutrition through agriculture is enormous, and CGIAR – the global agricultural research partnership – has already made great progress in this area. CGIAR's HarvestPlus program, for example, has developed new varieties of staple food crops that contain higher amounts of nutrients to improve nutrition and public health in a cost-effective and sustainable way.

Most of the new varieties are not only rich in key vitamins or minerals, but they are also high yielding and resilient to climate change, with tolerance to heat or drought. In India, where an estimated 70% of children under five are iron deficient, farmers are already growing iron-rich pearl millet, thanks to a partnership with a private seed company, Nirmal Seeds, which has helped to reach more people, more quickly, with improved seeds.

In Zambia, where over half of all children under five are vitamin A deficient, CGIAR is partnering with SeedCo Zambia to accelerate the commercialization of vitamin A-rich maize to stave off blindness, disease and – in some cases -- death.

A daunting challenge or honorable work? The bottom line is that we must take collective action now. The practice of agriculture must evolve. We must work across landscapes and we need to acknowledge trade offs while aiming for a triple win: nutrition and food security, improved yield and incomes, and emissions reduction and greater resilience.

It makes sense for farmers who will make money, save money and save time.

It makes sense for companies because this is about long-term sustainability of supply chains – it's about bottom line.

It makes sense for policy makers because it is about food and nutritional security and political stability.

Simply put, it just makes sense. People are better off living and working in healthy productive landscapes today, and will be better able to soften and withstand the blows of climate change tomorrow. Now we need to back this vision with strong political will and financing flows.

I started with Confucious. Let me end with a more universal notion. In all traditions, spiritual, cultural, religious, there is nothing more sacred, or more human, than to put nutritious food in front of family, children, neighbors, friends. To not be able to do so is dehumanizing. It is a calling. That call must be met, in part, here, in Wageningen.

Thank you.