# Reshaping Agriculture to Feed the World Sustainably: A MAHB Dialogue with Environmental Economist Federico Castillo

**Geoffrey Holland**

Sharing our World

*Federico Castillo PhD, is an Environmental/Agricultural Economist whose work focuses on how climate change impacts the agricultural sector and technology changes in agriculture. Some of his current projects focus on how extreme weather events related to climate change impact migration decisions among small coffee farmers and members of communities dependent on forest resources.*

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**Geoffrey Holland: These days, much of the world's food is produced with high yield farming practices that are heavily dependent on the use of chemicals. Is this industrial brand of agriculture sustainable?**

*Federico Castillo*: In regard to pesticides one could make the case that in general, less exposure of chemicals is better for humans, wildlife and plant life than more exposure. Modern large farming operations in the US and other high-income countries (and some middle-income

countries) depend on chemical use to sustain most production levels. We should always thrive for the use of less chemicals for pest control and to fertilize because chemical use does not have negative impacts on the farm only but also on near waterways, and wildlife among others. Externalities related to chemical use are well documented and although chemical use in the US and most high-income countries is highly regulated this is not the case in other geographical areas.

Large farm operations do not always result in more chemical input per unit of land and that is what I think we need to pay attention to. For example, in the US the use of fertilizer per unit of land is 79 Kg/ha while in Costa Rica, a middle-income country with much smaller farm operations the use of fertilizer is 165 Kg/ha.

**GH: The human population has doubled to nearly 8 billion in just the last 50 years. That number is likely to go to 10-12 billion by 2050. Are there enough resources on Earth to sustain that many people?**

FC: Many researchers, policymakers and others have predicted the doom of the planet if we do not check population growth. It is true that population growth is an issue that needs to be dealt with and the sooner the better. In Africa, particularly in the Sahel it is an urgent issue, in Latin America less so. That said, technological improvements have made it possible to grow food in a relatively steady manner over the years. Resource depletion (such as soil depletion and water quality and quantity related matters) are likely to be an issue for the planet if we do not address the social conditions that are driving population growth and result in resource depletion: child marriages in some parts of the world, political and social conflict that drives large migration waves and of course, the always present issues related to climate change. They are all inter-related. Resource use, including agricultural lands, will benefit from technology adoption and innovation that can result in improvements in agricultural production, thus reducing the impact of population growth. But that technology needs to be accessible to the ones that need it the most. By the way, what I mean by technology is not necessarily "high tech" such as drones, high cost irrigation systems, etc. Technology can be simple changes in farm management practices that result in improvements in production and more sustainable use of the factors of production in the agricultural sector such as soils, water, and vegetation cover in diversified farming systems, among others.

**GH: Looking at the future and the need to feed 83 million additional people a year, what are some of the mistakes we're making in agriculture right now?**

FC: From an institutional point of view, I think one mistake we are making is that we are locked in a "battle" of sorts. Some advocate the use of genetically modified seeds and other material to solve our food production and nutritional problems. Others advocate agroecology and related farming systems as the solution. In many instances the problem is posed as a binary choice. This

does not need to be the case all the time. We need to be "institutionally creative" to make sure access to food and food production issues are solved with all possible tools at our disposal. Sure, there are vested interests, particularly interests of large seed production companies that want to make it a "binary" choice but we can do better. For example, making sustainable urban farming part of the solution and enacting policies that favor urban farming could prove quite beneficial to society at large, particularly as large megacities are becoming more common.

Another institutional mistake we are making is that we are not focusing on bringing back cooperative extension systems (an information system, see Smith-Lever Act of 1914) in Africa and Latin America, which were phased-out in the 80s under the excuse of "government reform". When working properly, extension systems are a vital link between public universities and other institutions and farmers and help to disseminate technological innovation, improve farming practices and result in overall increases in the wellbeing in the rural sector. Restoring cooperative extension systems where they have been phased out is one critical step in improving food production in low income countries where there are high population growth rates. If we make an effort in bringing back cooperative extension systems we need to make sure that farmers, particularly small and vulnerable farmers, are involved at all levels. This was hardly the case before.

From a farm management perspective, I think the mistake is that we are not being discriminatory enough in promoting adoption of better farm management practices. There is no silver bullet that will improve food production and access to food in all places at all times. We need to target specific policies to specific needs according to the socio-economic, cultural and traditional norms of each geographical area. For example, a coffee farmer in Oaxaca, Mexico is very different than a coffee farmer in Honduras, or Costa Rica. A coffee farm operation in most of Oaxaca looks like a garden, where coffee is but one plant type that is also part of avocado trees, edible roots and even a medicinal plant agricultural system. In essence, nutrition and cash crops are interlinked in Oaxaca. Whatever is advised to improve coffee production in Oaxaca needs to be very different advice than provided to a farmer in Honduras or Costa Rica where farmers have more homogeneous farm operations and are more linked to world markets.

**GH: Current industrial scale agriculture practices have resulted in substantial losses of fertile top soil. How can we preserve our precious top soils and maintain their fertility?**

FC: The simple answer would be to change farm management practices. This is true for both large and small farming operations. Adoption of farm management practices that improve soil conditions include but is not limited to no tilt, the use of vegetation to cover soil, the implementation of diversified farming practices, use of organic fertilizer, and others. This is easier said than done. Market conditions, regulatory restrictions, farmer socio-economic profile and other factors determine whether or not these farming practices are adopted. Thus, it is not

enough to say “adopt this or that practice”. We need to complement the notion of adoption to promoting the conditions that would result in the adoption of soil enhancing and conservation practices. That is, maintaining healthy soils is as technical issue as much as an institutional issue.

**GH: A high percentage of the food we eat depends on bees and other pollinators. These beneficial insects are being decimated by the widespread use of pest control chemicals. Is there a solution to this problem?**

FC: The solution would be to incorporate bees and other pollinators into both our conservation efforts and farm management practices. For example, often agricultural related activities result in landscape fragmentation, impacting bees and other pollinators, resulting in negative impacts to agriculture itself. It is a vicious cycle of sorts. Changing the way we view biodiversity conservation and its relationship with agriculture would improve bees and other pollinator’s populations.

Another solution would be to follow the guidelines, incomplete as they may be, proposed by the EPA and other government agencies so that chemical use has a reduced effect on pollinators. For example, chemical application has an impact on bees but that negative impact depends on timing of application, ambient temperature, wind speed and other variables. There are guidelines for chemical applications that clearly indicate when and how to apply chemicals when pollinators are present. In addition, chemical contamination of waterways, and flowering fields adjacent to the treated field can impact pollinators negatively.

Educating chemical applicators, agricultural workers, farm owners and consumers about the role played by bees and other pollinators would go a long way in reducing the negative impacts of chemical use in their populations.

**GH: Public policy in pretty much every arena, including agriculture, is shaped by special interests. Shifting to more sustainable farming practices is impeded by these profit driven corporate interests resisting needed changes. What are some possible solutions to this problem?**

FC: In the last instance, consumer choice is important. For markets using more sustainable farming practices to increase in acreage of production levels we need to convince consumers to buy products produced under those schemes. One possible solution is to engage consumers more in the development of markets for products that are produced under alternative farming practices such as diversified farming systems, or farming systems that are less intrusive to the environment. Educating the public about the social benefits and advantages of alternative production systems will go a long way in terms of consumer choices. We could learn from how the organic farming product market has evolved in terms of consumer choice. Obviously, the organic farming movement has seen its share of problems such as corporate farming taking over

some or most of the production of certain crops, or small farmers being excluded of the system due to high costs of certification. But if we are creative enough we could avoid these pitfalls experienced by the organic food production movement.

Another solution is to enhance the role of the public sector to carrying out research to improve the production levels of systems that are alternatives to the corporate food production model. For example, I learned in a meeting the other day that while the University of California system has a large cooperative extension service, there are only two extension specialists that have expertise in diversified farming systems. This and other factors work against the dissemination of alternative farming systems. Thus, a potential solution to the reluctance for change in the food production systems would be to highlight the benefits of alternative systems. This can be done via research and assigning the financial and human capital resources that help overcome the lobbying efforts which resist change.

**GH: What are some advantages (to people's diet, food prices, supply levels) to encouraging people to switch to more local food sources or transitioning the world's food supplies to come from smaller scale supply chains?**

FC: Some of the potential advantages is that food produced locally is probably more nutritious via freshness. In addition, if food is produced more locally then transportation and related costs (such as storage costs) could be lower, making it more affordable. If food is produced locally under a seasonal production regime then the supply chain is "shorter and simpler", less number of intermediaries playing a role in supplying food. This also could result in lower food prices.

That said, there is no guarantee that locally produced food, coming from a smaller scale supply chain is going to be cheaper. Market characteristics such as number of consumers, demographic profiles, etc. as well as regulatory components could very well result in higher food prices.

**GH: There is a lot of controversy about the use of genetically modified seeds in industrial scale agriculture. Can you discuss the pros and cons?**

FC: Many crops in the US and around the world have been affected by science in one way or another. The modification of the genetic material in the way GMOs are understood today is relatively new (in the history of mankind). Modification either gives new characteristics to a crop or enhance an existing characteristic. Some of the benefits touted by those who support the use of GMOs are better pest resistance, larger yields and faster growth thus producing more food in a shorter period of time. Those in favor of the use of MGOs also sustain that there is less chemical use when using MGOs than in conventional crops thus reducing the possibility of water and soil contamination. Advantages cited include a larger shelf life, thus making transportation of food over long distances possible, more nutritious characteristics and lower prices.

Some of the negative impacts cited by those who oppose the use of GMOs are: a) Cross pollination. This can result in the presence of "super weeds" that are as resistant to chemicals as the crops are; b) The increase in health elated issues such as allergies and anti-biotic resistance on the part of consumers; c) To a large degree, long term impacts are unknown.

For every advantage cited one can make a counter-argument and likewise for each of the disadvantages. I would argue that we need to practice what is known as the "precautionary principle". That is, until we know more about the long term impacts we should proceed with caution. The "cat is out of the bag" on this however. In the US cotton, corn, soybeans and many other crops are produced mostly using seeds that are the result of some modification in the modern sense of the word. I worry about the impact of MGOs in other geographical areas, particularly in low income countries. While I was doing research in Honduras I spoke with farmers who were told they were not buying genetically modified seeds when in fact they were. The impact on farmers in this case can be disastrous. For example, seeds for the next season may not be available or the nutrition and health of the food produced is changed, placing farmers in a vulnerable position.

**GH: How would a shift from consumption of animal protein to a plant-based diet impact people and the planet?**

FC: In theory a shift from animal- based protein diet to a plant-based diet would help the planet and people's health. Apart from nutritional benefits it is likely that the greenhouse effect would decline. Emissions from the agricultural sector resulting from livestock production are quite high at all stages of production. That said, if the shift results in the use of large amounts of fertilizer and inefficient use of water and soil resources then the benefits are not likely to benefit the planet. That is, we know that a reduction of consumption of meat benefits our body and the planet but it all depends to what we change to and how do we produce what we switch to.

Let's keep in mind that global demand for meat is not likely to decrease in the near future. A colleague recently gave a talk where he shows that while demand and consumption for meat in the US and other countries has been declining (but not by much) over the last 30 years meat consumption is increasing dramatically in Asia, particularly China. Given the demographic momentum and the increasing role of the "new" middle class in China, global meat consumption is not likely to decrease. This does not mean that more cannot be done to encourage consumers to consume a larger plant-based diet but a dose of realism is in order in terms of the global meat consumption levels. Targeted regional approaches are more likely to succeed in reducing meat consumption than generalized approaches. Efforts in educating consumers to the benefits of a diet based in less meat consumption and making sure prices reflect social costs and not only private financial costs would go a long way in making permanent changes in our diet preferences.

**GH: Recently in the US, we've seen the agricultural commodities be used as bait in Trump's tariff war with China. Do current political trends or political dialogues influence how the average person in the US understands the looming crisis for agricultural renovation?**

Let's say from the outset that trade wars are not likely to produce any winners, whether it is farmers from the US or China or other countries. Let's recall that Trump did not impose trade barriers on agricultural commodities, but the Chinese did in retaliation for the barriers imposed by the US on steel and other goods. This has cascading effects since now the Chinese are likely to look elsewhere to buy some of the agricultural products that currently have a high tariff. Whether it's dairy products or grains, US farmers and those in the rural sector could lose access to the Chinese markets for a long time. To the degree that those agricultural producers in the US will need to innovate to have access to new markets is perhaps, the silver lining of the tariff war. This "forced innovation" will remain an elusive goal at least in the short and medium term. If the trade wars result in changes in the mode of production, say, from producing homogeneous crops in vast tracts of land to diversified farming systems, then perhaps this innovation is good. This will be very geographic and crop specific.

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*The MAHB Dialogues are a monthly Q&A blog series focused on the need to embrace our common planetary citizenship. Each of these Q&As will feature a distinguished author, scientist, or leader offering perspective on how to take care of the only planetary home we have.*

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